

Surgery Expansion Phase 1

Children's National Medical Center

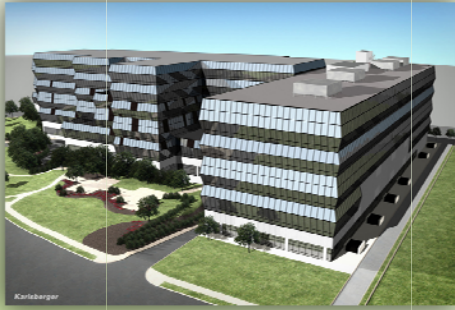
111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

Thesis Proposal

Table of Contents

Executive Summary.....	2
A. Introduction.....	3
B. Analysis 1: Industry Research.....	5
C. Analysis 2: Prefabrication Implementation.....	9
D. Analysis 3: Noise Penetration.....	10
E. Weight Matrix.....	11



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

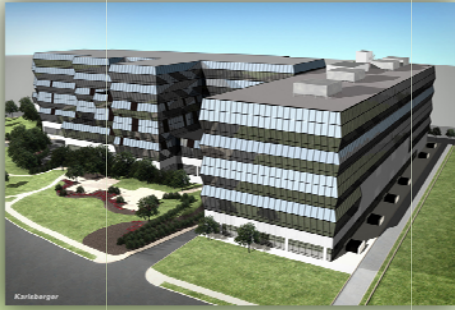
Executive Summary

This thesis proposal is for the analysis work and industry research portion of the AE Senior Thesis. It includes the details for what my research on prefabrication in relation to the Infection Control Risk Assessment (ICRA) put forth by the American Institute of Architects (AIA), an analysis for prefabricating the mechanical systems and interior partitions, and an analysis of the acoustics of the Neonatal Intensive Care Unit (NICU), Critical Intensive Care Unit (CICU) and the two new operating rooms.

The industry research on prefabrication is a study of what contractors can prefabricate to reduce the risk of patient infection. It is an attempt to determine how much can actually be prefabricated off site. Using surveys, a list of the largest concerns of hospital owners and staff will be comprised. The list will allow for more detailed research into specific systems and products. Ultimately, the result of this research will be a guide for owners, contractors and designers to use in supplement to the ICRA regulations and help them determine what extra measures they can take.

Prefabrication will also be used as the main analysis tool of the mechanical system. In an effort to reduce the project schedule and costs, I am going to examine applying prefabrication. The mechanical detail will be a breadth study, to include an analysis of the elements as designed, and the possible redesign of elements to maximize the amount of prefabrication. Interior partitions will also be examined for prefabrication as a cost and schedule reduction method. Constructability reviews will also be conducted in determining if prefabrication is a viable option and should be seriously pursued.

Noise penetration will be studied as an acoustical breadth. The efforts of this analysis will focus on what measures can be taken prior to construction to minimize the impact of construction noise for the rest of the hospital. Two particular areas of focus will be the NICU and CICU which house patients with extremely sensitive conditions. The new operating rooms will also be examined for acoustical isolation as designed. If necessary, new measures will be added to the project to isolate these rooms to allow for better concentration of the surgeons, and to prevent issues during future construction projects.



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

A. Introduction

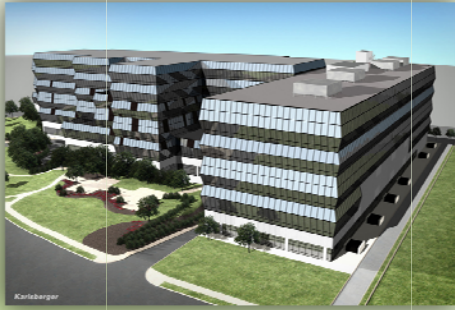
Children's National Medical Center (CNMC) was originally built in the 1970s with the addition of the west wing in the 1990s. Within the past two years it has expanded again to include the east wing patient tower and decontamination wing. The overall building is 902,972 gsf, and has six (6) occupied floors, five (5) interstitial floors, and four (4) underground parking levels.

The addition of the east wing provided space for renovations within the original hospital footprint. The Surgery Expansion Phase 1 project is a conversion of office space to two (2) new surgical suites and their support. It also includes some renovation of a waiting room area, a floor of the decontamination building, and a new elevator. All the renovation is on the second floor and its subsequent renovation of floors 1.5 and 2.5 to alter the electrical and mechanical systems. The entire area of renovation is 45,512 sf and will cost approximately \$10.2 million.

Due to renovation being done in an occupied space there are several extra measures which will be implemented as part of the construction. There is a large concern for infection control, primarily due to the dust generated during construction and the frailty of the patients' health. The construction site will be completely contained and isolated from the operating sections of the hospital. A tunnel will be constructed the hallway that runs the length of the site for construction access and ease. The tunnel will run from the bottom of the deck at interstitial level 2.5 to the finished floor at level 2. Inside the boundaries of the site will be a negative air flow machine to draw air into all leak spaces and keep the dust within the site. As an extra precaution walk-off sticky mats will be placed at the entrance door to the site to clean off the shoes of anyone who exits the site into the functioning hospital.

Another main issue with construction in this occupied space is to cause as little damage to the existing structure. To maintain the integrity of the façade curtain wall the construction team will only remove several panels of tempered glass, and louvers. All materials will be delivered through a hoist into the building at level 2. Other materials not able to be brought onto site using the hoist may use the service elevators located through the loading dock with special permission and under certain time restrictions.

Construction in hospitals is especially unique due to the regulations for contamination. Infection Control Risk Assessments (ICRAs) are required by law prior to beginning construction. The extra measures used to maintain a safe environment for the patients affect the project on many levels. The intricate nature of the spaces and patients at CNMC require even more care. For these reasons, the following research proposal and analysis topics will focus on making it easier to reduce contamination in the hospital. The research will focus on the ICRA regulations and the possibility of using prefabrication to aid in meeting them.



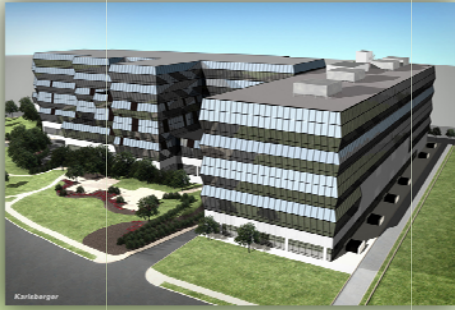
Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

Prefabrication has many implications for schedule and cost reductions, as well as value engineering if applied correctly. The first analysis will focus on the possibility of prefabricating the mechanical system and possibly some interior partitions as options for improvement. Seeing another main concern of the hospital is noise and vibrations traveling to Intensive Care Units (ICUs), the second analysis will help determine what steps can be taken prior to construction to eliminate disturbances. Limiting these issues may cause a schedule and cost reduction due to delays for stopped work when there are problems. It will also evaluate the acoustic design for the two operating rooms to determine if more measures should be taken now to prevent noise penetration during future construction projects.



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

B. Analysis 1: Industry Research

Problem Statement:

Hospital renovations and expansions are an integral part of maintaining the health care system in the United States. Unfortunately, to meet to the continual needs of the public, these projects must typically be conducted while the rest of the hospital continues to operate. Working in partially occupied spaces is not a new concept for the construction industry however the risk of contamination and infection in an occupied hospital is a particular cause for concern. While the implementation of ICRA's, in hospital construction has alleviated many of the problems, there are new technologies which may provide more or better solutions.

Prefabrication is one possible solution to alleviate contamination in occupied spaces but there remains little to no information on what extent of prefabrication can be used, and what possible cost and schedule savings may also result.

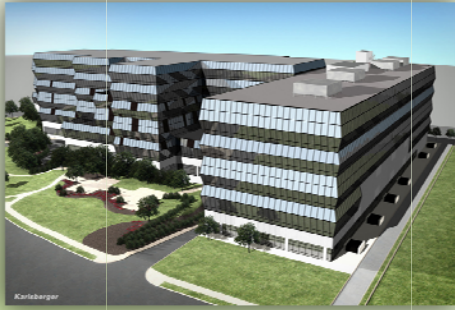
Research Goal:

It is the goal of this research to examine the effects of prefabrication on hospital renovation projects in relation to the ICRA regulations. The focus of this research is to see if there is evidence in support of using prefabrication methods to reduce infection risks, and if so, which methods are the most beneficial. Possible benefits are better isolation and reduced contamination, schedule reduction, onsite labor reduction, and cost savings.

The intent of this research over the coming semester is to create a guide with prefabrication ideas to implement on hospital construction projects where infection control is a major concern. There are practices already in place by certain contracting trades which will provide examples and experience to compare to newer ideas. The guide will be for the use of owners, contractors and facility managers to aid in using prefabrication as a means of better meeting the ICRA guidelines set forth by the American Institute of Architects (AIA).

Research Steps:

1. To obtain a true understanding of the current ICRA regulations. Read the guideline established, and make contact with contractors to ask questions confirm the feasibility of the research goal.
2. Research statistics on hospital renovation and expansion projects to create a firm basis of need and verify the target audience.
3. Make contact with owners and owner's representatives to establish what concerns they have about the ICRA regulations and which issues prefabrication may help address. This will hopefully provide target areas of research to best benefit the end user.



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

4. Send out preliminary surveys to general and trade contractors to discern what methods of prefabrication are already being used for healthcare projects. These surveys would include the amount and method of prefabrication, target trades for prefabrication and any suggestions for what else it may be of use to. An example of this would be contacting mechanical contractors known for prefabrication to see what expertise and advice they have.
5. Compile data from these contacts to determine how best to format a guide, and to provide further direction on which trades to focus on.
6. Create the guide for prefabrication in healthcare projects using language friendly to owners, designers, and contractors. The hope for this guide is to create something which can be implemented early in a project for the maximum benefit.
7. Establish credibility of the guide by asking members of the target audiences, both experienced and inexperienced, to review the guide and complete a survey. This survey would include questions about how easy the guide is to understand and implement, and if they would use it in practical applications.
8. Using the results from the surveys and comments from industry members, the guide will be reevaluated and adjustments made as required.

Sample Survey Questions:

Preliminary Survey to Owners

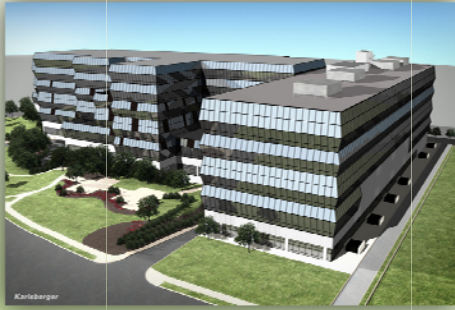
Are you familiar with the 2006 ICRA guidelines established by the AIA?

Have you used ICRA guidelines for past or present projects in your facility?

Did you have difficulties in maintaining any of the procedures outlined in your program? If so, what were they, and how did you attempt to solve them?

Was prefabrication used to any extent during your project?

Do you think fabricating materials and systems off site is a viable option to help maintain the ICRA guidelines?



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

Post Guideline Survey

Was the guide easy to understand and follow?

Did the guide provide sufficient information on prefabrication practices and implementation?

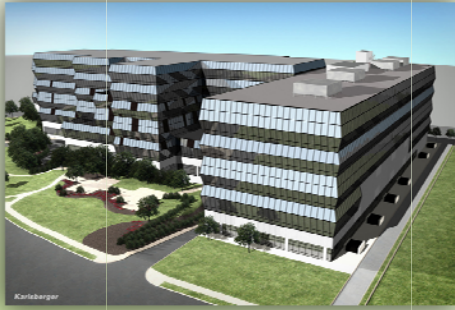
Do you feel the topics outlined covered issues prevalent in healthcare construction?

Do you feel this guide would be useful to future project owners and construction teams?

Do you have any suggestions for ways to better the guide or the ideas for prefabrication outlined within the guide? Examples: newer technologies, workforce issues, etc...

Are there any suggestions you wish to make for material the guide is missing?

Would you use this guide in future projects either alone or in conjunction with the ICRA regulations?



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

C. Analysis 2: Prefabrication Implementation

Problem Statement:

The primary goal for Surgery Expansion Phase 1 is the construction of two (2) new operating rooms and their support areas. Operating rooms provide a large portion of revenue for hospitals, and an earlier completion would allow the owner to make a faster return on their investment. Implementing prefabrication as a construction method may possibly reduce the cost and onsite project schedule.

Research Goal:

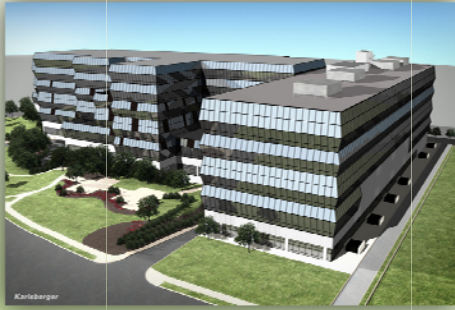
This analysis will focus on two possible systems for prefabrication: mechanical systems and interior partitions. Prefabricating both of these systems will require constructability reviews due to the constraints for how materials reach the site.

Mechanical contractors already use prefabrication to a large extent in most of their projects. Examining the mechanical system as it is designed to see if prefabrication is possible, or if small amounts of redesign may allow for more prefabrication and provide several advantages. A shorter schedule for onsite work would lower the chances of spreading infection and would also save money in labor costs.

Interior partitions is one of the major packages of this job. It is almost 10% of the overall project cost and totals 2692 lf of new partition walls. Fabricating partition walls off site will reduce the amount of dust produced on site and the risk of infection for the patients. This piece of analysis will require a closer look at trade interaction, code compliance and constructability.

Research Steps: Mechanical

1. Contact mechanical contractors who are known for hospital work and discuss what amount of prefabrication they typically use and what they recommend. Ask for lessons learned.
2. Analyze the mechanical system as designed for repeating components or common lengths which would encourage prefabrication.
3. Examine elements which would be difficult to fabricate off site and see if redesign is possible.
4. Determine constructability of desired elements. Check to ensure they can be moved into the building and placed. Examine schedule of construction with other trades.
5. Calculate schedule for fabrication and installation.



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

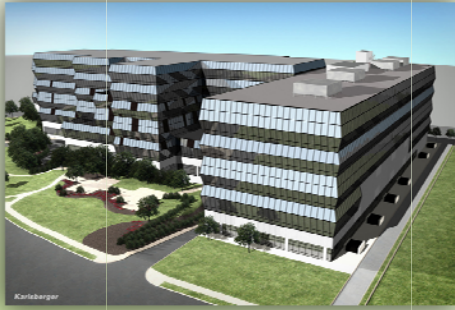
6. Calculate cost and compare system to what is currently designed and being built.

Research Steps: Partitions

1. Evaluate what systems (lighting, electrical, data) are designed to be built into walls.
2. Determine which partition types should be analyzed for prefabrication. Not all types can be built outside of building (ex. shaft walls).
3. Research construction methods for partitions, possible products (ex. smart walls).
4. Examine DC codes and laws to see if prefabrication is an option and what restrictions there are.
5. Select product/method for construction of partitions.
6. Check to verify they can be moved into building. Check maximum size, elevator/hoist loads for constructability.
7. Coordinate construction with other trades and calculate schedule and cost effects.

Expected Outcomes:

The expected outcome of this analysis is primarily schedule reduction. Removing workers from the site will allow the hospital to use the renovated spaces sooner and gain the revenue the operating rooms will provide. Possible cost reductions will result from not having laborers on site, and from fewer restrictions on the hours construction can be performed. It will also coordinate with the industry research in determining if there are alternative methods for reducing dust penetration of the rest of the building during construction.



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

D. Analysis 3: Noise Penetration

Problem Statement:

Construction in an occupied space requires special care to minimize the impact on the normal operations of the building. Hospitals are particularly unique because the systems must be operational twenty-four (24) hours a day, and the building occupants are especially sensitive. At CNMC the new operating rooms are located near both the Neonatal Intensive Care Unit (NICU) and Critical Intensive Care Unit (CICU). The smallest vibration or noise penetration can affect their recovery, and result in temporary stop work orders. When workers must stop construction it causes schedule delays and increases the project cost by paying people for time onsite spent doing nothing. Distinct measures need to be made to ensure the patients are affected as little as possible by the construction and the construction can still progress.

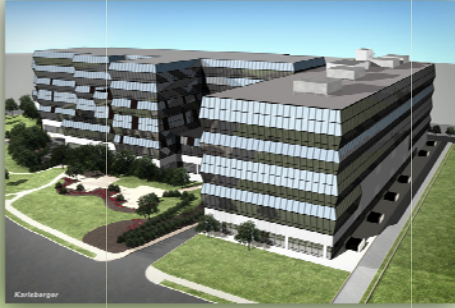
Research Goal:

It is the goal of this analysis to determine what measures should be taken at CNMC to ensure the patients in the NICU and CICU are not affected by the construction. With specific actions in place prior to construction, there will hopefully be fewer work stops and the schedule will be maintained better. This will also add to the value of the overall building by isolating the different units for any more construction that may take place in the future.

Another small analysis will be done of the operating rooms to determine if they are isolated well enough to prevent disturbances there from future constructions. The doctors operating need to have full concentration and construction noises can be particularly distracting, especially if they are unexpected.

Research Steps: Prior to Construction

1. Speak with the nursing staff and facility manager to determine what areas are particularly affected by the construction noise.
2. Gather data on materials in place in the interstitial floors.
3. Perform an acoustical analysis on the interstitial space to determine where the problems are and how what needs to be done.
4. Select products and methods to put into place prior to construction.
5. Calculate time savings from preventing work stops.
6. Calculate the cost and verify it is cost effective.



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

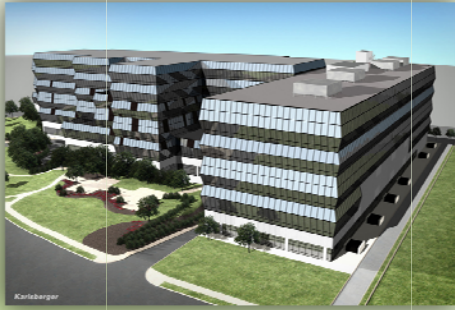
Andrea Klein • Construction Management • Advised By Dr. Messner

Research Steps: Operating Rooms

1. Gather acoustical information on the materials surrounding the operating rooms. (Ceiling tiles, flooring, partitions)
2. Examine connection points with interstitial decking for pipes and ductwork. Are there isolation devices in place?
3. Research products to install which will help prevent noise penetration and select what will be used on the project.
4. Calculate the cost and determine if it is cost effective.

Expected Outcomes:

The expected result for this analysis is to save time on the schedule by reducing the work stops on site, and in increasing the value of the new construction by putting measures in place to reduce future problems.



Surgery Expansion Phase 1

Children's National Medical Center

111 Michigan Avenue, NW • Washington, DC 20010

Andrea Klein • Construction Management • Advised By Dr. Messner

E. Weight Matrix

Description	Research	Value Engineering	Constructability Review	Schedule Reduction	Total
HVAC Analysis	10	5	10	10	35
Noise Penetration		15		10	25
Prefabrication	20		10	10	40
Total	30	20	20	30	100