Ancient Medicine & Hospital Architecture

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AR2A011 Architectural History Thesis (2023/24 Q3)

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The Greco-Roman influence on contemporary hospitals

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Abstract

It can be imagined that, due to fast technological innovation in the field of healthcare, current Western medicine distanced itself from ancient knowledge and practices. The aim of this thesis was therefore to find out to what extent it is possible to still recognize influences of classical medical texts and architecture in contemporary hospital architecture. Greco-Roman literature was studied to construct a theoretical framework of architectural principles that relate to classical healthcare methods. This was complemented by principles found in two case studies of Greco-Roman healthcare architecture. The framework was then applied in a case study of the nursing department of the Erasmus MC. It was possible to conclude that the case study shows many similarities to the derived framework, such as the prioritization of flexibility, focus on the individual, and climate control. In addition, some differences were discovered, such as how flexibility is achieved, the relation of the hospital to the city, and the use of daylight. This proves that Greco-Roman influences can still be found in contemporary Western hospital architecture.

Keywords

Greco-Roman healthcare, contemporary hospital architecture, classical literature, ancient medicine

Content

I Introduction

The roots of Western medicine can be traced back to ancient Greek civilization. In the Greek town of Epidaurus, one of the first steps was taken in the development of public healthcare: the foundation of the Asclepius cult (Cilliers & Retief, 2002; Leonard, 2017). The religious healing practice that took place there was quickly adopted by the rest of ancient Greece, and Asclepius sanctuaries popped up all across the country; in Kos, Pergamon, Corinth, and many other towns (Levine, 2008). Even the Romans, who are known to have had great respect for Greek wisdom, sought out the help of the god Asclepius after a devastating plague in 293 B.C. (Ingravalle & Prinzivalli, 2015). The poet Ovid (8 C.E./1916) even saw fit to incorporate this event into his *Metamorphoses* (figure 1.1).

At the same time, medicinal theories by Hippocrates were broadly accepted and practiced. These theories were philosophical in nature, based on rational thought rather than religion, and they too were expanded upon by the Romans (Cartwright, 2023). The famous Roman architect Vitruvius (27 B.C.E./1931) for example built some of his chapters in *De Architectura* on the medical foundation that Hippocrates laid out.

OVID

nec Apolline vobis,
qui minuat luctus, opus est, sed Apolline nato.
ite bonis avibus prolemque accersite nostram."
iussa dei prudens postquam accepere senatus,
quam colat, explorant, iuvenis Phoebeius urbem,
quique petant ventis Epidauria litora, mittunt;

METAMORPHOSES BOOK XV

Nor have you
any need of Apollo to abate your troubles, but of Apollo's son. Go
with kindly auspices and call on my son." When the senate, rich in
wisdom, heard the commands of the god they sought in what city
the son of Phoebus dwelt, and sent an embassy by ship to seek out
the coast of Epidaurus.

Figure 1.1: Passage from Metamorphoses by Ovid (Ovid, 8 C.E./1916)

Having advanced further into the field of medicine, modern Western society has potentially distanced itself from ancient sources of wisdom. With the introduction of medical technology, for example, healthcare gradually became more specialized and practical. This value was reflected in the systematic, rational architecture of modern hospitals that was meant to resist the earlier more emotional and spiritual practices (Sahabi, n.d.).

It can be imagined that amid such medicinal advancements, certain ancient healing practices were lost to history. Assuming that this is the case, it would be worthwhile to study Greco-Roman theories and see what we can learn from them. For the field of architecture specifically, it would be interesting to find architectural principles from ancient texts and related buildings and compare them with contemporary hospital architecture.

Academic context

Researching the influence of ancient medicinal principles on more recent architecture in itself is not a new idea. Barbara Kenda (2006), a professor at the School of Architecture, University of Notre Dame, examined 16th- and 17th-century Renaissance villa architecture. In her book, she highlighted the central role of 'pneuma' (airflow) in these villas and relates that to ancient texts on pneumatic theory, for which Hippocrates laid the foundation. Moreover, two examples could be found wherein ancient theories were even used in the design process of new projects. Misty Campbell (2007) for example wrote a thesis on the renewal of a historical Canadian neighborhood using ancient Greek and Roman medicinal theory. She thoroughly researched ancient Greek medicine and the architecture of Vitruvius, which she then applied to her design process. Additionally, Ana Albano Amora (2015) wrote

about the implementation of the hygienic view, suggested by Hippocrates and Galen, into urban planning for Brazil.

When however it comes to contemporary hospital architecture, no articles could be found that described an approach in which the architecture was analyzed considering ancient healing practices. This is unfortunate because we know that many ancient practices could have had some merit. Olympia Panagiotidou (2021) for example attempted to explain the potential of the healing processes in Asclepieia (sanctuaries of the Asclepius cult) in her article on *The Placebo Drama of the Asclepius Cult*. In this article, she considers various factors that might have contributed to the recovery of patients through what we now know to be the placebo effect. From this, we can conclude that there is more to Greco-Roman healthcare than meets the eye.

Questions and Methods

The goal of this thesis is to find out whether Greco-Roman healthcare practices can be traced in contemporary hospital architecture. For this purpose, Greco-Roman literature and architecture will be studied. The knowledge acquired from these studies will then be compared to a contemporary hospital case study. The differences and similarities between the Greco-Roman views and contemporary architectural principles that result from this comparative analysis could then encourage future research into these principles and their potential.

The research question for this thesis is as follows:

'To what extent can we trace influences of classical medical writings and concurrent Greco-Roman healthcare-related architecture in contemporary Western hospital architecture?'

This question can be divided into three separate queries, each of which will be explored in a separate chapter.

In chapter II, *Understanding Ancient Medical Theory*, texts by several classical authors will be studied, to find out how medical principles in writings from the Greco-Roman era can be translated into architectural principles. For this purpose, access was acquired to the Loeb Classical Library, which contains a vast collection of translations of classical writings. This chapter will conclude with a temporary theoretical framework of architectural principles that will be derived from the literature study.

In Chapter III, *Recognizing Architectural Principles*, two cases of healthcare-related architecture from the Greco-Roman period will be studied to discover what architectural principles can be recognized in Greco-Roman healing-site architecture. For this chapter, the Asclepius sanctuaries and the Roman military hospitals (valetudinaria) will be analyzed. This chapter will add to the theoretical framework from Chapter II.

In Chapter IV, *Case Study: The Erasmus MC*, The nursing department of the Erasmus MC will be subjected to a case study through the lens of the theoretical framework from Chapters II and III. This case study will help to define the existence or absence of architectural principles in a contemporary hospital.

Finally, in the conclusion, the findings will be presented and the main research question will be answered. In the discussion, the limitations and implications of this thesis will be reflected upon.

II Understanding Ancient Medical Theory

To be able to study a contemporary hospital case study through the lens of ancient texts, first, those texts ought to be studied. For this purpose, access was established to the Loeb Classical Library; a reliable catalog of texts by classical authors and their translations. This library, however, contains over 2000 texts by both Greek and Roman authors, most of which are irrelevant for this thesis, as they have nothing to do with medicine or architecture. Finding useful texts was challenging. The main approach was to search the studied literature for references to specific authors or texts. This resulted in the five texts that will be explored below.

Hippocrates

The text *Airs, Waters, Places* forms the starting point for this thesis. It seems that most other writings are based on the principles that Hippocrates (figure 2.1) laid out in this text. *Airs, Waters, Places* is based on previously written works of Hippocrates himself. The most important of these texts is *Humours*, essentially describing the need for balance of the four fluids (humours) that make up the human physique, to be healthy (Hippocrates, 400 B.C.E./1931).

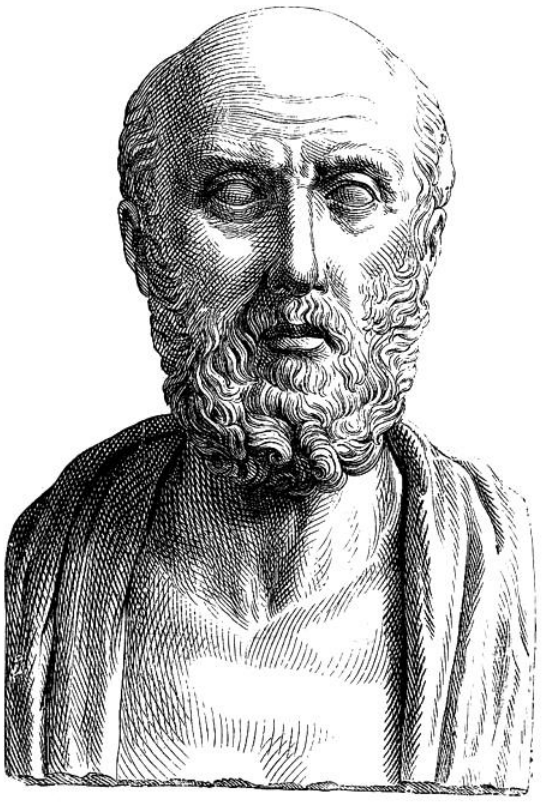


Figure 2.1: Hippocrates (*Hippocrates*, 2005)

Airs, Waters, Places

In *Airs, Waters, Places*, Hippocrates elaborates on the effect of environmental factors on the human body, the humours, and resulting diseases and temperaments. To understand the constitution of his patients, the physician must first become acquainted with the characteristics of their location (figure 2.2). He must, according to Hippocrates, consider the seasons, the wind, the water, the orientation in relation to the sun, the terrain, and the lifestyle of his patients (Hippocrates, 400 B.C.E./2022). This suggests a similarity between ancient Greek medicine and the architectural design process, as both practices start with an analysis of the subject's context.

σταθμῷ, οὕτω καὶ ἡ δύναμις διαφέρει πολὺ ἑκάστου. ὥστε ἐς πόλιν ἐπειδὰν ἀφίκηταί τις, ἧς ἄπειρός ἐστι, διαφροντίσαι χρὴ τὴν θέσιν αὐτῆς, ὅκως κέεται καὶ πρὸς τὰ πνεύματα καὶ πρὸς τὰς ἀνατολὰς τοῦ ἡλίου. οὐ γὰρ τωὐτὸ δύναται ἥτις πρὸς βορέην κέεται καὶ ἥτις πρὸς νότον οὐδ' ἥτις πρὸς ἥλιον ἀνίσχοντα οὐδ' ἥτις πρὸς δύνοντα. ταῦτα δὲ χρὴ ἐνθυμέεσθαι

and in their weight, their effects too are very different. Thus, when a person arrives in a town with which he is unfamiliar, he should examine the position in which it lies in relationship both to the winds and to the risings of the sun. For a town that faces north cannot have the same effect as one that faces south, or one that faces the rising of the sun, or one that faces the setting of the sun.

Figure 2.2: Passage from Airs, Waters, Places by Hippocrates (Hippocrates, 400 B.C.E./2022, p. 73)

Various diseases can according to Hippocrates be attributed to the properties of succeeding seasons. A cold, dry winter and a warm, rainy spring will result in fevers, ophthalmias and dysenteries in the summer. A hot, dry summer followed by a cold, rainy fall will cause headaches, coughs and coryzas in the winter. Many such examples are given, but the essence of this passage is clear: seasonal patterns should be studied, as they help to predict epidemics (Hippocrates, 400 B.C.E./2022).

What stands out in this passage is that many of the examples given by Hippocrates are characterized by big fluctuations in temperature and/or humidity from one season to the next, followed by diseases in the succeeding season. It can thus be concluded that mild and balanced seasonal transitions are beneficial to people's health.

The quality of the drinking water is another thing to consider. Marshy, stagnant water is troublesome and leads to many diseases. In most cases, the next worst type of water is spring water, as it is too hard to pass through the body without causing problems. The spring sources that face east or north are the best; the sources facing west or south are the worst. Hippocrates also explains how this water can lead to the formation of kidney stones. Water from high places is better because it is less salty. Rainwater however is best of all, because it has been lifted from the salt and mixed with air by the sun, thereby separating the lightest parts from the heavier parts (fog). Rainwater should however still be purified, as it putrefies quickly. People suffering from constipated cavities (clogged sinuses) should drink light and sweet water. Constipation is caused by dryness, and lighter water moistens the body better. The opposite is also true. People with phlegmatic cavities (a runny nose), benefit from harder, saltier water, as this dries the body (Hippocrates, 400 B.C.E./2022).

The wind is the most important factor to take into account. Air was thought of as being the most potent 'nutrient', because it is the main driving force behind other elementary phenomena, such as the seasons, the quality of the water and the movement of the sun (Hippocrates, 400 B.C.E./2023). Hippocrates wrote a whole separate text on what he called 'pneuma', meaning 'breath' or 'wind', which will be briefly discussed hereafter.

What is important to know is that towns facing west experience both cold and hot winds (from the north and south) and morning mists, which are considered harmful or unhealthy. Towns facing east are healthiest because the temperatures are mild and the mist is cleared by the morning sun. North- and south-facing towns are not ideal, since they experience only respectively cold and hot winds.

Breaths

Hippocrates' pneumatic theory elaborates on the causes of disease. The general consensus that Hippocrates poses is that "opposites are cured by opposites" (Hippocrates, 400 B.C.E./2023, p. 227). If the physician knows the cause of the disease, he will be able to determine the cure (figure 2.3).

καὶ πηγὴ γίνεται τῶν ἐν τῷ σώματι κακῶν; εἰ γάρ τις εἰδείη τὴν αἰτίην τοῦ νοσήματος, οἷός τ' ἂν εἴη τὰ συμφέροντα προσφέρειν τῷ σώματι ἐκ τῶν ἐναντίων ἐπιστάμενος τῷ νοσήματι·[3] αὕτη γὰρ ἡ ἰητρικὴ μάλιστα κατὰ φύσιν ἐστίν. αὐτίκα γὰρ λιμὸς νοῦσός ἐστιν· ὃ γὰρ ἂν λυπῇ τὸν ἄνθρωπον, τοῦτο καλέεται νοῦσος. τί οὖν λιμοῦ φάρμακον; ὃ παύει λιμόν· τοῦτο δ' ἐστὶ βρῶσις· τούτῳ ἄρα ἐκεῖνο ἰητέον. αὖτις αὖ δίψαν ἔπανσε πόσις· πάλιν αὖ πλησμονὴν ἴῆται κένωσις, κένωσιν δὲ πλησμονή· πόνον δὲ ἀπονίη, ἀπονίην δὲ πόνος.[4] ἑνὶ δὲ συντόμῳ λόγῳ, τὰ ἐναντία τῶν ἐναντίων ἐστὶν ἰήματα· ἰητρικὴ γάρ ἐστιν ἀφαίρεσις καὶ πρόσθεσις, ἀφαίρεσις μὲν τῶν πλεοναζόντων,

source of the evils in the body? For if a person knew the cause of a disease, he could apply remedies to the body, starting out from opposite things to counteract the disease: such a medicine is most in accord with nature. For example, hunger is a disease, since anything that makes a person suffer is called a disease: what then is the remedy for hunger? Whatever puts an end to hunger, food then, and hunger should be treated with this. Or thirst, for example, is relieved by drink. Or then again fullness, which is cured by emptiness, and emptiness which is cured by fullness; just as rest relieves exhaustion, and exertion relieves idleness. In one short word, opposites are cured by opposites: for medicine consists

Figure 2.3: Passage from Breaths by Hippocrates (Hippocrates, 400 B.C.E./2023, p. 227)

As said before, the air we breathe is the most important 'nutrient' according to Hippocrates. The proof for this statement is the fact that people can live without the other nutrients (food and drink) for several days, whereas stopping respiration is lethal within minutes. Besides being an important nutrient, air can also be a potential cause of disease. For example, pestilence fevers are caused by everyone breathing the same air, polluted with the same disease-causing miasmas. Secondly, there are fevers caused by bad regimen, such as breathing too quickly, which creates an imbalance in the body. Both principles are elaborated on by Galen in *Hygiene* (Galen, 129-199 C.E./2018).

Air can also hurt the body externally, by passing through the tender parts of the body. Cold winds for example have the ability to paralyze parts of the body. Such parts then need to be protected with warmth (the opposite), or the wind needs to be dispersed (Hippocrates, 400 B.C.E./2023). Vitruvius later explored this concept on the scale of buildings and cities (Vitruvius, 27 B.C.E./1931).

Physician

In this rather short text, Hippocrates describes the physical attributes of a doctor-patient encounter. After stating a few qualities that the physician should have in order to appear trustworthy and capable, Hippocrates proceeds to list aspects of the space in which the encounter takes place. Draught must be avoided, as it causes annoyance. Bright light or direct sunshine can cause harm to the patient. Sufficient lighting is necessary for the physician to examine the patient properly, but the patient must never face the source of brightness. Couches must be level, although Hippocrates does not explain why (Hippocrates, 400 B.C.E./1995). The rest of this text is about medical procedures and the quality of the required tools and other resources, which is irrelevant to this thesis.

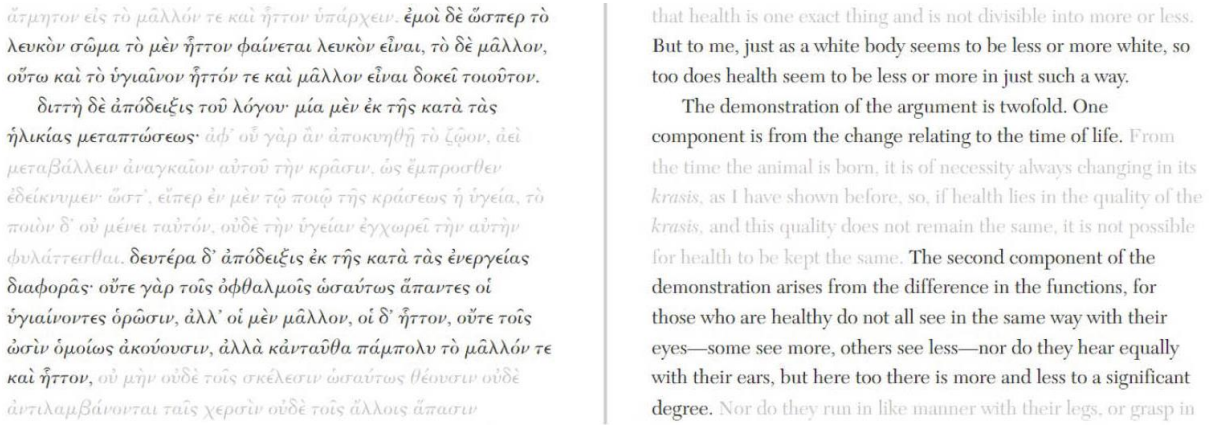
Galen

Galen's work as a physician builds on the foundation that Hippocrates created. Similarities are evident as he also speaks of elements, humours and the need for a balance of these substances in the body. It is noteworthy however, that Galen (figure 2.4) seems less interested in the environment and abstract qualities of the elements. He rather assumes this prior knowledge and expands upon it with concrete nuance and reason.

Figure 2.4: Galen detail (Vigneron, 1872)

Hygiene

In *Hygiene*, Galen starts by challenging himself to define the constitution of health. He opposes the view that health is an absolute scale where one person is healthier than another, or that health is defined as perfection of the mixture of elements, which Galen calls 'krasis'. Instead, Galen proposes that the maximum healthy constitution is different for each stage in life and for each part of each individual (figure 2.5). No perfection of this constitution is required, because small imperfections do not lead to distress (Galen, 129-199 C.E./2018).



ἄτμητον εἰς τὸ μᾶλλόν τε καὶ ἧττον ὑπάρχειν. ἐμοὶ δὲ ὥσπερ τὸ λευκὸν σῶμα τὸ μὲν ἧττον φαίνεται λευκὸν εἶναι, τὸ δὲ μᾶλλον, οὕτω καὶ τὸ ὑγιαῖνον ἧττόν τε καὶ μᾶλλον εἶναι δοκεῖ τοιοῦτον.

διττὴ δὲ ἀπόδειξις τοῦ λόγου· μία μὲν ἐκ τῆς κατὰ τὰς ἡλικίας μεταπτώσεως· ἀφ' οὗ γὰρ ἂν ἀποκυηθῇ τὸ ζῷον, ἀεὶ μεταβάλλειν ἀναγκαῖον αὐτοῦ τὴν κρᾶσιν, ὡς ἔμπροσθεν ἐδείκνυμεν· ὥστ', εἴπερ ἐν μὲν τῷ ποιῷ τῆς κράσεως ἡ ὑγεία, τὸ ποιὸν δ' οὐ μένει ταὐτόν, οὐδὲ τὴν ὑγείαν ἐγχωρεῖ τὴν αὐτὴν φυλάττεσθαι. δευτέρα δ' ἀπόδειξις ἐκ τῆς κατὰ τὰς ἐνεργείας διαφορᾶς· οὔτε γὰρ τοῖς ὀφθαλμοῖς ὡσαύτως ἅπαντες οἱ ὑγιαίνοντες ὁρῶσιν, ἀλλ' οἱ μὲν μᾶλλον, οἱ δ' ἧττον, οὔτε τοῖς ὠσὶν ὁμοίως ἀκούουσιν, ἀλλὰ κἀνταῦθα πάμπολυ τὸ μᾶλλόν τε καὶ ἧττον, οὐ μὴν οὐδὲ τοῖς σκέλεσιν ὡσαύτως θέουσιν οὐδὲ ἀντιλαμβάνονται ταῖς χερσὶν οὐδὲ τοῖς ἄλλοις ἅπασιν

that health is one exact thing and is not divisible into more or less. But to me, just as a white body seems to be less or more white, so too does health seem to be less or more in just such a way.

The demonstration of the argument is twofold. One component is from the change relating to the time of life. From the time the animal is born, it is of necessity always changing in its *krasis*, as I have shown before, so, if health lies in the quality of the *krasis*, and this quality does not remain the same, it is not possible for health to be kept the same. The second component of the demonstration arises from the difference in the functions, for those who are healthy do not all see in the same way with their eyes—some see more, others see less—nor do they hear equally with their ears, but here too there is more and less to a significant degree. Nor do they run in like manner with their legs, or grasp in

Figure 2.5: Passage from Hygiene by Galen (Galen, 129-199 C.E./2018, p. 21)

'Hygiene' is the practice of preserving a healthy condition, whereas therapeutics is the practice of changing the condition back to a healthy one. Health can be impacted in two ways. Firstly, the inevitable factors determine the quality of the krasis, which in turn determines the rate of drying (aging) of the body. Secondly, there are avoidable factors, such as the quality of the surrounding air, or physical trauma. Especially the inevitable factors are interesting for this thesis. One such factor has its roots in the formation of the body, where the krasis is determined during pregnancy. Another inevitable factor is the occurrence of 'superfluidities' (excesses or lacks) of substances in our body, as we cannot always expel or ingest the precise amount of a specific substance to preserve balance.

Galen often involves common opinions in his texts. Although he might critique these opinions, he never completely debunks or denies them. One such example is an expansion upon the miasmic theory that Hippocrates previously proposed. Galen says the following:

"People say the seeds of diseases are present in us. But they themselves also in fact agree that these seeds escape our perception of them due to their small size. Let it be so, then, if they wish, that there is some distressing condition in us, but one so small and imperceptible as not to disturb those who have it" (Galen, 129-199 C.E./2018, p. 29).

It is clear that Galen directs his attention towards a truth that differs from person to person, rather than a search for absolute answers. This individualistic approach can be valuable to the architecture of hospitals as well.

Vitruvius

De Architectura – book I, chapter VI

De Architectura by Vitruvius (27 B.C.E./1931) is a vast collection of ancient architectural principles. A recurring analogy in this collection is the comparison of the human body to the complex physicality of buildings (Campbell, 2007). This analogy can be extended with theories by Hippocrates and Galen so that it does not only apply to living beings but also to architecture.

De Architectura contains a short chapter dedicated to the relationship between wind and architecture, based on the pneumatic theory of Hippocrates. In this chapter, Vitruvius names all eight wind directions and describes how cold and hot winds impact our health. If all winds are excluded, a space is most healthy and those who are ill will recover quickly. Wind is harmful because it has a drying potential, making the weak even weaker. In essence, protection against the elements, a preventative form of medicine to which Galen would refer as 'Hygiene', is one of the key tasks of an

architect (Architecture as Environmental Medicine, 1996). Vitruvius then poses a complex geometrical methodology of circles, lines and intersections that would result in the perfect layout for alleys in a city in relation to the winds. Although the method itself is hard to comprehend, it is clear that the goal is to block and diffuse troublesome winds, as winds in alleys have the tendency to become stronger. Winds must hit the corner of a building to break it apart and make it weaker.

Defining a theoretical framework

The texts that have been explored above can be summarized with three keywords: balance, scenery and individuality. These words form the backbone for a theoretical framework that architects can use in an analysis or design. In the next chapter, this framework will be utilized in two case studies of hospital-like structures, aiming to further develop the framework and recognition of architectural principles that the ancient Greeks and Romans used.

Balance

The foundation for all Greco-Roman medicinal knowledge lies in Hippocratic theory. Health or recovery is achieved through the balance of the humours, and thus a balance of the elements within our bodies (Hippocrates, 400 B.C.E./1931; Hippocrates, 400 B.C.E./2022). Any factor (or stressor) that throws this balance off, is therefore negatively impacting our wellbeing. In the architecture of a healing site, such stressors must be mitigated as much as possible.

Scenery

Most stressors will come from the environment, which ought to be thoroughly analyzed by the architect. Vitruvius (27 B.C.E./1931) for example demonstrates how an architect can deal with unhealthy wind in city planning. Hippocrates mainly writes about temperature, humidity, air, water and light (Hippocrates, 400 B.C.E./1995). Auditory stressors are not taken into account, although we now know that noise can affect our well-being through different pathways (Daniel, 2007). In '*Airs, Waters, Places*' we read that big qualitative fluctuations from one season to the next can cause various diseases or epidemics. Fluctuations in temperature and humidity must therefore be kept as small as possible. This can be done by providing an orientation to the east, because there we find pleasant morning breezes, a mild sun and little temperature fluctuations (Hippocrates, 400 B.C.E./2022). If such an orientation is impossible, passive design strategies can aid in mitigating big fluctuations.

Individuality

Hippocrates (400 B.C.E./2023, p. 227) states that "opposites are cured by opposites". An example is the drinking of specific waters that diminish an excess or lack of phlegm in the cavities (Hippocrates, 400 B.C.E./2022). This is done in order to counteract superfluidities and regenerate balance within the body (Galen, 129-199 C.E./2018). Galen tells us that the '*krasis*' is not the same for everyone, and neither is the composition of their healthy constitution; not every body part of each individual performs in the same way. Thus, superfluidities and the required opposites for recovery are also not the same for every person. Recovery can be encouraged differently for each individual case, by carefully controlling the flow of nutrients through the patient's body and the environmental factors in which the recovery takes place. Architecture can play a role in providing such an individualistic approach to healing. Recovery rooms for example could be private instead of semi-private. While writing this thesis, it was discovered that this topic is already a widespread discussion. One article stated that private rooms not only improve patient care, but they can even be financially beneficial (Boardman & Forbes, 2011).

III Recognizing Architectural Principles

In the previous chapter, a theoretical framework was defined. This set of general principles can be translated to architectural interventions centered around the topics of balance, scenery and individuality. Some suggestions for interventions were already given, however more can be learned from studying concurrent health-care-related architecture.

Analysis of Sanctuaries of Asclepius

Although according to Cilliers & Retief (2002), Hippocrates disliked the healing practices of the Asclepius cult, their practices were successful to an extent, for which a possible explanation is provided by Panagiotidou (2021). It is worth looking into the architecture of these sanctuaries so that the theoretical framework is not based on one medicinal movement alone. Perhaps, the best place to start is the Asclepius sanctuary at Epidaurus, because not only did the cult start there, but the Romans later took this sanctuary as their example, and even to this day it is the world's most complete Greek sanctuary (UNESCO World Heritage Centre, 2024; Ovid, 8 C.E./1916; Ingravalle & Prinzivalli, 2015).

For some reason, Asclepius sanctuaries, especially the earlier examples like Epidaurus, were always built in wooded areas outside the city (figure 3.1) near a source of water (Cilliers & Retief, 2002; Panagiotidou, 2021). Plutarch (figure 3.2) wrote about this practice in his *Moralia*, saying that these sanctuaries were "situated in places both clean and high" (Plutarch, 100 C.E./1936, p. 141). From Hippocrates (400 B.C.E./2022) we already learned that higher places did in fact offer better water quality. Additionally, the location and natural setting, as well as the addition of a gymnasium, a theater and such sociocultural functions, contributed to detaching patients from daily stressors (Panagiotidou, 2021). The Romans later chose to situate their adaptation of Epidaurus' sanctuary on an island in the Tiber (Ovid, 8 C.E./1916; Ingravalle & Prinzivalli, 2015). This is yet another way to detach the healing site and its patients from the city.

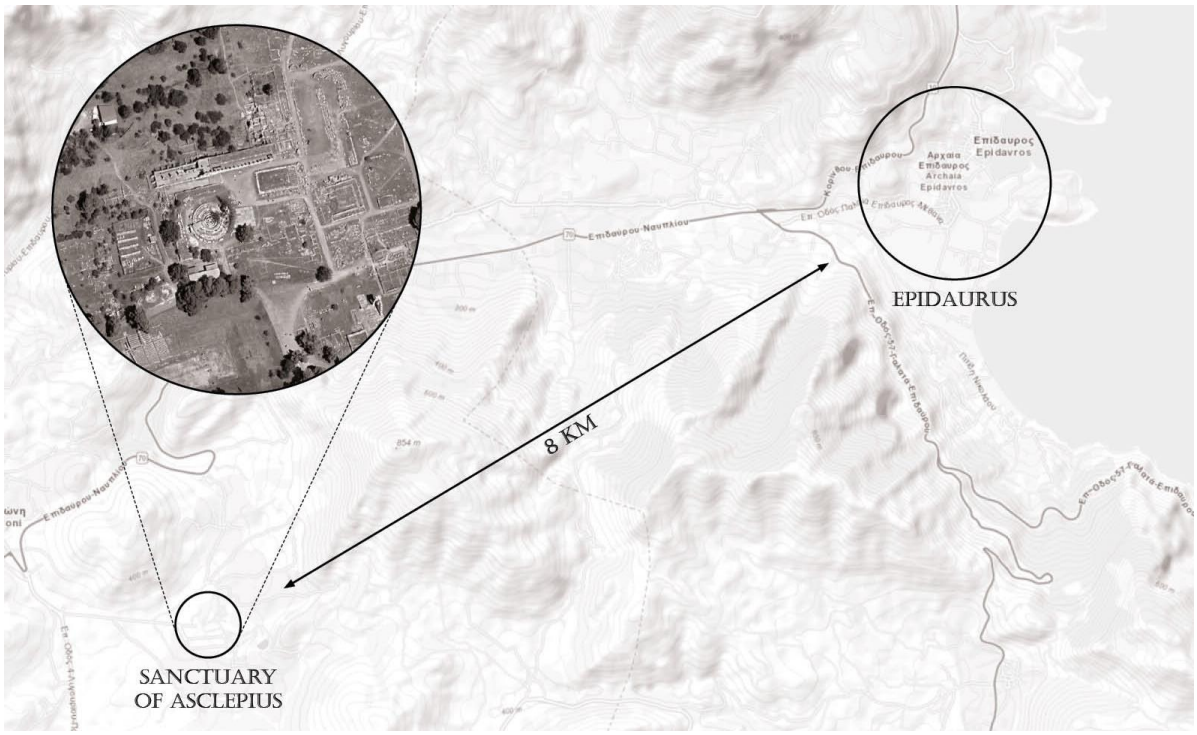


Figure 3.1: A map showing the location of the Asclepius sanctuary in relation to the city

D Πότερον ὅτι τὰς ἔξω διατριβὰς ὑγιεινοτέρας ἐνόμιζον εἶναι τῶν ἐν ἄστει; καὶ γὰρ Ἕλληνες ἐν τόποις καὶ καθαροῖς καὶ ὑψηλοῖς ἐπιεικῶς ἱδρυμένα τὰ Ἀσκληπιεῖα ἔχουσιν.

Ἢ ὅτι τὸν θεὸν ἐξ Ἐπιδαύρου μετάπεμπτον ἥκειν νομίζουσιν, Ἐπιδαυρίοις δ' οὐ κατὰ πόλιν ἀλλὰ πόρρω τὸ Ἀσκληπιεῖον ἔστιν;

94. WHY is the shrine of Aesculapius[b] outside the city?

Is it because they considered it more healthful to spend their time outside the city than within its walls? In fact the Greeks, as might be expected, have their shrines of Asclepius situated in places which are both clean and high.

Or is it because they believe that the god came at their

Figure 3.2: Passage from Moralia by Plutarch (Plutarch, 100 C.E./1936, p. 141)

The structure of the complexes was standardized (Cilliers & Retief, 2002). As we can see in Figure 3.3, the 'cella' of the temple of Asclepius at Epidaurus is opened only to the east and surrounded by a colonnade (Walker, 1911). Accessibility was clearly taken into account there, as all temples were provided with a ramp at the entrance (figure 3.4) (Sneed, 2020; Tempel van Asklepios, n.d.). To the southwest was the circular Tholos, which we know from inscriptions to be an architectural representation of a pit of sacrifice. The abaton to the northwest was the place where the process of incubation took place. The patients would sleep there, and dream of the god Asclepius. The priests would interpret those dreams at dawn and attempt to cure the patient (Panagiotidou, 2021).

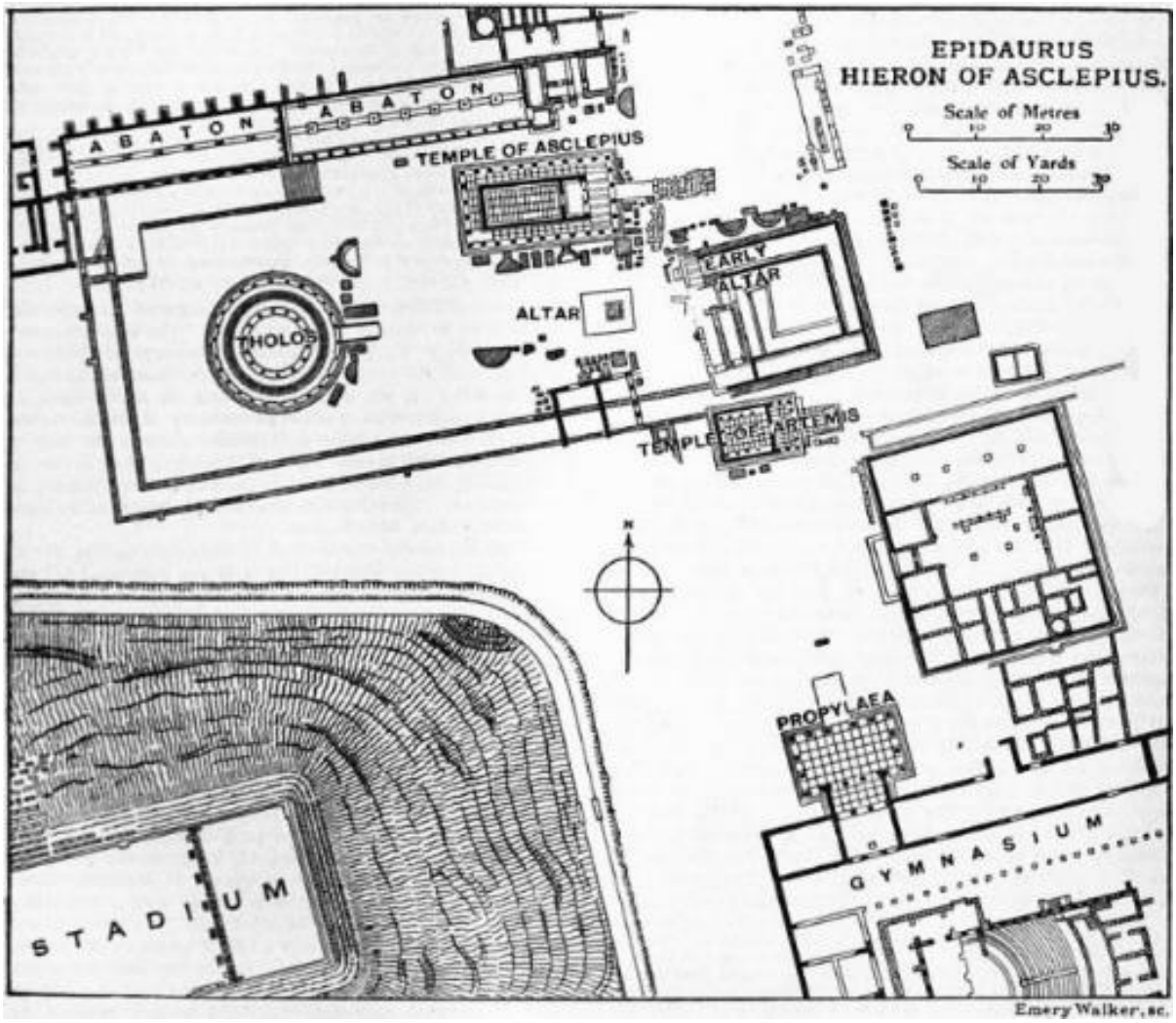


Figure 3.3: Hieron of Asclepius at Epidaurus (Walker, 1911)

Figure 3.4: Tempel van Asklepios (*Tempel van Asklepios*, n.d.)

In the Asclepieia, the healing practices were reflected in, and supported by, the architectural layering of the complex (Dominiczak, 2014). Rachel J. Levine (2008) intensively researched the architecture of Asclepieia in her doctoral dissertation and drew several conclusions that will help elaborate on the theoretical framework. She states that experience with the rituals led architects to create a well-routed unified complex with a beneficial ambiance. Upon arrival, and possibly even beforehand through texts and stories, the patients are met with a diverse web of symbolism that represents the success of the healing process. Because each individual is different, there are different means of access to this web, such as texts, images and architecture. Panagiotidou (2021) described this feature in her paper as the setting of the placebo drama. Illustrating the previous success of the ritual will build trust and increase the chances of it being successful again. This concept was clearly exploited within the sanctuaries of Asclepius.

From the sanctuaries of Asclepius we learned two new concepts that can be added to the framework of architectural principles. Firstly, the patients of a healing site must be allowed to disengage from their everyday life. This can be stimulated with architectural interventions, such as situating the site in an isolated environment, creating a physical barrier between the site and the world around it and adding sociocultural functions for distraction. Secondly, the healing process must be visualized to build trust and familiarity with the patient. This can be achieved through a web of symbolism that spans across many forms of media, such as illustrations, texts, but also architecture.

Analysis of Valetudinaria

Like ancient Greece, the Roman Empire did not have hospital-like complexes suited for longer stays. Instead, patients were visited at home, or treated at the doctor's office and sent home thereafter.

When this became impossible however, due to the expansion of the empire, more permanent forts were equipped with military hospitals called ‘valetudinaria’. Although valetudinaria are not seen as having impacted the evolution of hospitals, since they were functionally military in nature, some were later adopted as civilian hospitals (Cilliers & Retief, 2002). Therefore they might be worth looking into.

The design of valetudinaria was standardized. These structures were sized according to the needed capacity; approximately 5 to 10% of the military force stationed in the area. This capacity is reflected in the number of wards that lay adjacent to both sides of the central rectangular corridor wings, that wrap around a central courtyard (Risse, 1999; Cilliers & Retief, 2002). These ward units (figure 3.5) consisted of two rooms with a maximum of three beds each, joined by a (possibly sentried) vestibule, to allow for flexibility in privacy, distancing or a buddy system according to demand (Jefferson & Heneghan, 2020; Risse, 1999). Besides the wards, there were rooms for other functions, such as a dispensary, a kitchen, staff quarters and sanitary facilities (Cilliers & Retief, 2002; Risse, 1999).

This general structure is what defines the valetudinarium, as becomes evident from a comparison of several cases: the valetudinarium at the Roman Legionary fortress of Inchtuthil (figure 3.6), the valetudinarium at Castrum Novaesium in Neuss (figure 3.7) and the one at Windisch (figure 3.8). However, there is also some variation among these cases.

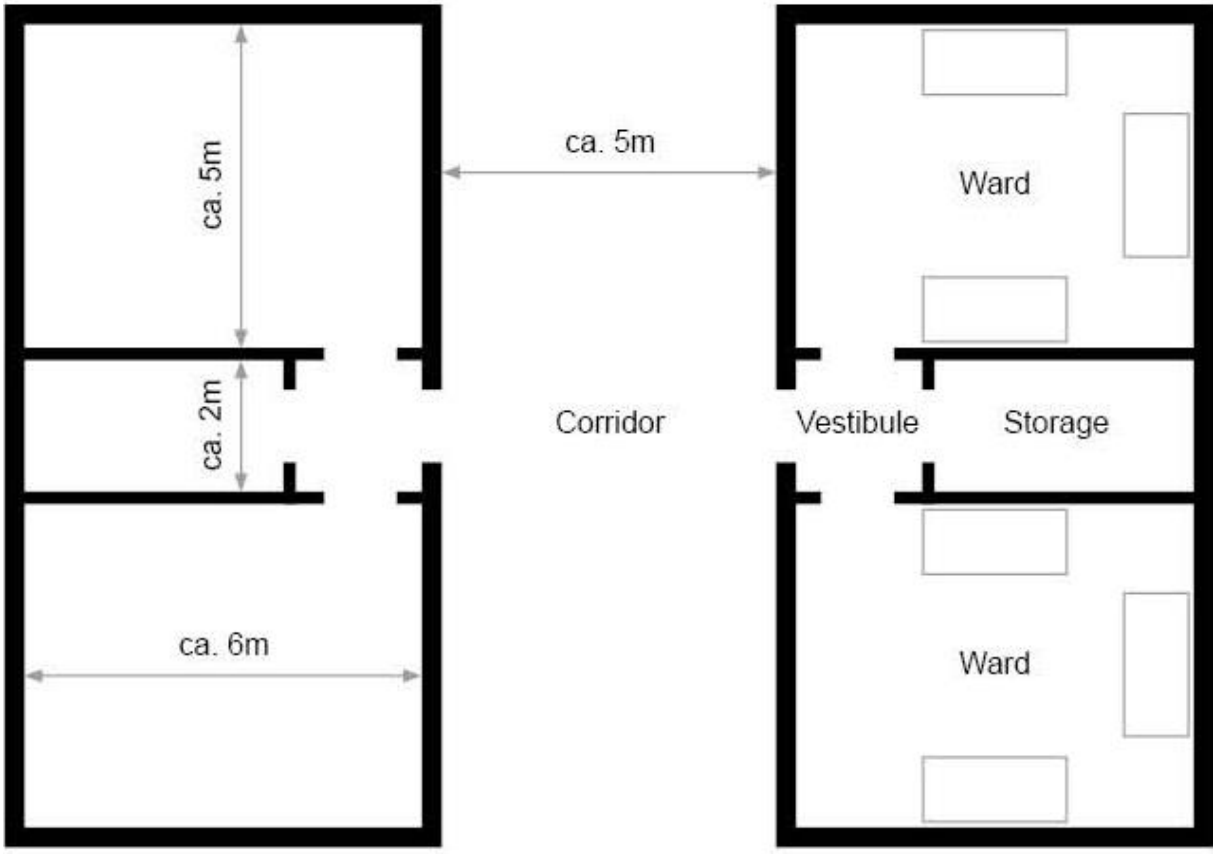


Figure 3.5: Standardized Ward Unit for Valetudinaria

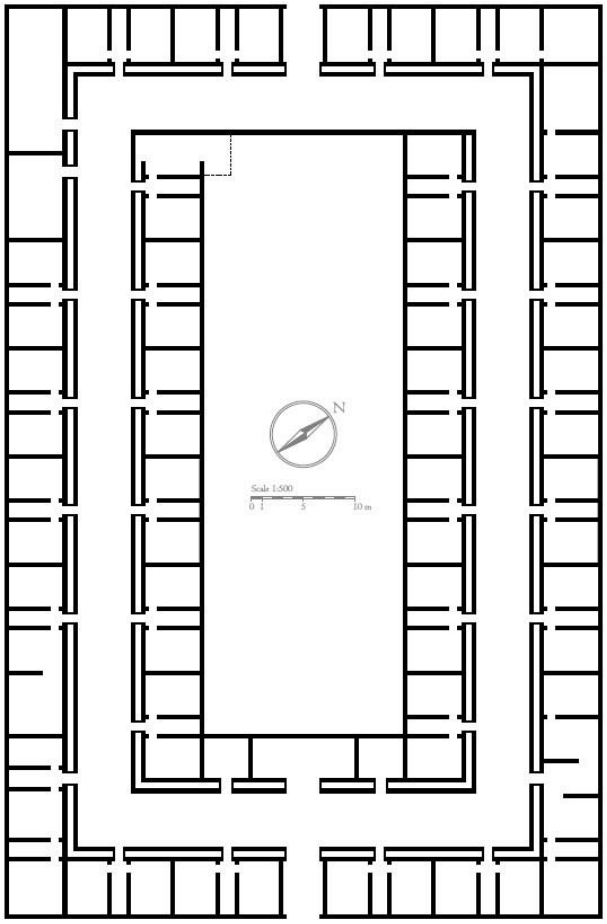


Figure 3.6: Valetudinarium Inchtuthil Floorplan [Redrawn]. Original found at (Jefferson & Heneghan, 2020)

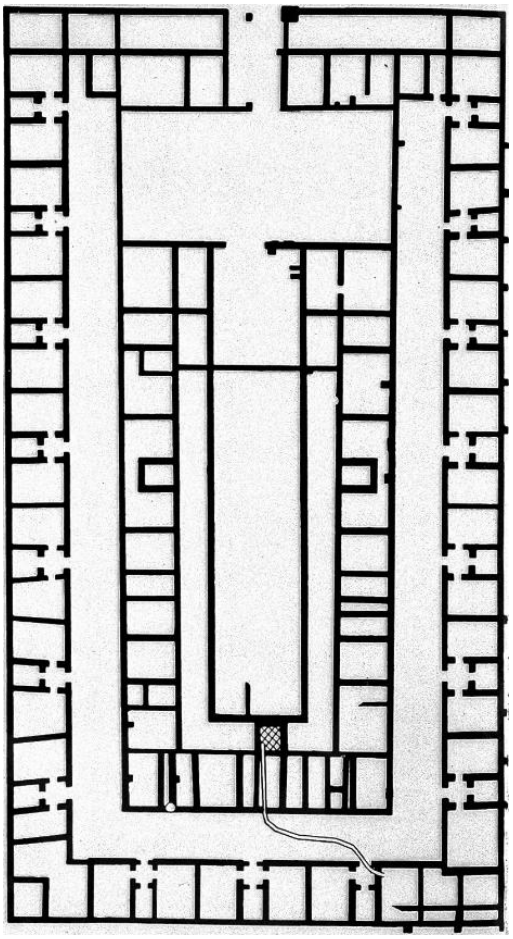


Figure 3.7: Roman Military Hospital - Valetudinarium - late 1st c. A.D. (Wellcome Collection, n.d.)

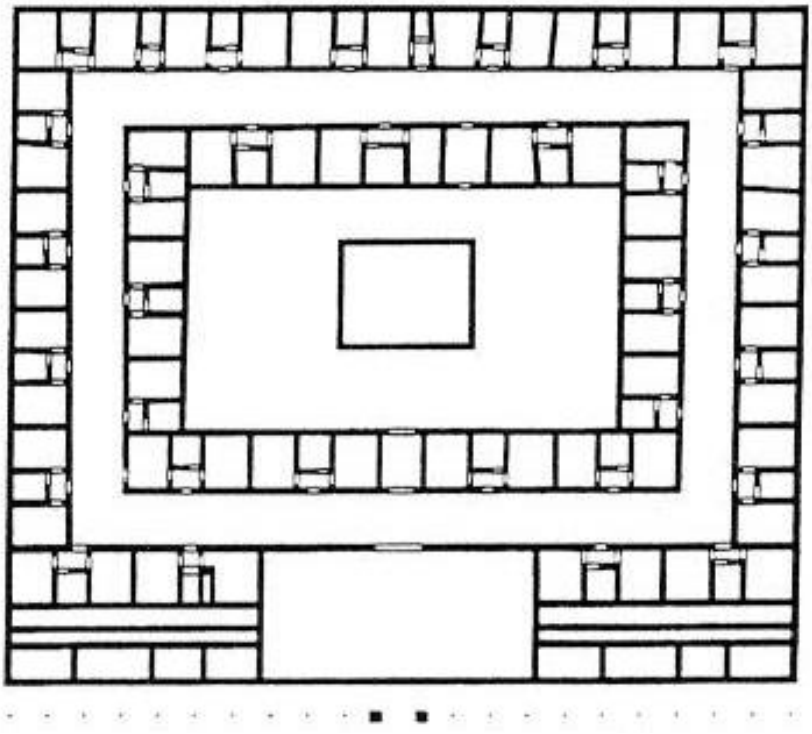


Figure 3.8: Het legioenkamp van Windisch (Janssens, n.d.)

The valetudinarium at Inchtuthil was a more temporary structure, built and dismantled within 3 years, whereas the one in Neuss was more permanent, constructed from tuff and limestone (Jefferson & Heneghan, 2020; Janssens, n.d.). The latter building also had an atrium at the entrance, just like the valetudinarium at Windisch, functioning as a reception.

Valetudinaria were often situated along the quiet edge of the forts (Cilliers & Retief, 2002). Sometimes, an acoustic buffer was built along the street side of the hospital in the form of storerooms or shops, as was the case at Windisch (figure 3.8) (Janssens, n.d.; Risse, 1999). It appears that, despite the influence of Hippocratic theories on Roman healthcare, the Romans often considered auditory environmental factors more thoroughly at healing sites.

As with the Asclepius sanctuaries, the location of Roman military forts was partially based on the hygienic criteria of Galen. Forts were often built on well-drained soil on a hillside and wells were dug for fresh water. The typical vestibule-ward structure, besides facilitating social control, decreased the intrusion of noise and dust from the corridor (Risse, 1999). A cross-section of the valetudinarium of Inchtuthil (figure 3.9) shows that cavities were created between the corridor and the wards to allow for proper ventilation and noise control. High windows and vents in the outer wards and the corridor would catch incoming daylight (Jefferson & Heneghan, 2020). “These permanent complexes were obviously intended to mitigate adverse climatic conditions” (Risse, 1999, p. 17).

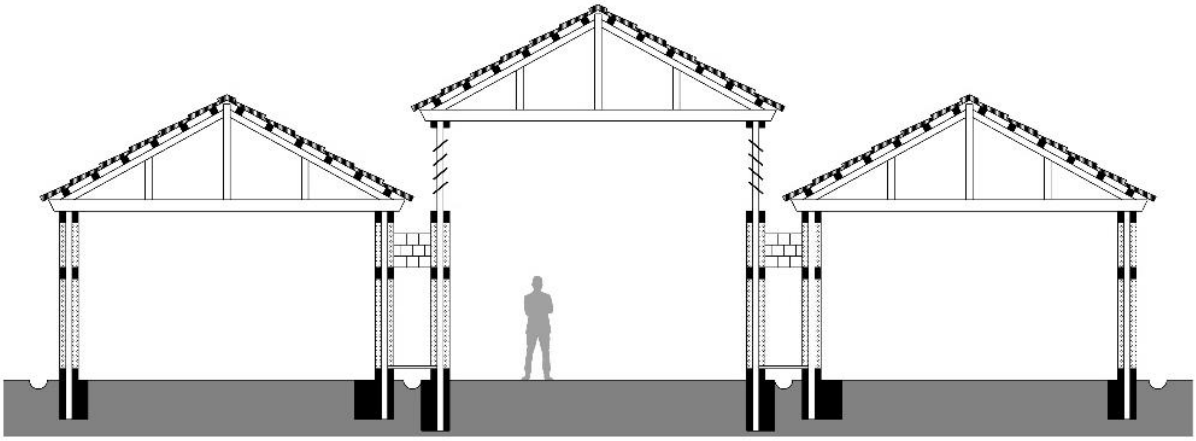


Figure 3.9: Valetudinarium Inchtuthil Section [Redrawn]. Original found at (Jefferson & Heneghan, 2020)

Jefferson & Heneghan mention various architectural interventions that can be derived from these valetudinaria, in an article attempting to learn from these buildings for future hospital developments: “(…) distancing, air circulation, (…) light, privacy, insulation, buddy aid, (…) flexibility in the face of the unknown (Jefferson & Heneghan, 2020, par. 10). To this, we can add the attention for noise-reduction and a standardized design format, scaled according to the needed capacity.

Expanding the theoretical framework

The theoretical framework based on the texts, as defined in the previous chapter, was complemented with concepts derived from concurrent health-care-related architecture.

From the Asclepius temples, we learned that the situation of the healing site is important to take into account. Preferably, this should be a clean, natural setting, some distance away from the city so people have a chance to detach themselves from daily stressors. To complement this, the site should be well-routed, well-oriented and recognizable, as well as featuring sociocultural functions to aid in

the process of detachment. Lastly, trust in the healing practice must be built, possibly through a web of symbolism in which architecture can play a role.

In the Roman valetudinaria, we could see that much attention was given to all climatic factors, such as air circulation, light, thermal insulation and noise reduction. This all adds to the Hippocratic theory of mitigating extreme fluctuations, as seen in Chapter II. Other than that, the valetudinaria pose a standardized format for design that can be scaled according to need, based on a general standard nursing-ward unit. In this unit, a balance between privacy, monitoring and buddy aid is created, providing great flexibility in the way the space is used.

IV Case Study: The Erasmus MC

In this chapter, the acquired framework from Chapters II and III will be tested on a modern case study hospital: the Erasmus MC in Rotterdam by EGM architects. To be specific, only the new nursing department of the Erasmus MC will be studied, as this department is architecturally and functionally comparable to the function of the Asclepius temples and valetudinaria. This department was completed and fully operational in 2018 (E. Hilgers, & Erasmus MC, 2016).

It would be valuable to study the design principles of the architects first, and compare them to the building plans. Luckily, both the Erasmus MC and EGM architects provided pamphlets in which they elaborated on the thought processes and guiding themes behind the design of the hospital. For the sake of organization, the topics in these pamphlets will be studied in the same order as the discovered Greco-Roman principles in Chapters II and III.

Balance, Scenery, Individuality

Hippocratic theory taught us that health is achieved through a balance of substances (humours or elements) within the body. Stressors that throw this balance off, should therefore be mitigated in the architecture of hospitals. It seems that this was one of the top priorities of EGM architects as well. In their pamphlet, they directly state that the design was aiming for “a pleasant, stress-reducing environment” (EGM architecten, 2018, p. 11). One way of achieving such an environment is mentioned by Landscape-architect Cor Geluk:

“We attempted to recreate a home-like environment where patients would feel at ease.” (Hilgers & Erasmus MC, 2026, p. 8).

Additionally, in the floorplan of the Erasmus MC’s nursing department, we can see public areas amidst the private rooms that adopt a living room-like layout and aesthetic. We know that, before the existence of hospitals, patients were often treated at private homes (Cilliers & Retief, 2002). Perhaps this practice had a similar reasoning behind it in Greco-Roman antiquity.

Mitigating climatic factors also played a big role in the reduction of stress. For this purpose, EGM architects were advised by Bureau Peutz on the topics of wind, fire safety, thermal insulation, noise reduction and other forms of climate control (Hilgers & Erasmus MC, 2016). An example of an architectural intervention that resulted from this, is the second-skin façade in front of all rooms in the nursing department, which was designed to reduce the nuisance from wind, noise and pollutants (EGM architecten, 2018). It consists of metal tubes with glass panels in a sawtooth pattern (figure 4.1).

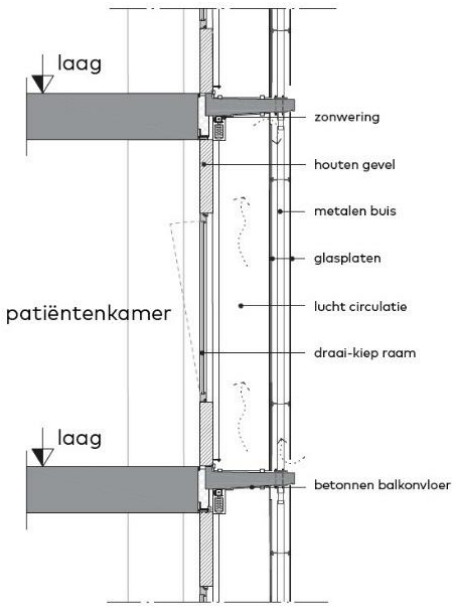


Figure 4.1: Details glass second skin (EGM architecten, 2018)

Another function of this glass façade is the entry of an abundance of daylight (Hilgers & Erasmus MC, 2016). The same is said for the glass reception hallway that connects all separate departments together. On this aspect, we must be more critical. Hippocrates (400 B.C.E./1995) writes in *Physician* that bright light or direct sunshine can in some instances be harmful to the patient, although sufficient lighting is necessary for examination by the physician, or nurse in this case. From this we can conclude that lighting too must be balanced, and it is not a matter of 'more equals better'.

Another feature of the design of the Erasmus MC however nullifies this issue. Besides attention to climate control, the design of the nursing apartment also prioritizes self-sustainability, so that patients are able to take control over the qualities of their own healing environment, and thus their own opposites (chapter II), through the use of a tablet (EGM architecten, n.d.; Hilgers & Erasmus MC, 2016). Shading and lighting are among the factors that can be controlled individually (Houweling, 2018). This is made possible because Erasmus MC only has private rooms for patients, which also positively impacts the rest, hygiene and therefore the recovery.

It seems that the themes 'balance' and 'individuality' are distinctly present in the design of the Erasmus MC. There is however less unmistakable evidence for the influence of the scenery on the design. Although the design process was most probably preceded by a thorough analysis of the environment, as is crucial in the field of architecture, hardly any conclusions from this analysis are mentioned in the pamphlets.

The value of 'orientation' is considered, although this should be interpreted more as 'knowing where you are in respect to the surrounding city' rather than the orientation in relation to the sun and wind as Hippocrates (400 B.C.E./2022) vouched for in *Airs, Waters, Places*. In the floorplan of the 8th floor (figure 4.2) we can see that only a few parts of the façade of the nursing department face east and thus catch the mild morning breeze and sun. Instead, more practical and urbanistic aspects such as view and traffic flows dictated the parameters for orientation in the Erasmus MC (EGM architecten, n.d.).

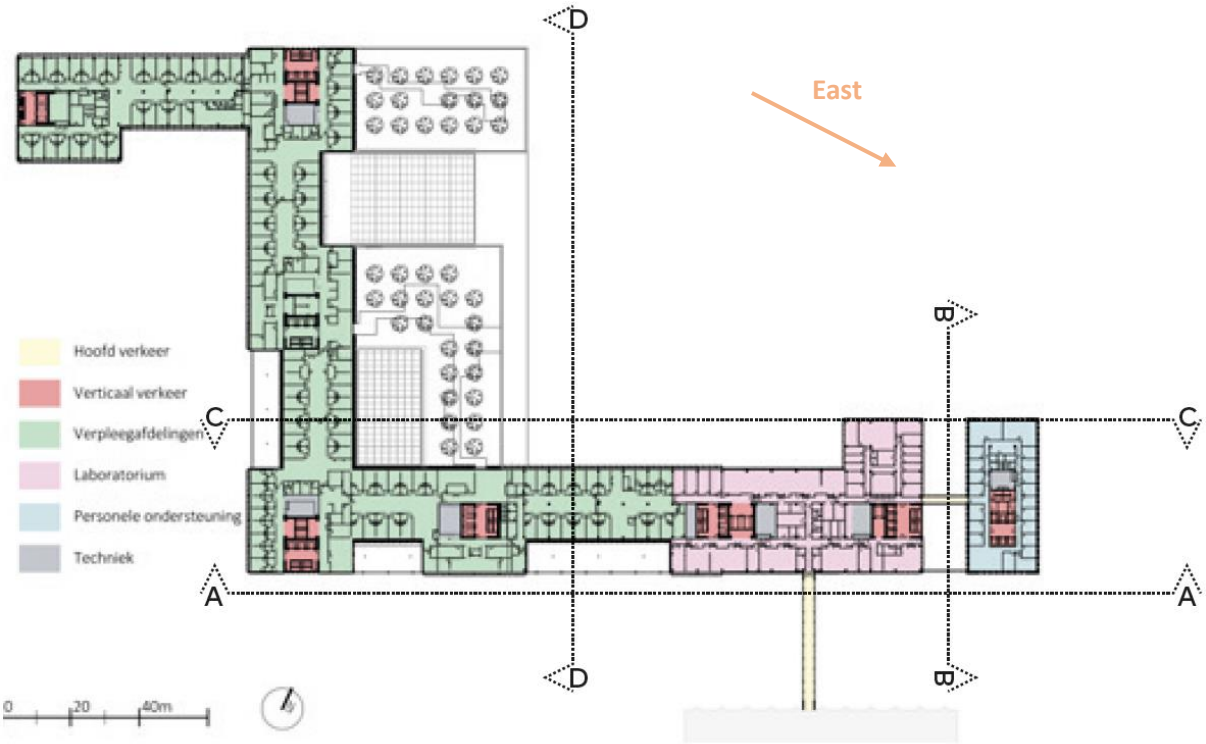


Figure 4.2: 8th floor (EGM architecten, 2018)

Comparing to Sanctuaries of Asclepius

Asclepius temples were originally situated in clean natural environments, away from the city, so that patients had the opportunity to detach from daily life and fully focus on the healing process. Even the Romans adopted a similar strategy, by situating their sanctuary on an island, thereby creating a physical barrier between it and the city. Although such interventions would prove to be difficult in a modern urban setting, it is noteworthy that EGM architects specifically sought out the connection with the surrounding city; even naming it “one of the key values of the Erasmus MC” (EGM architecten, n.d., par. 2).

In the design, city life is actively symbolized, especially in the reception hall. It is designed in such a way that it represents a city on the interior, complete with streets, squares, greenery and facades. This approach is at odds with that of Asclepius sanctuaries. However, this criticism only applies to the hospital complex as a whole. The nursing department itself is, ironically, situated according to different values within this complex. Although orientation through a view over the city and the two adjacent parks is still actively pursued, the entire nursing department is lifted up to the 8th floor and above (figure 4.3). EGM architecten (2018) explains that they thought about this principle deeply. They wanted the nursing department as far away from the clamorous city life as possible.

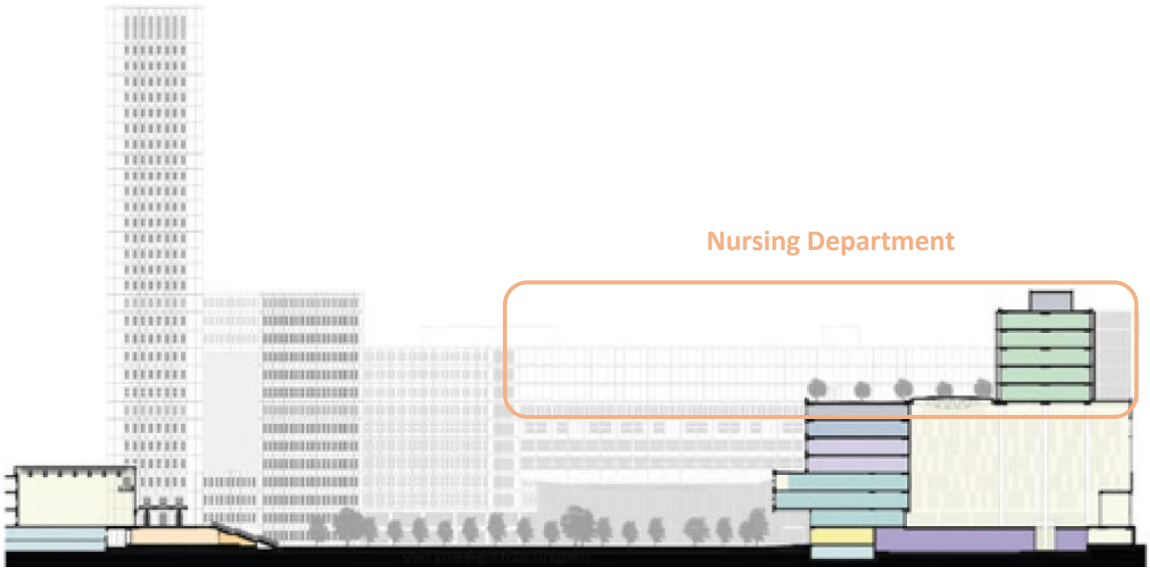


Figure 4.3: Cross-section C-C (EGM architecten, 2018)

In the sanctuaries of Asclepius, there were also socio-cultural functions such as a theater and a gymnasium. Apart from some shops and restaurants, no such functions could be discovered in the floorplans of the Erasmus MC. The nursing department itself is only provided with public living rooms for relaxation and perhaps social interaction. It could be argued that there is no need for other sociocultural functions, since the hospital is situated in the middle of a city filled with them. However it is unlikely that patients from the nursing department would regularly take a stroll through the city in search of entertainment. If the Asclepius sanctuaries are to be taken as a serious example, the Erasmus MC might benefit from the addition of a gymnasium and theater.

Lastly, there is the matter of symbolism. When patients visited Asclepius sanctuaries, or even beforehand, they would be exposed to symbolism across various types of media, such as texts and images, but also architecture (Levine, 2008). Additionally, the architects were highly experienced with the cult’s processes, and thus could create a very well-routed complex. This helped to contribute to

the trust and therefore the effectiveness of the healing process that took place there, as patients would know what to do, where to go and what to expect.

EGM architects (n.d.) also admit to creating recognition and unity in the building by standardizing the grid and layout. Peaceful illustrations were also added to the walls of many rooms for a calming effect (Hilgers & Erasmus MC, 2016), although these images are not meant to illustrate the healing process itself. Contemporary medicine is vastly different from the more spiritual practices of the ancient Greeks, which might explain why we do not find clear symbolism in the architecture of the Erasmus MC. Prof. Dr. Cor Wagenaar states in an interview that the architecture of modern hospitals even meant to resist religious interpretations of healthcare, and instead meant to represent science and reason (Sahabi, n.d.). It would therefore be inaccurate to suggest that the Erasmus MC lacks symbolism of the healing process in its architecture. This is merely the result of a changing historical context.

Comparing to Valetudinaria

As mentioned before, the nursing department of the Erasmus MC is lifted up as far away from the city as possible, to the 8th floor and above (EGM architecten, 2018). In terms of purpose, this placement is comparable to that of valetudinaria, which were situated at the quiet edge of the forts (Cilliers & Retief, 2002). In both instances it seems, noise reduction and rest through zoning played a central role in the contribution of architecture to the recovery of patients.

For further comparison to the Roman military hospitals, a closer look at the floorplan of the nursing department is necessary. This floorplan is similar to that of the valetudinaria, consisting of a central corridor with nursing ward units on either side (figure 4.4). These units consist of eight wards per landing spot, which is positioned in the middle of the corridor. Even a vestibule-like indentation can be recognized in front of all the doors, adjacent to this corridor. It is likely that this layout has a similar reasoning behind it as that of the valetudinaria, centered on hygienic principles, distancing, climatic control, but also efficiency (EGM architecten, n.d.).

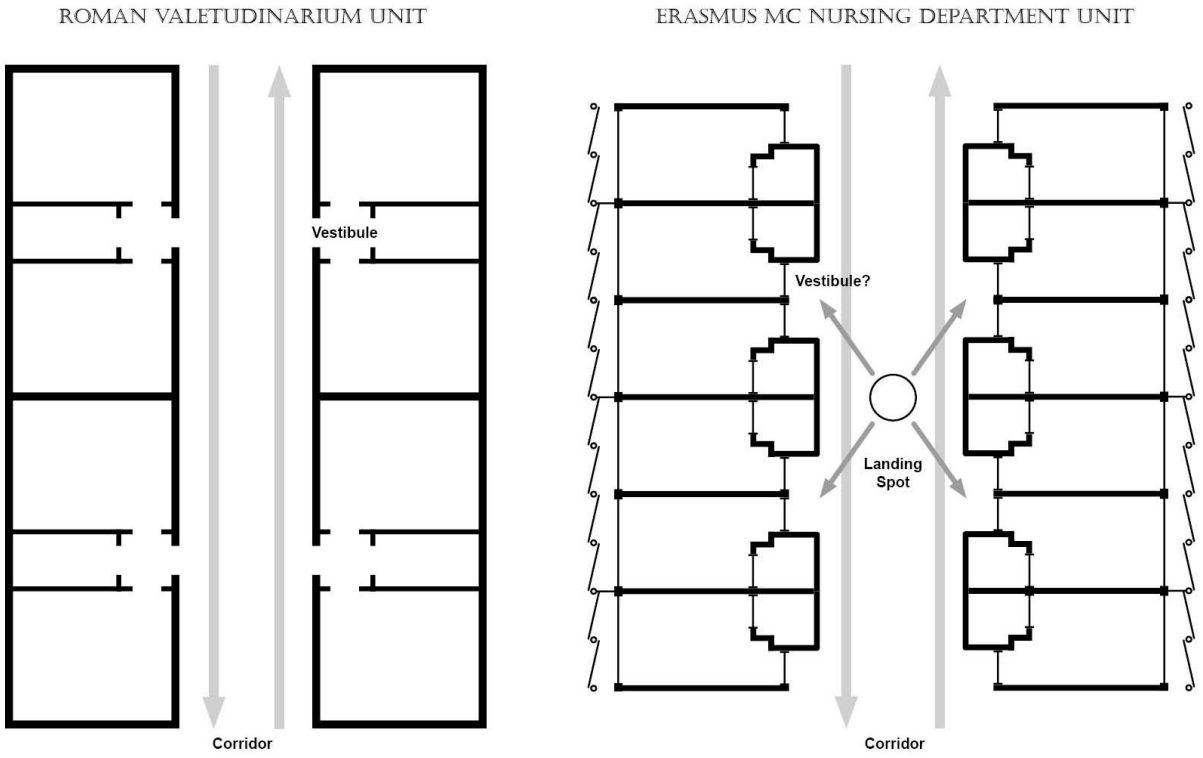


Figure 4.4: Comparison of valetudinaria and Erasmus MC nursing department

However, there are also clear differences. The concatenation of these ward units in the Erasmus MC, unlike that of the valetudinaria, does not form a closed rectangle that encapsulates a central courtyard. Instead, it forms an S-shape, from which at certain points an adjacent rooftop garden is accessible. Furthermore, the rooms are private only (EGM architecten, n.d.), whereas in valetudinaria rooms were semi-privately reserved per century in the legion, with a maximum capacity of three people (Cilliers & Retief, 2002). In both cases, privacy and flexibility are key values, however the Erasmus MC clearly prioritizes privacy over flexibility, while valetudinaria suggest the exact opposite.

This difference can be attributed to the difference in context in which these two typologies exist: valetudinaria were military field hospitals and therefore functionally uncertain, while the Erasmus MC is a civil hospital with (usually) a more stable patient flow. It must be noted however that the Erasmus MC, as mentioned before, has a standardized layout. This means that the problem of flexibility in capacity is solved by adapting similar rooms to the required function, rather than diminishing the privacy value, as becomes evident from this quote:

“The design for the new hospital is characterized by (…) optimal flexibility (…). Shifting the capacity is made possible by having a standardized layout for most rooms” (Hilgers & Erasmus MC, 2016, p. 9).

This proves that privacy and flexibility are not necessarily mutually exclusive, even in times of crisis. It can be considered an improvement upon the concept of flexibility and privacy that was adopted from valetudinaria in the theoretical framework of this thesis.

V Conclusions & Discussion

The aim of this thesis was to figure out to what extent we can trace influences of classical medical writings and concurrent Greco-Roman healthcare-related architecture in contemporary Western hospital architecture. To provide an answer to this research question, three steps were taken. Firstly, ancient literature on medicine was studied. Secondly, the architecture of Asclepius sanctuaries and Roman valetudinaria was analyzed. Lastly, the acquired architectural principles from these two studies were applied in a case study of the nursing department of the Erasmus MC in Rotterdam.

Conclusions

The theoretical framework

The studied literature by Hippocrates, Galen and Vitruvius led to a theoretical framework that can be summarized with the words 'balance', 'scenery' and 'individuality'. Health and recovery are achieved through minimizing stressors and maintaining a balance of substances within the body. Analysis, control and use of the scenery is essential, as most stressors come from the environment. Big fluctuations and extremes in climatic conditions must be avoided, for which orientation and climate design are valuable tools. In addition, it must be acknowledged that people can differ greatly from one another, and thus every individual would have a unique ideal environment for recovery and a unique ideal healthy constitution. These three aspects could be derived from Greco-Roman literature on medicine, and should be considered a valuable framework for hospital architecture. This framework can be expanded with conclusions from the concurrent architectural case studies.

Asclepius sanctuaries were situated at a virtual or literal distance from the city, preferably surrounded by natural scenery. Their designs were supported by plenty of experience with routing and orientation, and complemented with sociocultural functions. The architecture and situation helped patients to detach from their daily stressors. Lastly, various media of symbolism were used to illustrate the effectiveness of the healing process, potentially contributing to its success. Roman valetudinaria on the other hand, were rooted in the practicalities of war. Flexibility and patient capacity are key values in their standardized design. Additionally, climate design strategies, especially noise reduction and ventilation, were considered in the layout.

The case study

When comparing this architectural framework to the design of the nursing department of the Erasmus MC, many similarities were discovered.

Stress reduction, flexibility, privacy, orientation, light, routing and self-sustainability are all mentioned as important values for the design. A calming home-like environment was created in the private rooms, where climatic factors can be influenced by each individual patient. Climatic fluctuations are further diminished by the detailing of the second-skin façade. The floorplan of the department has a similar layout to that of the Roman valetudinaria, and it is assumed that this is done for similar reasons, such as noise reduction, distancing, hygiene, and efficient monitoring. Although the hospital complex is situated in the middle of the city, and connection to the city was prioritized, the nursing department itself is lifted up and away from the noisy streets, creating a virtual distance between it and the city.

There are however some differences. Firstly, a lot of glass was used to catch as much light as possible, while we know that light too is a climatic factor that must be balanced rather than maximized. To combat this, the Erasmus MC provided patients with autonomous control over their indoor climate. Secondly, orientation is mentioned as an important design principle, although it seems to imply a different concept than our theoretical framework would suggest. Orientation is

considered in relation to the urban setting rather than the environmental scenery. Thirdly, the concepts of a web of symbolism in the architecture and the addition of sociocultural functions seem to be missing in the architecture of the Erasmus MC. This implies that there is room for improvement in terms of helping patients relieve stress and build trust and expectations for the healing process. Lastly, although the designs of both the Roman valetudinaria and the Erasmus MC are centered around flexibility, the approaches differ greatly. Valetudinaria provide flexibility through the expansion of patient capacity within the nursing wards, whereas the Erasmus MC allows for the expansion of the number of nursing wards, due to a standardized design of rooms throughout the entire complex.

This thesis concludes that traces of classical medical writings and concurrent Greco-Roman healthcare-related architecture are clearly present in contemporary Western hospital architecture. A case study of the nursing department of the Erasmus MC in Rotterdam resulted in both similarities to and differences from the theoretical framework of architectural principles that was derived from Greco-Roman texts and architecture.

Discussion

A few notes must be made to illustrate the relevancy and limitations of this thesis. First of all, especially the differences between the Erasmus MC case study and the defined theoretical framework suggest future research. It would be interesting to study the effects of visual connection to the city as opposed to a complete detachment of the hospital complex from the city. Another topic for research could be a cost-benefit analysis for the facilitation of sociocultural activities in the hospital setting.

There are some limitations to consider for this thesis as well. First of all, due to constraints in both time and resources, this thesis does not present an all-encompassing study of the Greco-Roman literature and architecture. Hippocrates, Galen and Vitruvius wrote many texts, of which only several were intensively analyzed. Furthermore, there are many other less famous classical physicians and philosophers that were not discussed in this thesis. The same applies to the architectural case studies of Asclepius sanctuaries and valetudinaria. Many cases could have been considered and studied apart from one another. However, due to the mention of a standardized set of design principles in both instances, it was decided to analyze and compare only a few cases. For these reasons, it is possible that the framework of architectural principles that was derived from these studies is incomplete.

Additionally, this framework was only tested on one case study of a contemporary hospital. It cannot be assumed that the conclusion of this thesis thus applies to all contemporary and future hospital architecture. It is merely meant to serve as an example of how Greco-Roman healthcare-related principles can be considered or recognized in contemporary hospital architecture.

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Figure 3.4

Tempel van Asklepios. (n.d.). [Photo] ViaTioga. https://viatioga.nl/voorpret/bezienswaardigheden/griekenland/peloponnesos/epidaurus/

Figure 3.5

Own Work.

Figure 3.6

Own Work.
Abstraction based on illustration found at:
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Figure 3.7

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Figure 3.8

Janssens, M. (n.d.). *Het legioenkamp van Windisch*. [Illustration] ethesis.net. http://www.ethesis.net/romeinse_arts/romeinse_arts_hfst_2_b.htm

Figure 3.9

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Figure 4.1

EGM architecten. (2018). *Erasmus MC Persbericht – projectpresentatie*. [Detail in Brochure]. EGM architecten.

Figure 4.2

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Figure 4.3

EGM architecten. (2018). *Erasmus MC Persbericht – projectpresentatie*. [Section in Brochure]. EGM architecten.

Figure 4.4

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