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GLOBAL VASCULAR INSTITUTE
BUFFALO, NY

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TECHNICAL ASSIGNMENT THREE

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EXECUTIVE SUMMARY

Technical Assignment three is designed to identify areas of the project where there is potential for research, alternative methods, value engineering, and schedule reduction for the Global Vascular Institute. This project includes a 450,000 SF new hospital/research facility connecting to the existing Buffalo General Hospital as well as 8,600 SF of renovation work to the existing central plant. The biggest challenge with this project is that the site is located between two existing structures, both of which are included in the projects scope of work, as well as connecting into a hospital that must remain functional during the entire construction schedule.

The top three **constructability challenges** identified on this project are the site congestion being located between two existing structures in the downtown area of Buffalo, NY, the weather, and connecting the Buffalo General Hospital to the link of the Global Vascular Institute. Each of these challenges presents different issues that the construction team must address to complete the project. Several **schedule acceleration scenarios** are identified and include techniques on resolution. **Value engineering topics** that were used on the project are described and the cost savings of the techniques used are determined.

Through the in-depth analysis of the constructability challenges, schedule acceleration scenarios and value engineering topics along with the Project Management interview with Mark Dowling of Turner Construction, several features were identified as being potentially problematic on the Global Vascular Institute project. Some of these problem areas are identified and further discussed in the four construction management analysis methods that include elimination of site congestion, sustainable techniques, day lighting, and LEED Certification. Each of these methods has the potential into possible research topics for the spring thesis proposal.

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CONSTRUCTABILITY CHALLENGES

For the Global Vascular Institute project, the construction management encountered many unforeseen issues during the construction. Three of the major constructability challenges include site congestion, weather, and connecting the existing hospital at the link.

SITE CONGESTION

For a typical Buffalo construction site, GVI is considered very congested. If this project were constructed in say New York, Chicago, or Boston, this would be a normal site size. Since it is located in Buffalo though, the construction team is not as used to this size of site with this large type of a project. Figure 1 shows the GVI site and the blue blocking indicates the available material storage and layout areas on the site. So due to this small site size, numerous issues arose, one of which was material storage. It became apparent that material storage onsite would become a problem and had the potential of causing great congestion. To resolve this issue, multiple solutions would put into effect. One solution used was to store some of the materials offsite. This was done for larger materials and then brought to the site when they were known to be needed. Another technique used to resolve the congestion issue was "just in time" delivery. Careful planning was done so that materials were delivered to the site exactly when they needed

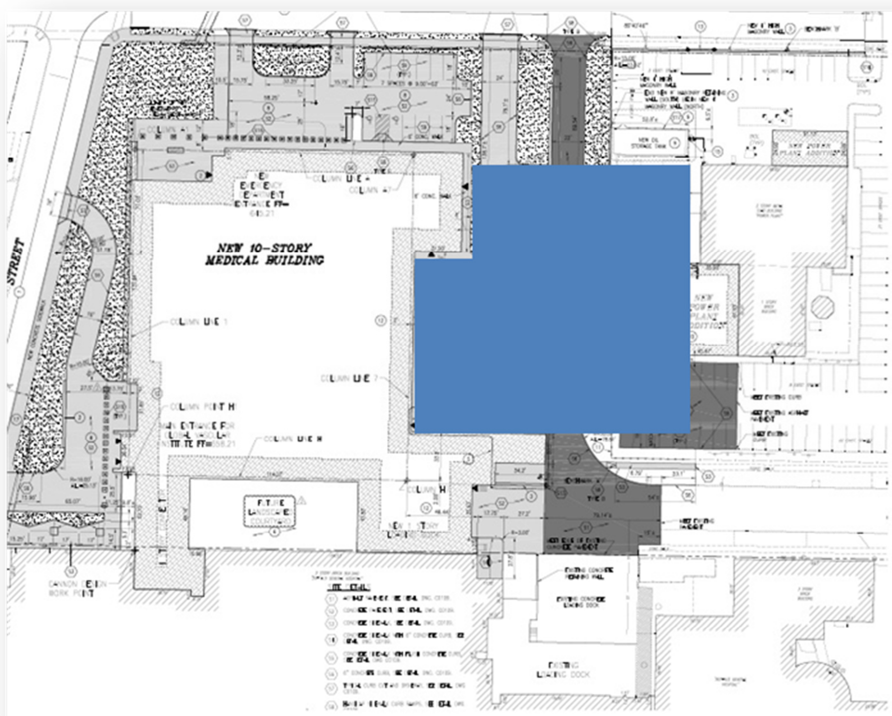

Figure 1: GVI site map showing material storage and layout areas

to be installed. As mentioned previously, materials that happened to be delivered early or that needed to be used later were kept in the offsite storage units. Along with the "just in time" delivery, a plan of "nothing hits the ground" was put into place. This idea meant that as soon as the material was delivered to the site, it was to be immediately installed. By doing this, no material should have to be moved or handled more than two times maximum. This also helped to reduce surplus materials onsite and in turn reduced congestion. Another method used to reduce site congestion was the use of BIM modeling. The use of the BIM was done to prefabricate the piping for bathrooms, sink units, curtainwall panels, and mechanical system pumps. All of these units were then made up in an offsite shop, shipped to the site and installed right in place. This helped to reduce site congestion because it allowed for less materials needing to be stored onsite as well as reducing the amount of labor needed onsite to construct all the pieces individually. By having these units fully constructed before arriving onsite, only minimal work needs to be done to connect the units to the rest of the building.

Another issue that arose due the small size of the site is the type and amount of cranes to be used on the site. The original plan was to use multiple crawler cranes so that they could move around the site. This was initially thought to be the way to go due to work needing to also be done on an adjacent power plant as well as the GVI building. It was decided though that with the limited amount space available, a single tower crane would be better in lieu of the multiple crawler crane setup. This was done so that the crane would not have to move and would take up less space. Additional issues though had to be resolved to make sure that this change would work. These issues included transporting and assembling the crane onsite, making sure the reach of the crane was long enough so that it did not need to be moved and swing/pick safety. Due to using a larger crane, the reach of the crane is much larger and has the potential of swinging over occupied construction areas. Picks that would swing over these areas had to be planned out and precautions were taken to ensure safety of everyone around.

WEATHER

The second major issue for the construction team on this project was the weather of Buffalo. The weather in this area can be very unpredictable and extreme, especially in the winter months due to heavy snowfall from the being so close to the Lake Erie.

The first issue that the construction team faced was with soil of the site. The team initially over-dug the entire site so an engineered fill was required to resolve this issue. An engineered fill was selected that was not susceptible to normal freeze thaw. This allowed the team to continue working straight through the first winter on the foundations with minimal delays due to the soil.

Another weather issue that had the potential of being a concern on the project was that the building was located where the winds are the highest in the city. The wind is a problem because it affects the picks that can be done with the crane. If the wind is too strong it will cause the pick to swing too much and could cause unsafe working conditions. High winds also can cause additional loads to the building that need to be taken into account when designing the structural system of the building. To resolve the issue of the wind on the picks, steel erection began earlier in the morning, at about 5:30am (or when enough light allowed safe work) in lieu of 7am. The wind in this area would increase between 12pm and 2pm and would severely knock down the productivity. By starting earlier, productivity increased from an average of 32 pieces a day to 46 pieces a day. To resolve the wind load issues on the building, a wind study was done. From this analysis, additional reinforcing steel was added to support the curtainwall. Additional, construction of the West and South walls was done first since the wind typically comes from the Southwest direction. Once these two sides were on, the wind was a minimal issue for the installation of the North and East walls. Figure 2 below shows the location of the GVI site relative to Lake Erie. The red black on

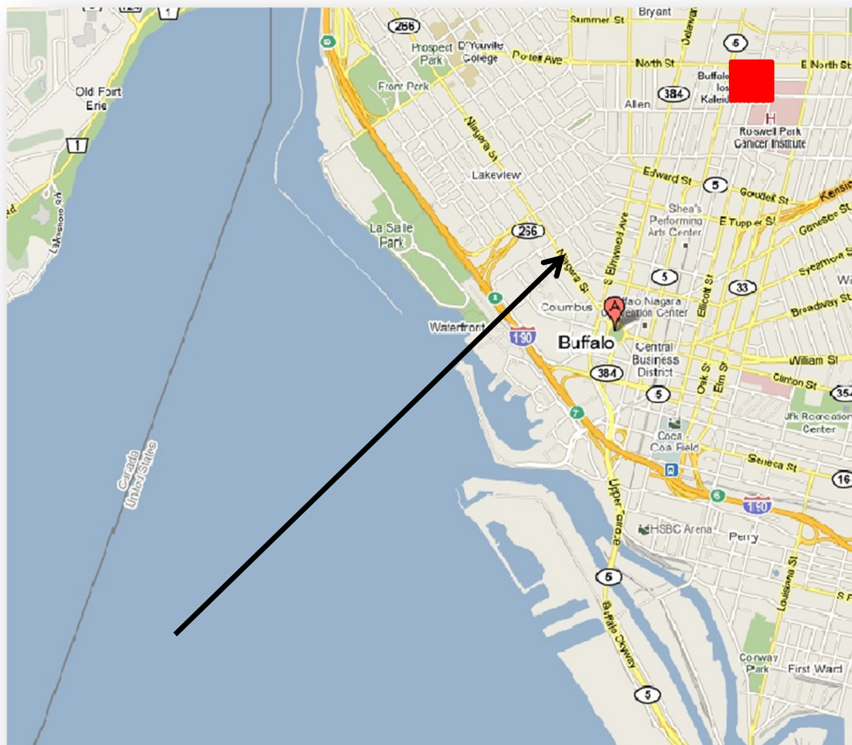

Figure 2: Map of GVI site in relation to Lake Erie

the map shows the location of the site and the arrow indicates the direction that the wind takes coming off of the lake.

CONNECTING TO THE EXISTING HOSPITAL AT THE LINK

Since GVI is connecting to an existing hospital (Buffalo General Hospital) that was to remain functional during construction, numerous issues were encountered. Figure 3 shows the GVI site. The red lines indicate where Buffalo General Hospital will connect to the Global Vascular Institute. Special precautions and regulations had to be followed exactly to ensure the safety and wellness of all the staff and patients of Buffalo General Hospital. The first regulation that was completed was an Infection Control Risk Analysis (ICRA). This analysis was required to be done prior to cutting any openings, tying pipe into GVI systems or any other adjacent work connecting the buildings. This analysis is done to determine how to control all issues that could affect patient health. This included cleaning of any water/liquid to avoid fungus/mold/bacteria growth and dust protection. Stirring up of dust that could get into the hospital can contain bacteria, viruses, fungus or other particles that could cause a reaction. This could become a serious issue to a patient whose immune system is already diminished. In addition to the dust protection, a dust control system was put into place to maintain fresh air intakes that is clean and clear of dust for the mechanical system. Also, smoke detectors had to be either disconnected or covered as to not set off false alarms in the hospital,

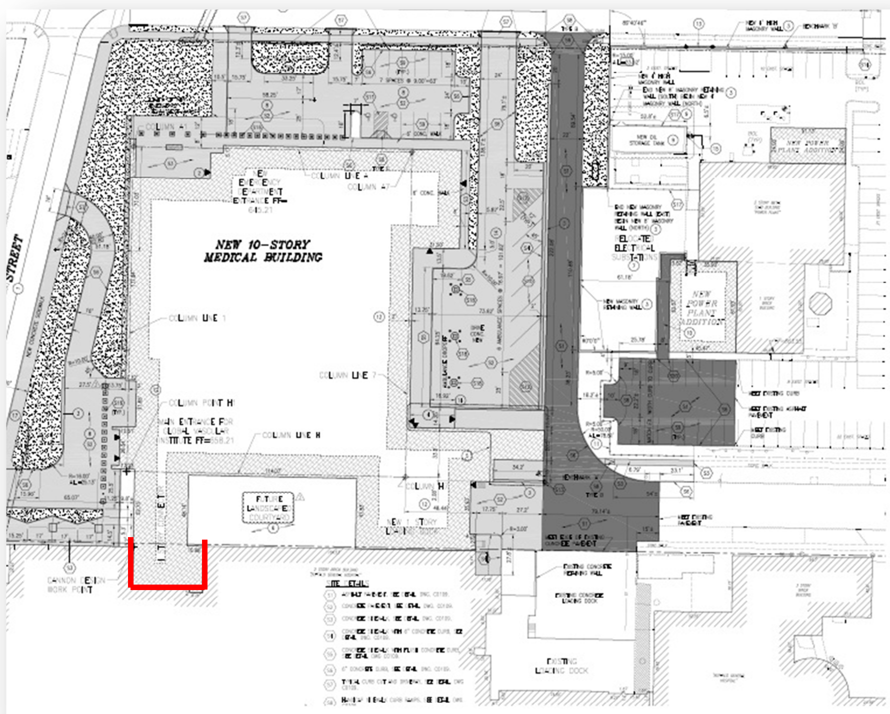

Figure 3: Site layout of GVI showing where the link connects to Buffalo General Hospital

which could cause undesired disruptions. Another issue in connecting the existing hospital at the link was with noise and vibration control. As that it is not possible to eliminate all noise and vibration during construction, coordination between the hospital and construction team had to be managed. All major surgeries had to be planned around so that no vibrations occurred at that time. For a hybrid surgery, where machines are used to go into the body to do the surgery, even the slightest vibration could have a major impact on the procedure. The amount of noise also needed to be checked because it could disrupt the results of sensitive monitoring instruments.

SCHEDULE ACCELERATION SCENARIOS

CRITCAL PATH

The critical path of the Global Vascular Institute runs through the connecting of the building to permanent power. For GVI, this happens in two stages. This is done because the bottom floors are to be turned over to the owner before the entire project is to be completed. Figure 4 below shows the general sequence of the critical path. These are determined to be the critical path items because the next phase of construction cannot begin until the preceding item is complete. It is important to not have too many delays in the superstructure and building dry phases because they both require extensive use of the only crane the project has, so accelerating these areas would be very difficult to do. To accelerate the other phases of the project, additional man-power could be used to help to make up time. For every phase, increasing the work hours could help to accelerate the schedule.

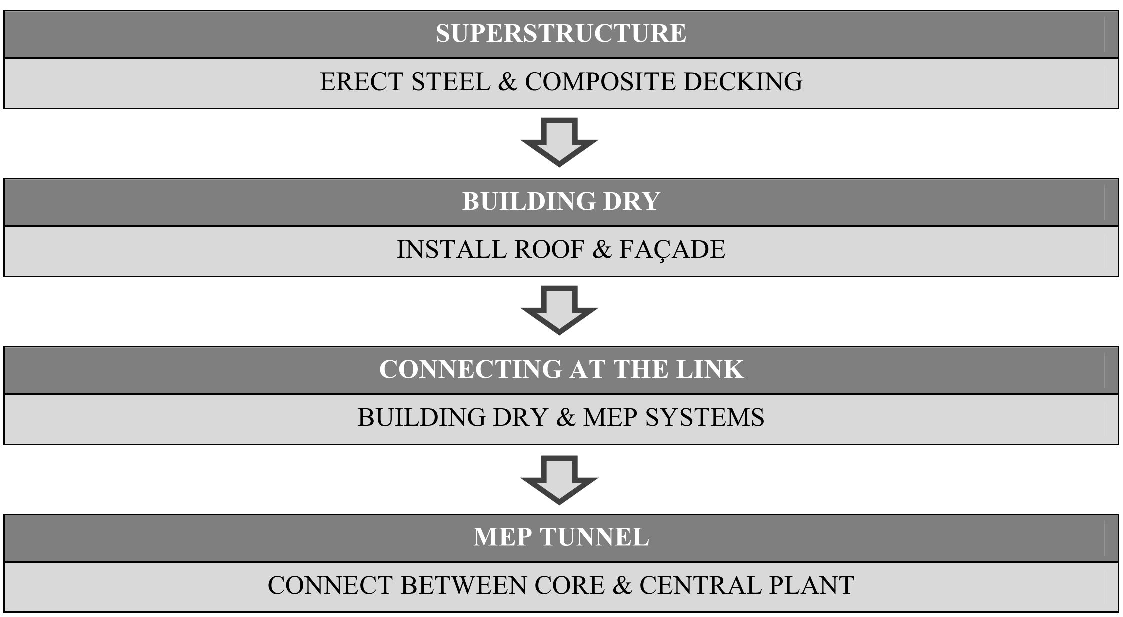

Figure 4: Critical Path for Global Vascular Institute

BIGGEST RISKS

One of the biggest risks to the schedule of the Global Vascular Institute is considered to be the electrical “Backyard” area. This section of work only has three days of float. This work involves connecting the substation and new MEP tunnel to a new electrical feed being provided by the

electrical company National Grid. This new electrical feed will connect the renovations to the central plant to the core GVI building and link. It was known ahead of time that the electric company has been traditionally late in response to completing work so there have been weekly meetings with them to get service to the new substation gear. Work for this section was originally scheduled for July 2010 so as to put pressure on the electric company to meet the actual desired date of December 1, 2010. Wire pulling began on November 12, 2010 and connection to the 1st switchgear cabinet is set for mid-December, which is within 2 weeks of the originally planned date.

Other than the main power electrical installation, the biggest risk to the schedule is the mechanical sheet metal. In the Buffalo area, getting ductwork installed in the time frame scheduled is always difficult. This is because coordination between the MEP/FP systems always lags as contractors incorporate changes which cause a slow-down in work. To manage this better, BIM modeling was used to reduce the amount of clashes when installing all of the MEP items. Overall, there have only been three items that have not coordinated during installation in the field. Using BIM has made MEP installation go much smoother.

VALUE ENGINEERING TOPICS

Due to the timing of the job, many contractors were short on work, materials were readily available and prices were down, only minimal value engineering techniques were implemented on the project to meet the owner's budget. All of the value engineering ideas occurred during the schematic design phase. There was a list of sixteen items that were utilized for alternate pricing. In the end, the owner chose to use all of the alternate pricing to save in overall cost. Table 1 below shows a breakdown of the three main items that the alternative pricing was chosen for.

Value Engineering Alternatives	
Item	**Savings**
Eliminate Skylights	$500,000
Reduce Rigid Insulation in Mech Rooms	$500,000
Reduce Interior Glass Handrails & Glass Partitions	$600,000
TOTAL	**$1,600,000**

Table 1: Savings of value engineering alternatives implemented

The majority of issues with the owner's budget and the program needs and the A/E's intent were resolved in the Schematic design phase. The major change made to the building was the size of the "ribbon," an architectural feature of the curtainwall that was to stick out about 6 feet from the building. The "ribbon" had its own structural support and additional enclosure that amounted to over 4,000 SF of finish metal panel and light gauge framing backup. All of this was eliminated with the change of the size of the ribbon going from 6 feet to 18 inches. This reduced the cost of the curtainwall and steel by $1,000,000. Table 2 below shows the total savings from value engineering used on GVI. (Only included curtainwall changes and three main alternatives. Does not include savings from other 13 alternatives selected for GVI.)

Total Value Engineering Savings
$2,600,000

Table 2: Total Value Engineering Savings on Global Vascular Institute

PROBLEM IDENTIFICATION

With the in-depth analysis of the constructability challenges, schedule acceleration scenarios, and value engineering topics, several features were identified as being potential problem areas on the Global Vascular Institute. The following problems identified may possibly be pursued for research topics.

SITE CONGESTION

The site for the Global Vascular Institute is small, located between existing structures and located in downtown Buffalo, NY. There are two access points to the site but there is very minimal space available for material storage and layout. This makes it very difficult for multiple trades to work together at the same time, reducing safety and efficiency. The small space available for the site is even more constricted due to work being done on multiple structures at the same time. Renovation work to the adjacent central plant is occurring at the same time that the core GVI building is being constructed. The core GVI building will also be connected to an existing hospital that must remain functional during construction. Because of this, certain areas of the site must always remain unobstructed for ambulance access to the hospital. Also due to the limited space, only one crane is used for all three areas of work on the project. Coordinating with each trade is critical to minimize any delays on the project.

ENERGY USAGE

Due to the extensive size and functionally of GVI, updated renovations are required for the adjacent central plant; just so that the building's mechanical and electrical systems can sustain all of the needs of GVI. To complete these renovations, substantial costs occurred to replace and upgrade the existing generators, chillers, and cooling towers. Due to the restrictions of a tight budget, alternate energy methods may not have been pursued for the project such as PV panels, grey-water systems, etc., due to high initial costs.

LEED CERTIFICATION

For the Global Vascular Institute, LEED certification is not being pursued. This is identified as a problematic area because there is potential for this project to reach a minimum of LEED certification. Due mostly for budget reasons, a LEED certification analysis was never fully investigated. The GVI project though does have multiple sustainable features already implemented into the design such as a green roof system. As GVI is a high-tech research facility as well as a hospital, a LEED certification may also help add to the prestige to the building.

UTILITIES

Due to the critical path of the schedule, the main electrical feeders to the site have the potential to fall behind schedule causing further delays to the project if the building cannot obtain electrical functionality on time. Also, the tunnel connecting all of the other electrical and mechanical utilities from the central plant to the core GVI building runs right below where the majority of available layout space for the site is located. Coordinating and staying on schedule for the installation of these items is critical to remaining on schedule for the rest of the project.

TECHNICAL ANALYSIS METHODS

TECHNICAL ANALYSIS METHOD #1: ELIMINATION OF SITE CONGESTION

Site congestion is a major concern on this project. This problem affects all trades on the project and has the potential to cause delays in a number of areas. The lack of material storage and layout space can cause inefficiencies and unsafe working conditions. To resolve this issue the construction team has taken some steps to reduce the effect of this problem on the project, including a "just in-time delivery" system and prefabrication. Prefabrication that is already being done for the GVI project is with bathroom piping, curtainwall panels, and mechanical piping.

For this analysis, a further exploration into prefabrication will be done for the Global Vascular Institute project. This would help to reduce the amount of on-site material storage as well as on-site labor. One area that will be analyzed is the use of prefabrication of corridors and patient rooms. These areas have enough repetition that prefabrication could be beneficial in saving time. Because of the complexity of the electrical and mechanical systems in GVI due to it being a hospital, prefabricating these areas will reduce the problems that occur when installing these onsite. Areas that will be researched for this include schedule reductions, production capabilities, erection sequences and durations, as well as quality control issues with the mechanical systems to remove dust and other potential harmful particles to patients. It is believed that this technique will reduce the site congestion and delays due to MEP clashes during construction.

TECHNICAL ANALYSIS METHOD #2: SUSTAINABLE TECHNIQUES

For the Global Vascular Institute to become fully functional, renovations must be completed to the adjacent central plant that will power the building. To reduce the cost of energy that this building requires, a sustainable system of Photovoltaic (PV) panels could be utilized. The façade of the Global Vascular Institute is very different than any other building in the Buffalo area, due to the use of aluminum panels used on GVI instead of the traditional concrete used on the majority of the other buildings. So to use this difference beneficially, PV panels could be used in the place of the aluminum panels on at least one side.

This analysis will include an in-depth investigation into the financial feasibility of installing PV panels on the façade of the Global Vascular Institute. Research will also be done to determine what the optimal layout and size would be for the building. A study on how this may affect the structural system as well as the electrical system will also be researched.

TECHNICAL ANALYSIS METHOD #3: DAYLIGHTING

Since half of the building facade is aluminum panels, the amount of natural light into the building is limited. As that this is a hospital, having plenty of natural light entering patient's rooms is helpful to recovery. Having to provide lighting for these spaces 24-hr/day can become quite costly. By changing some of the aluminum paneled areas to glass, the required amount of lighting would be reduced.

This analysis will include an in-depth investigation into the potential energy and financial savings by changing the aluminum panels to Low-E glass. Research will be done to determine where on façade the most beneficially changes would be as well as what the best type of glass would be to use. An additional study will also be done determine what structural effects may occur due to this change as well as what additional heating/cooling requirements may occur will also need to be addressed. It is believed that this technique will reduce the amount of energy required to light these spaces as well as reduce the size of the structural system members.

TECHNICAL ANALYSIS METHOD #4: LEED CERTIFICATION

The Global Vascular Institute project is not pursuing LEED Certification once it is completed. Due to budgetary issues, becoming LEED Certified did not seem plausible or beneficial. Although initially a study was not done to determine if LEED should be pursued, becoming LEED Certified could have multiple advantages to the project, including energy savings, cost savings, as well as the prestige of being certified by LEED.

This analysis will include an in-depth investigation into techniques to have GVI become LEED Certified. Research will be done to determine whether these techniques are financial feasible for the Global Vascular Institute. It is believed that this technique will increase the sustainable possibilities for this project.