

THE EFFICACY OF MODULAR DESIGN

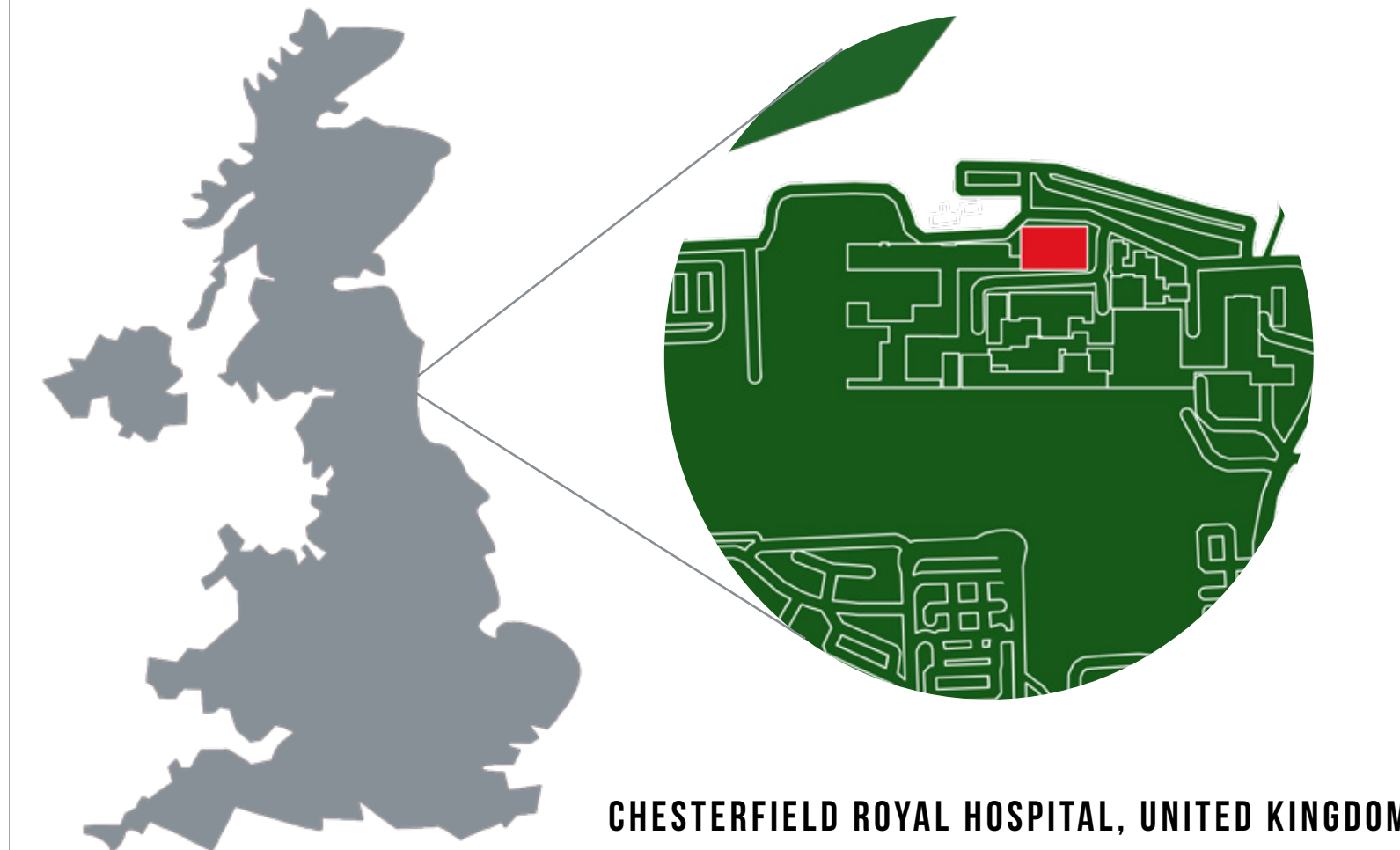
THE EXPLORATION OF MODULAR DESIGN IN HEALTHCARE THROUGH THE CONSTRUCTION OF A MODULAR TWIN UNIT AT CHESTERFIELD ROYAL HOSPITAL AND ITS MODULAR DESIGN



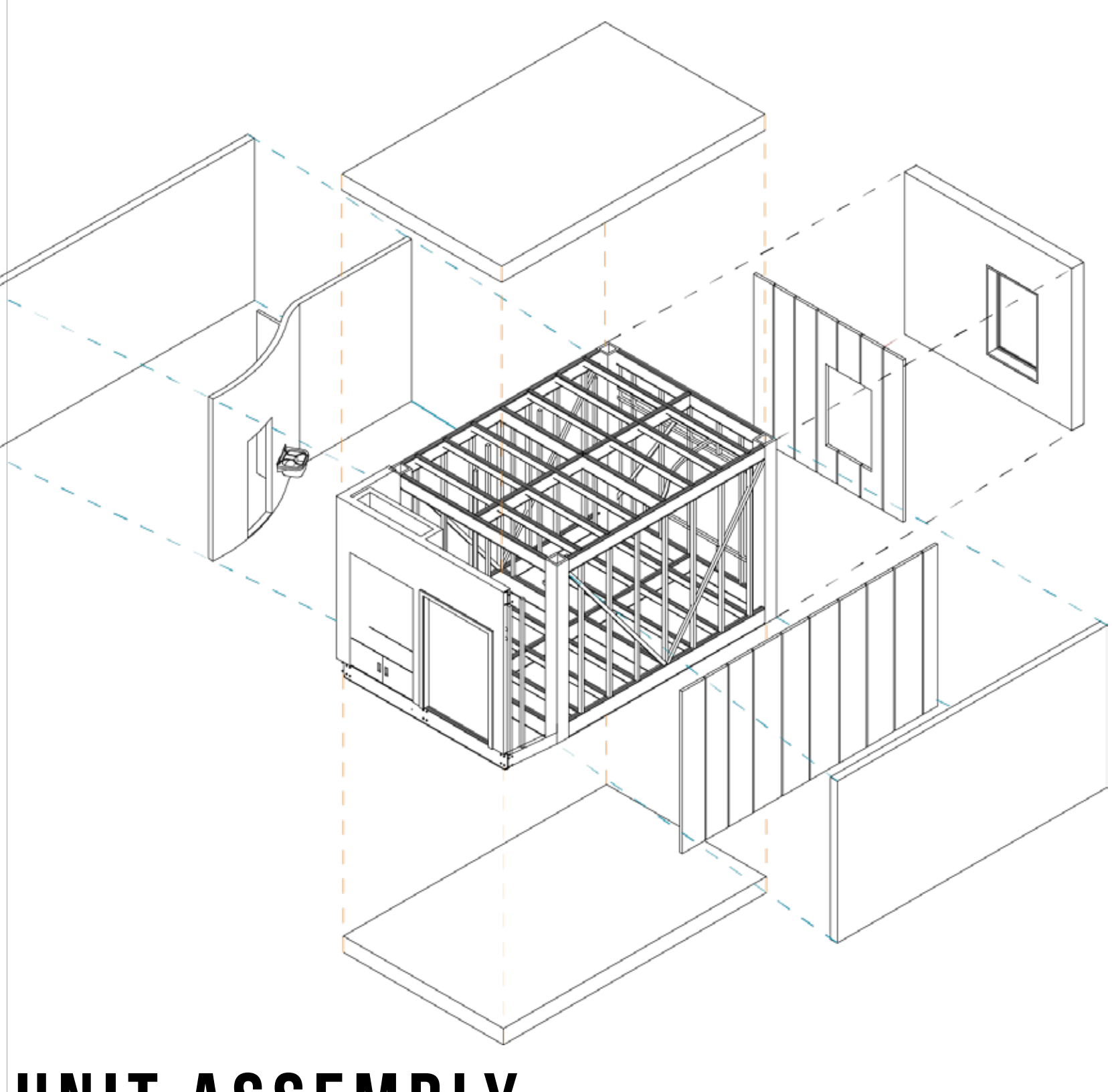
BACKGROUND

In practice, the study, and design of Healthcare Architecture; the application of medicine is steadily evolving to treat larger collectives of patients, demanding more ambulatory services and outpatient care. While not the first health crisis to spark this paradigm shift, COVID-19 has proven that the field of medicine was ill-prepared for the pandemic; most notably in construction and design. The occupancy of hospitals are determined by the standard daily limit of a unit's typology. When a public health crisis occurs, this leaves hospitals without proper facilities for the influx of patient care. The first solution is expansion, often times in the form of permanent construction with the risk of vacancy when the crisis subsides. The sudden imbalance of supply and demand fuels the risk of panic-architecture. A fast paced solution to a problem with a high likelihood of error and often times patient discomfort results. The Modular Twin to the NGS Macmillan Unit proposes an idea that expansion is still achievable without the need for panic, discomfort, or waste. Modular architecture is not a new development in the field. Originally intended for residential design, modular architecture subdivides a construction system into independently fabricated units, similar in size, shape, and functionality to formulate a structure. By lowering the time of construction, design development and planning, efficient growth is achievable in emergencies like the pandemic. Architects will be tasked with designing these mods similar to a product patent that can be later repurposed to continue its line for expansion. The on-site construction is reduced to a short assembly with little noise and environmental pollution. Patients in attendance during these times will be subjected to less stressful situations and noise which will ultimately promote recovery.

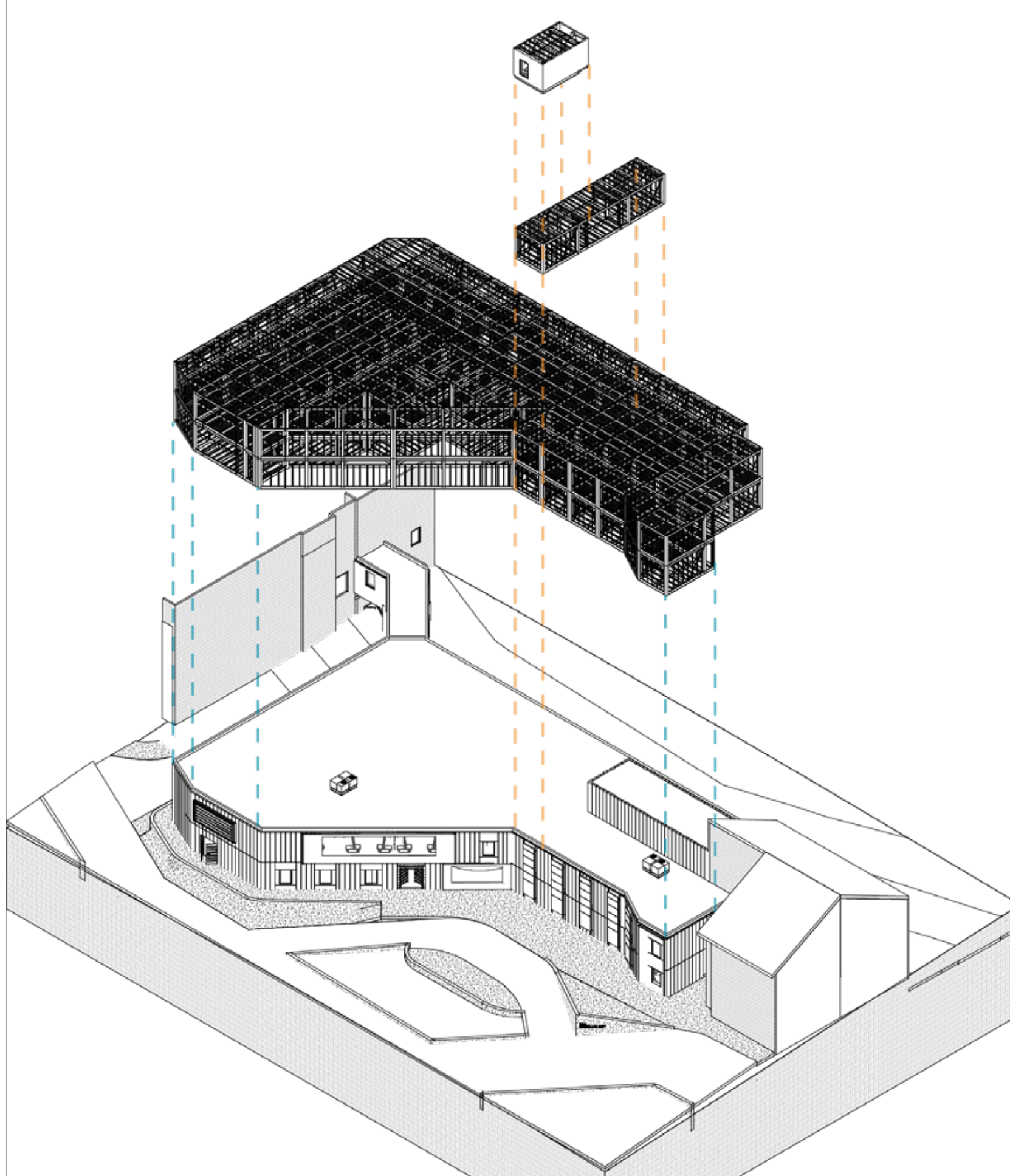
One of the most popular misconceptions of modular architecture is that it completely arrests creativity and efficient circulation. Influenced by the program and aesthetic of the NGS Macmillan Unit in Chesterfield, England, the proposed modular twin imagines a path where the architect for this treatment center utilized this life-saving design methodology.



CHESTERFIELD ROYAL HOSPITAL, UNITED KINGDOM



UNIT ASSEMBLY



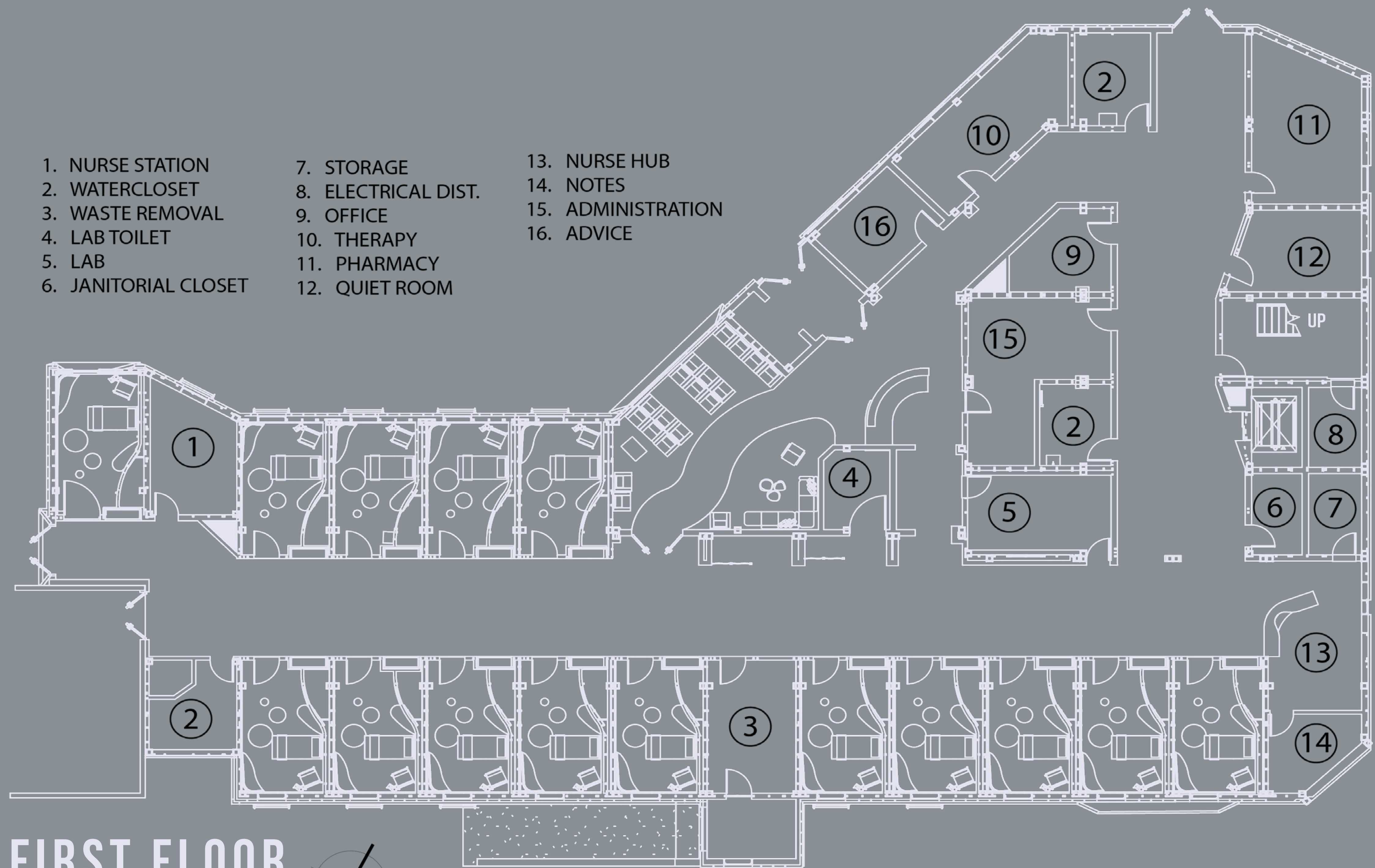
ISOMETRIC ASSEMBLY

MODULAR TWIN

The modular twin to the NGS Macmillan Unit operates under the same program of spaces and required amenities. The beauty of this space is that it was designed with the intention of blurring the lines between traditional brick and stick construction and modular assembly. With the exception of the envelope's parameters, the interior spaces guide patients with directional lighting, wall angles and floor markings. Curvature and warm lighting enable a soft, comfortable path for patients while linear and cool lighting directs staff members across the unit's long corridors to increase efficiency. The contrast of colors was intricately chosen per

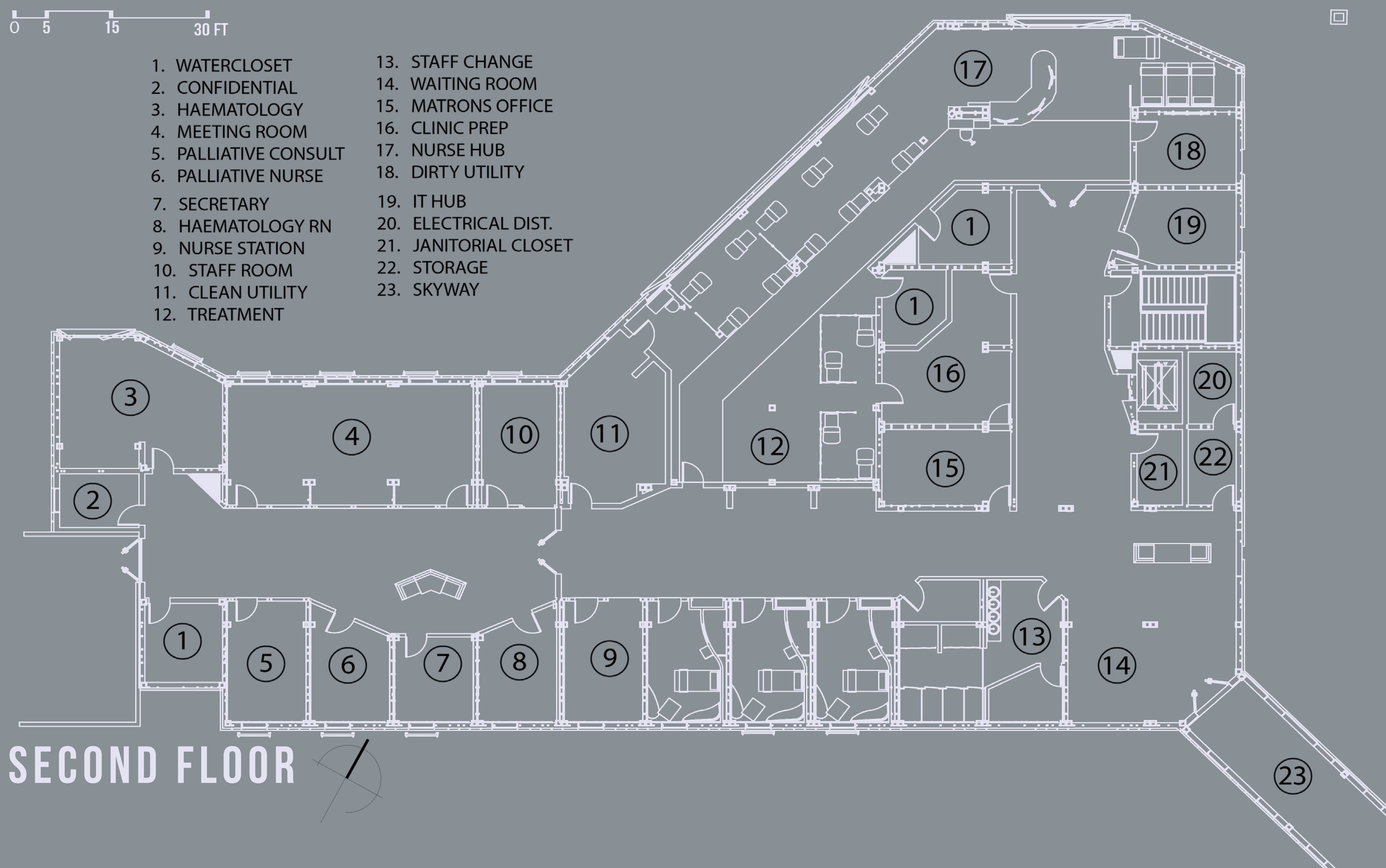
color theory's philosophy of psychological impact. The white of the primary elements of the spaces has a soft blue hue, chosen for its qualities of cleanliness and relaxation. Spots of orange subconsciously increase energy and growth. Maroon is an indication of trust and focus, primarily found in collaborative spaces between faculty and patients. Every element within the building envelope continued to allow creativity to flourish and maintained the patient in mind. The last step in determining the efficacy of modular design in healthcare is through quantitative evidence of efficiency. The following proposal for floor plans were measured simultaneously with the existing unit using the method of Anylogic simulation.

- | | | |
|----------------------|---------------------|--------------------|
| 1. NURSE STATION | 7. STORAGE | 13. NURSE HUB |
| 2. WATERCLOSET | 8. ELECTRICAL DIST. | 14. NOTES |
| 3. WASTE REMOVAL | 9. OFFICE | 15. ADMINISTRATION |
| 4. LAB TOILET | 10. THERAPY | 16. ADVICE |
| 5. LAB | 11. PHARMACY | |
| 6. JANITORIAL CLOSET | 12. QUIET ROOM | |



FIRST FLOOR

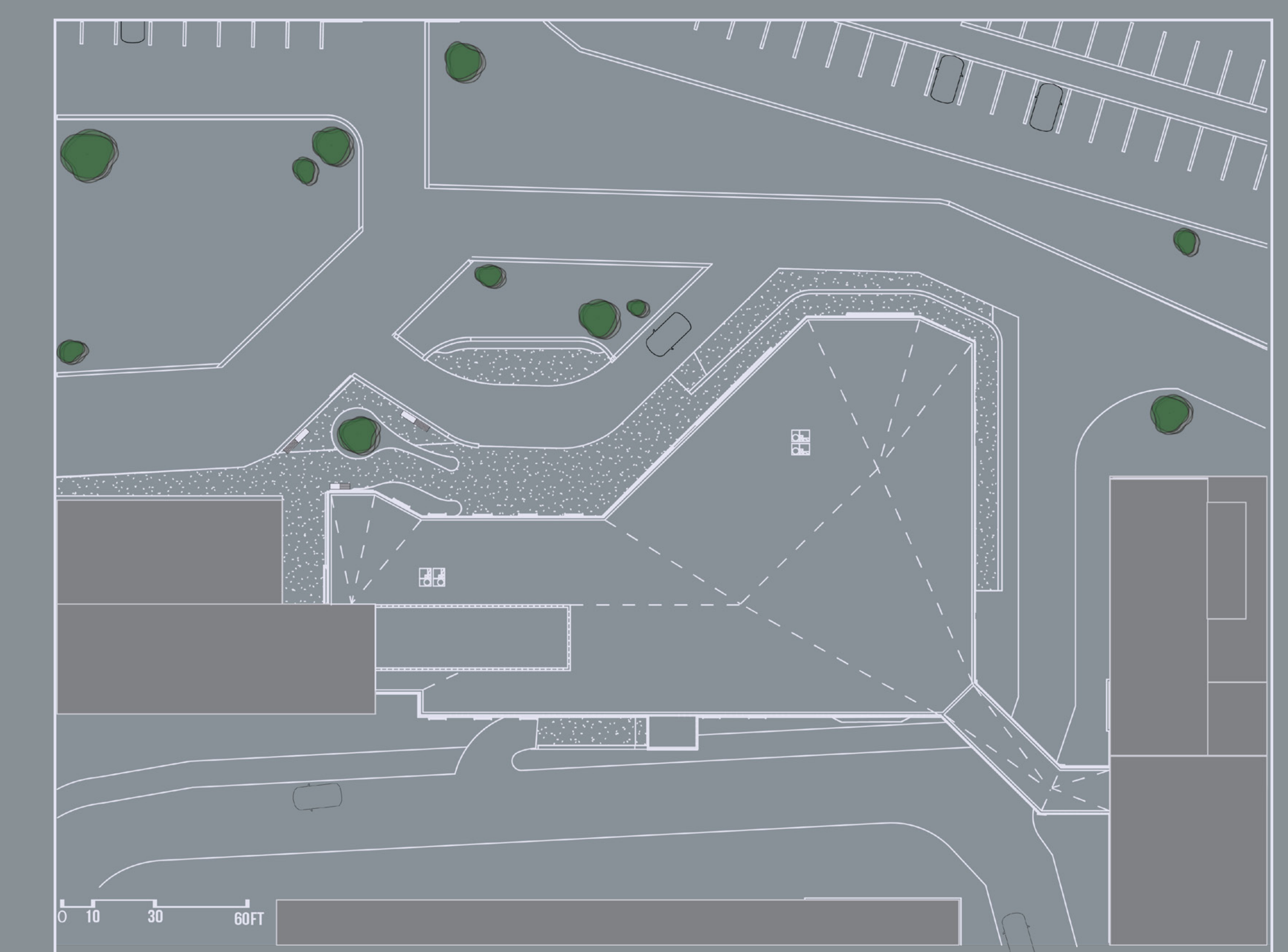
- | | |
|---------------------|-----------------------|
| 1. WATERCLOSET | 13. STAFF CHANGE |
| 2. CONFIDENTIAL | 14. WAITING ROOM |
| 3. HAEMATOLOGY | 15. MATRONS OFFICE |
| 4. MEETING ROOM | 16. CLINIC PREP |
| 5. PALLIATIVE NURSE | 17. NURSE HUB |
| 6. SECRETARY | 18. DIRTY UTILITY |
| 7. HAEMATOLOGY RN | 19. IT HUB |
| 8. NURSE STATION | 20. ELECTRICAL DIST. |
| 9. STAFF ROOM | 21. JANITORIAL CLOSET |
| 10. CLEAN UTILITY | 22. STORAGE |
| 11. TREATMENT | 23. SKYWAY |



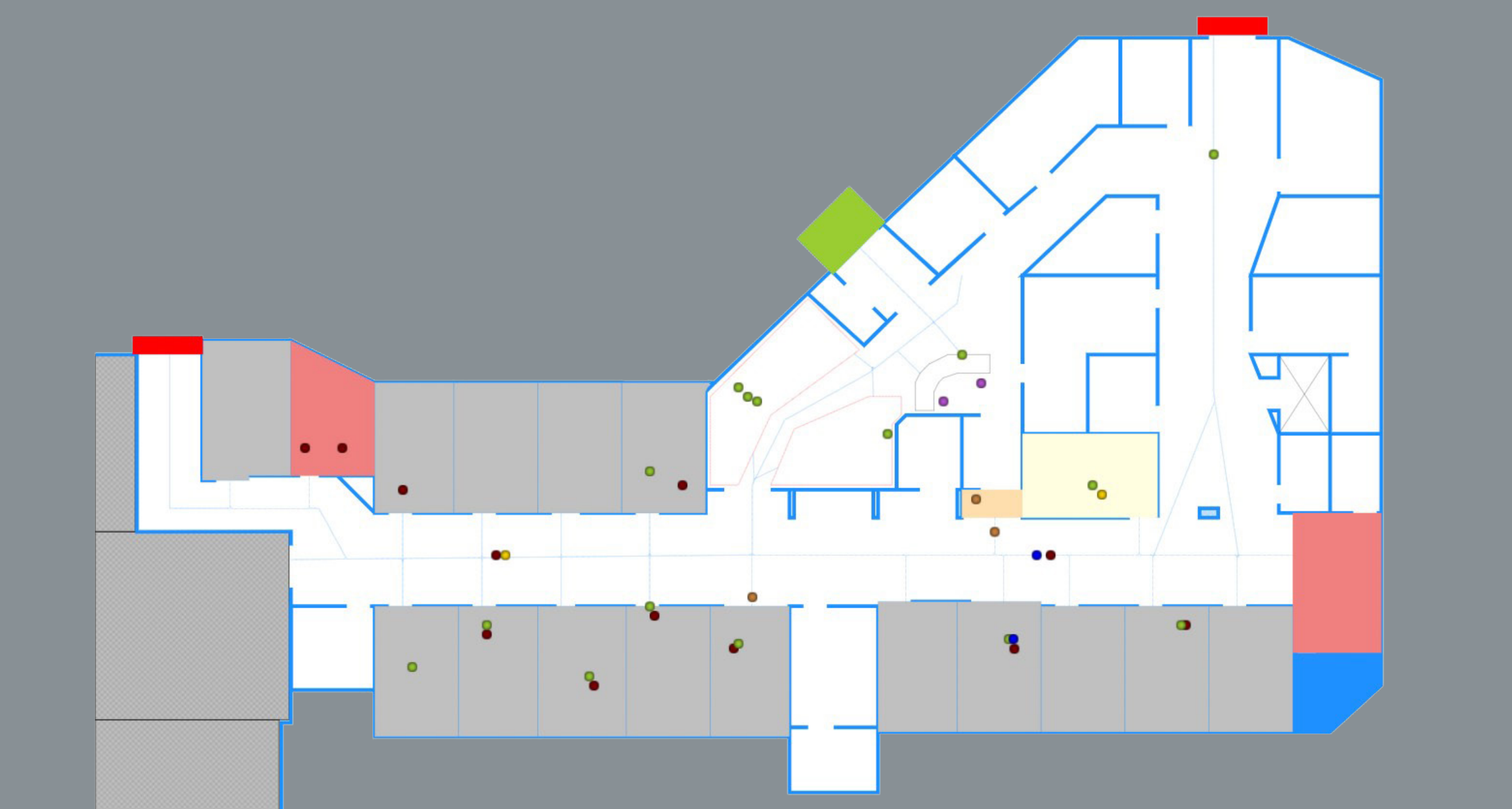
SECOND FLOOR

DESIGN IN HEALTHCARE

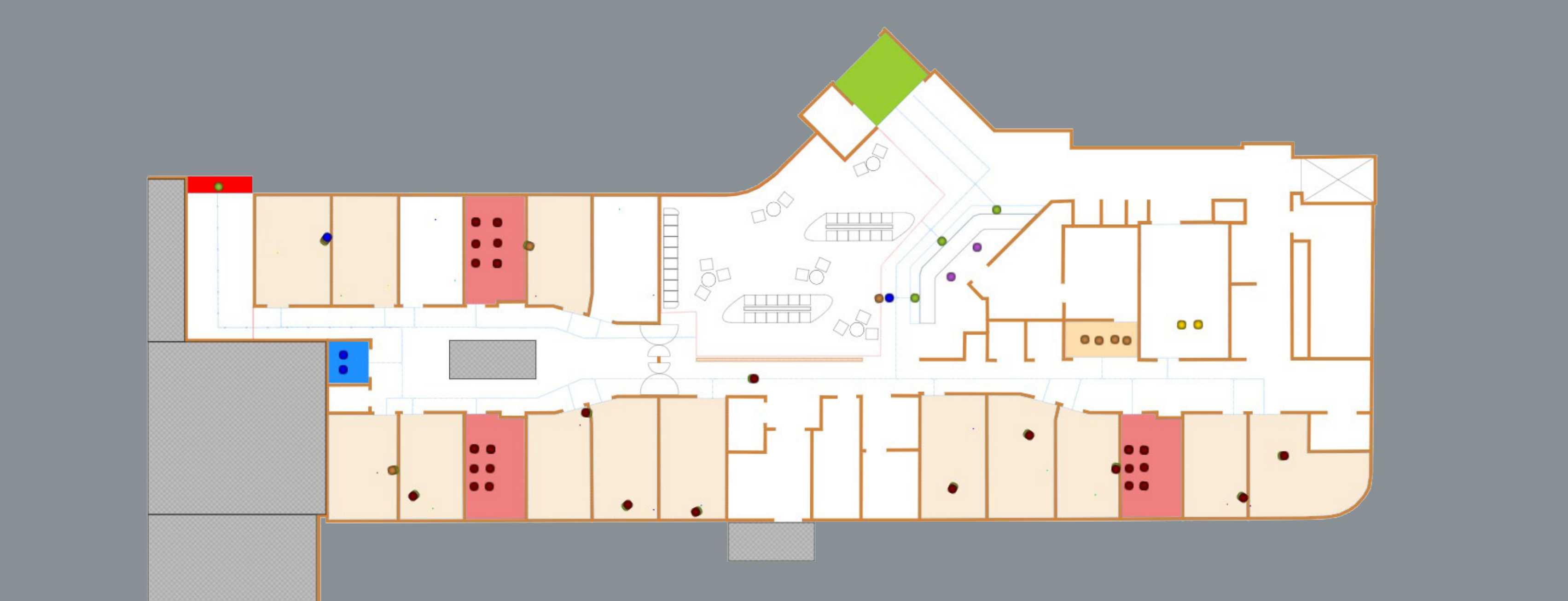
COMPARATIVE ANALYSIS OF A TRADITIONALLY CONSTRUCTED FACILITY AND ITS MODULAR TWIN



SITE PLAN



MODULAR TWIN SIMULATION



NGS MACMILLAN SIMULATION

Anylogic is a simulation modelling tool that supports agent-based and system dynamics simulation methods for business applications, planning and architecture. Having created a standardized/simplified simulation to determine the efficiency of building circulation, time of arrival (TOA) and length of stay (LOS) statistics the two structure's results indicate that modular construction was more efficient. The most recognizable attribution was the unavoidable close proximity of spaces in a modular layout. Having parameters set at 52' x 13' x 13', the distance between rooms was shortened. This limitation also caused the relocation of several room types. The angular walls of the modular twin in comparison to the NGS Macmillan remained relatively the same despite preconceived notions. In conclusion, through the process of replicating a building using strictly modular methods, the structure was successful in achieving aesthetic likeness, building program, creativity, and efficiency.

NGS MACMILLAN UNIT

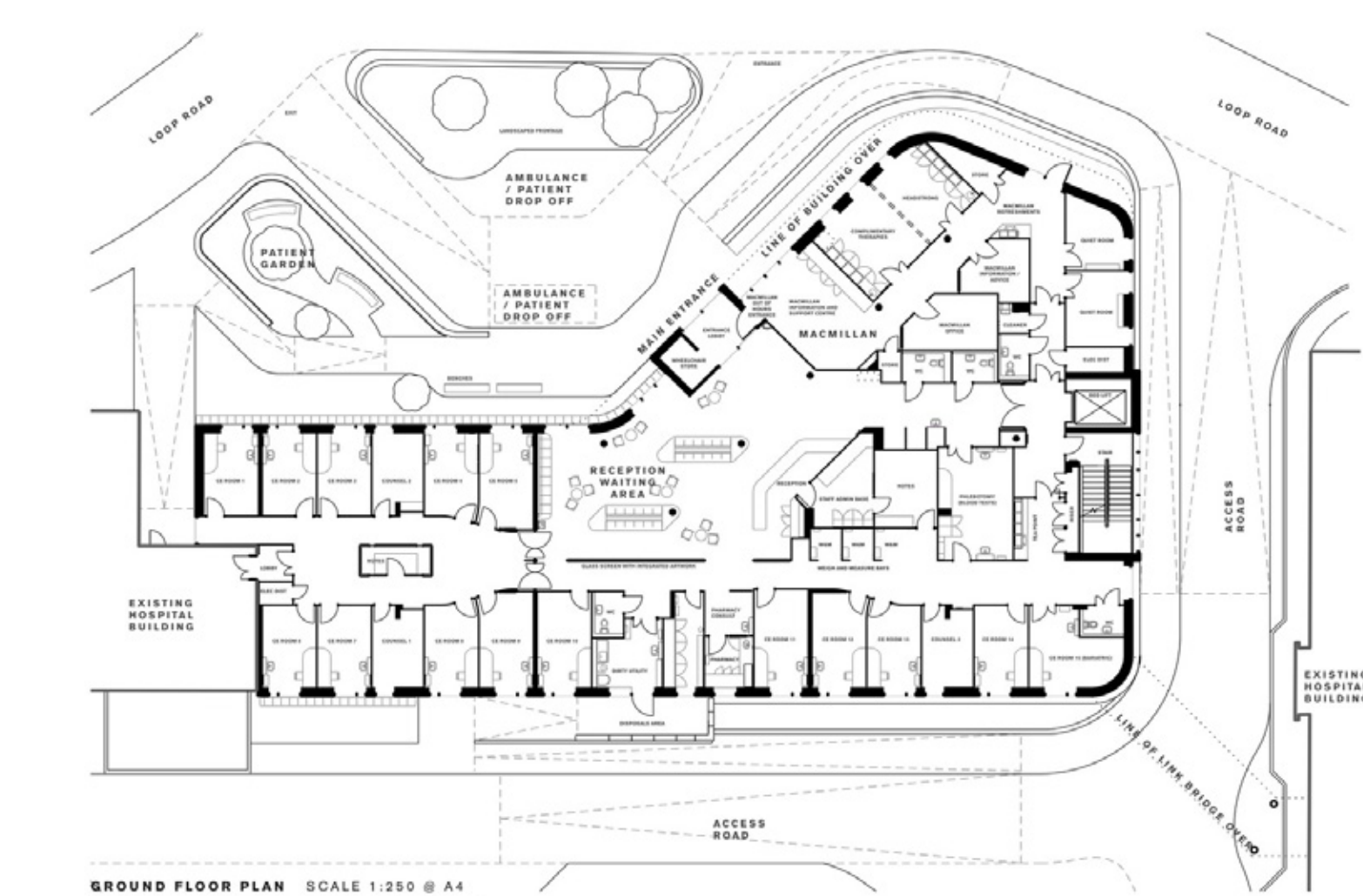
The NGS Macmillan Unit is a standard ambulatory and cancer patient care facility constructed as an addition to the Chesterfield Royal Hospital. Its services, professionals, scale, and typology are a perfect example of a clinic that had the opportunity to use prefabricated construction methods. Its unique spatial organization and envelope are a great representation of the possibilities provided by traditional construction. Reaching the limits of an organic facade while maintaining high efficiency, it is the perfect sample to be tested.

Access to Information

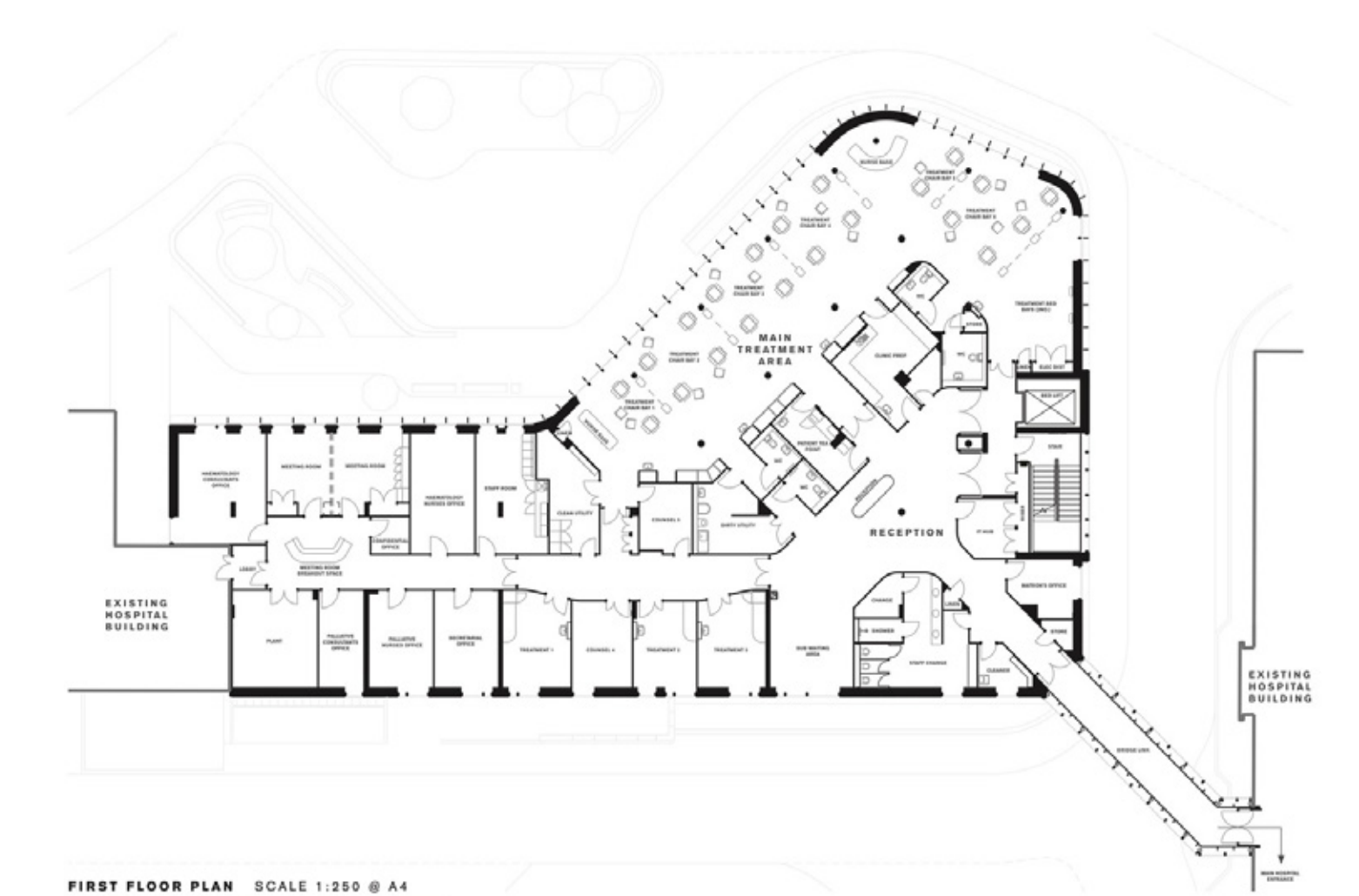
The NGS Macmillan Unit has readily available research and drawings for study. While it would be beneficial to visit this site in person, I have found it unnecessary due to the bountiful amount of information that can be found online.

Materiality

Healthcare facilities require an abundance of specific materials to maintain a sterile environment, provide safe passage and avoid contamination from units such as labs and X-rays. These are standardized and universal materials, however, the facade has more creative freedom as seen in the details. This would provide a challenge to create a design solution that not only functions properly internally but also capture the dynamic aesthetic of the NGS Macmillan's envelope. Utilizing the verticality of the seems between modular units, a similar effect can be drawn from the external fins on the existing facility. Window placement, white facade paneling and elbow shape all embody the characteristics of the form originally designed by The Manser Practice.



https://www.archdaily.com/880789/ngs-macmillan-unit-the-manser-practice



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NGS MACMILLAN RESULTS

FULL LENGTH ETA (E/W) (6.2)
Distance (m) - 16
ETA (sec.) - 22.4

FULL LENGTH ETA (N/S) (6.2 AR):
Distance (m) - 51.52
ETA (sec.) - 78.128

LENGTH OF STAY RESULTS (6.2 AR):
Day - 51.088 min.
Week - 52.061 min.
Month - 55.191 min

LENGTH OF STAY RESULTS (6.5):
Day - 52.646 min.
Week - 52.989 min.
Month - 57.300 min

EXAM ROOM UTILIZATION (6.2 AR):
Day - 73 Units
Week - 518 Units
Month (30 Days) - 2129 Units

DOCTOR UTILIZATION (6.2 AR)
Patients per hour - 5.55

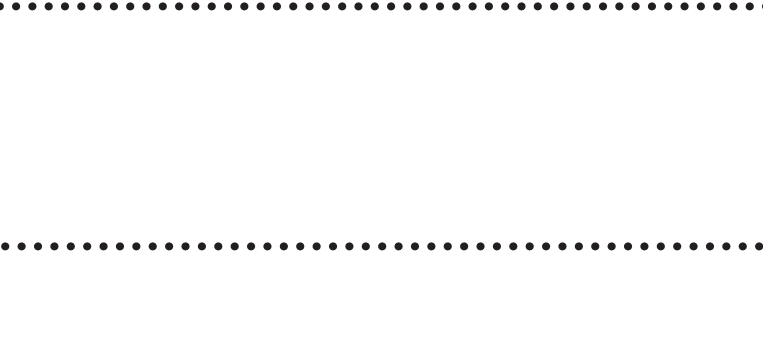
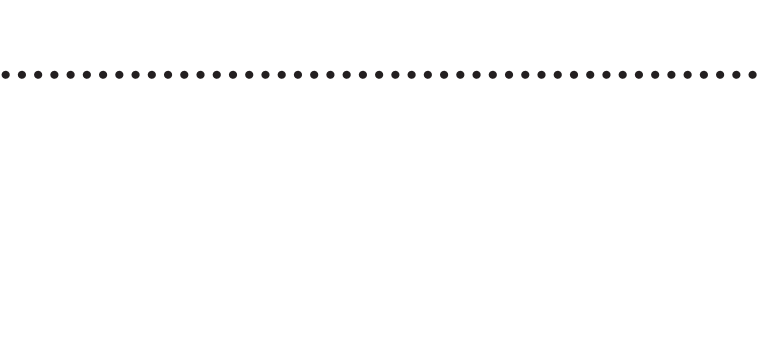
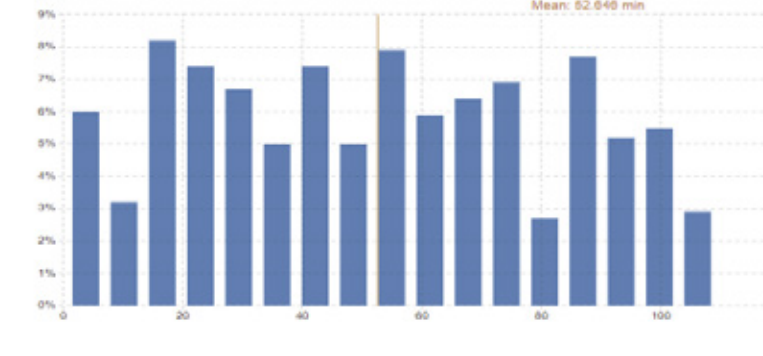
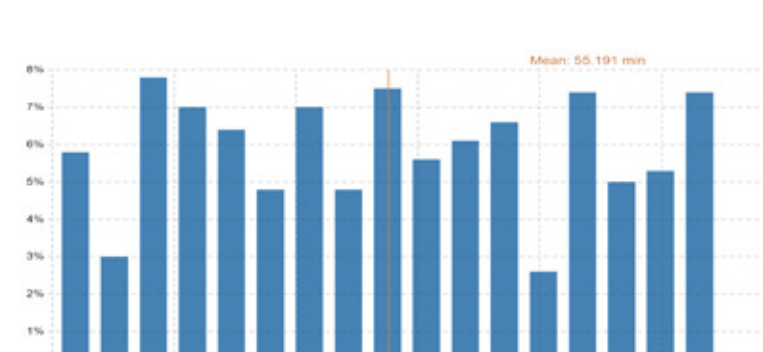
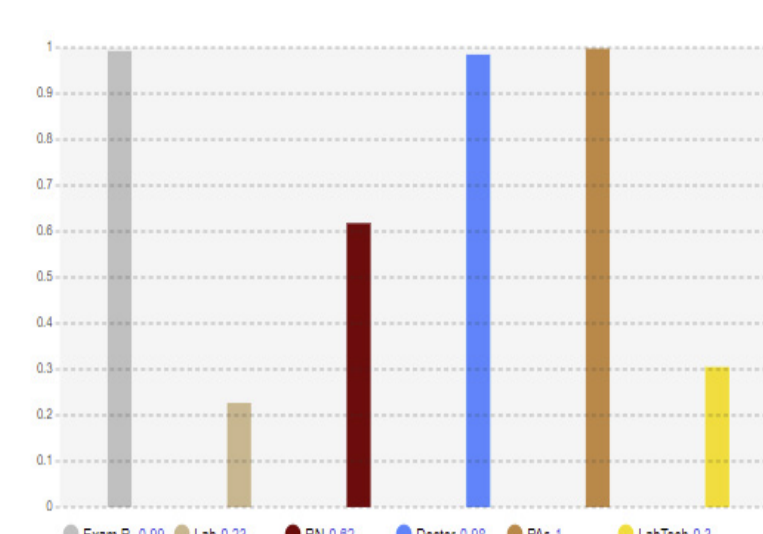
LAB UTILIZATION (6.2 AR):
Day - 17 Units
Week - 120 Units
Month (30 Days) - 490 Units

PA UTILIZATION (6.2 AR):
Patients per hour - 5.5

REGISTERED NURSE UTILIZATION (6.2 AR):
Patients per hour - 2.24

LABTECH UTILIZATION (6.2 AR):
Patients per hour - 10.95

UTILIZATION RESULTS



MODULAR TWIN RESULTS

FULL LENGTH ETA (E/W) (6.2)
Distance (m) - 16.1
ETA (sec.) - 21.05

FULL LENGTH ETA (N/S) (6.2 AR):
Distance (m) - 50.02
ETA (sec.) - 74.188

LENGTH OF STAY RESULTS (6.2 AR):
Day - 50.91 min.
Week - 51.43 min.
Month - 53.65 min

LENGTH OF STAY RESULTS (6.5):
Day - 52.486 min.
Week - 53.111 min.
Month - 55.621 min

EXAM ROOM UTILIZATION (6.2 AR):
Day - 73 Units
Week - 519 Units
Month (30 Days) - 2144 Units

DOCTOR UTILIZATION (6.2 AR)
Patients per hour - 6.05

LAB UTILIZATION (6.2 AR):
Day - 17 Units
Week - 119 Units
Month (30 Days) - 488 Units

PA UTILIZATION (6.2 AR):
Patients per hour - 6.5

REGISTERED NURSE UTILIZATION (6.2 AR):
Patients per hour - 2.24

LABTECH UTILIZATION (6.2 AR):
Patients per hour - 10.95