**IDEA Factory Design-Build Response to a Request for Proposal**

A Technical Report submitted to the Department of Civil and Environmental Engineering

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science, School of Engineering

**Duy Tran**
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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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**Final Report: IDEA Factory Project**

## 1. Introduction

### Project Problem Statement

Our capstone project will provide a response to a request for proposal (RFP) for a new construction project: the IDEA Factory STEM building on the University of Maryland campus. The problem statement we are addressing is "*How can a construction manager address the unique challenges of designing and constructing the Innovate, Design, and Engineer for America (IDEA) Factory Building at the University of Maryland?*"

This project's objective is to respond to the Request for Proposal (RFP) from the University of Maryland for the design and construction of the E.A. Fernandez Innovate, Design, and Engineer for America (IDEA) Factory. The IDEA Factory is a 61,000-square-foot building that will foster innovation in engineering and science, located in College Park. This world class research building will provide future engineers with essential tools and resources to foster innovation, enhance design skills, and promote collaboration. The facility will include a 12,000 GSF 1-level basement below grade, and 4 stories with 14,000 SF floor plate (max) above grade. A new pedestrian bridge will connect this project to the Jeong H. Kim Engineering Building. Key facilities include the Rotorcraft Laboratory, ALEx Garage, Quantum Technology, Microscope Suite, Startup Shell, and Robotics Realization Laboratory.

The formal response to the University of Maryland Facilities Management's RFP will be composed of design and construction recommendations detailing a plan to manage the high-water table in the area, material selection for cost-efficiency and structural integrity, site logistics planning, and interdisciplinary coordination within the budget and time constraints established.

Key design elements will be the delivery of construction documents for groundwater management, including construction dewatering and permanent subgrade drainage and waterproofing details, and the modeling of a three-stage, 3D site utilization plan. The 3D site plan will depict site utilization in the excavation phase, structural erection phase, and water-tight building phase.

**Statement of Project Scope**

Our team will develop a response to the University's Request for Proposal (RFP) for the IDEA Factory Building that demonstrates technical expertise across all necessary design and construction management capabilities required by the owner. The design will provide the owner, contractors, and end users with the space for their needs, as well as deliver the project within the owner's schedule and phasing around a busy college campus. This includes complex input from the owner, CM at Risk, subcontractors, and design team.

The team will be responsible for the following deliverables, which may be adjusted based on the team's expertise and interests: *(1)* solution for groundwater subsurface conditions: due to the constant challenge that a high-water table poses for the University of Maryland, including water leaks in existing buildings on campus, a solution will be developed that considers the high-water table during both the excavation and long-term operational phases. Schematic diagram(s) will be developed evaluating and recommending a dewatering system during excavation. Additionally, recommendations for permanent sub-drainage systems will be explained, discussing the requirements of the permanent sub-drainage system required below the selected foundation. This will be accompanied by a cross-section schematic diagram describing its components and the layout requirements. *(2)* Provide recommendations for support of excavation, foundation, and material selection. Provide an overview of the following shoring and bracing system options. Compare the options and provide pros/cons of each approach. Recommend a shoring and bracing system and provide justification. Options include soldier piles and lagging, sheet piles, secant piles, and struts and rakers. *(3)* Provide a brief overview of the following foundation options. Compare the options and provide pros/cons of each approach. Recommend a foundation system and provide justification. Options include spread/strip footings, mat slab, rammed aggregate piers, and driven steel piles. *(4)*

Evaluate the use of concrete versus steel for the above-grade structure and provide a recommendation. *(5)* Site logistics plan: develop a multiphase site logistics plan to ensure efficient movement, storage, and delivery of materials and equipment. The plan should include jobsite entrances for vehicles and worker access, traffic flow to/from the site, perimeter safety fencing, pedestrian pathways, material/equipment laydown areas, dumpster locations, and temporary sanitation facilities. *(6)* Project Schedule: Develop a 20-60 activity schedule in Primavera P6 with key milestones starting with design phase and ending with building occupancy. *(7)* Pricing Estimate: Perform a cost analysis to provide stakeholders with an estimate for overall budgetary commitments. *(8)* Formal Proposal Response and Presentation: Develop a formal written proposal and a presentation proposing and justifying design solutions and demonstrating team competencies and capabilities to the owner. This presentation will explain the recommendations included in the written proposal and specify the role and contributions of each team member.

<u>Assumptions and Constraints:</u>

For our project, we are assuming that the project site conditions provided are an adequate and accurate representation of existing conditions, design files and guidance will be provided throughout the semester, existing documents adequately provide prerequisite information, the team is competing to be awarded the project, unit rates will be supplied for project cost estimates (stable economic conditions), market availability of construction materials, there will be availability of skilled laborers and construction equipment, there will be regulatory compliance with all local and federal ordinances including prompt approval of necessary permits and adherence to building codes, and the design schedule listed in the formal response to the RFP will be upheld without significant modifications. These assumptions are what our team has deemed relevant to date. It is important to note that these assumptions could evolve as the project progresses, especially with client meetings and the development of proposals/recommendations.

The constraints of this project include the high-water table that presents a significant design challenge, the importance of cost and sustainability requirements in design recommendations, the response to RFP needing to be completed before graduation (April 2025), and the challenges associated with an active college campus that need to be considered in our site logistics plan and scheduling.

Stakeholders

Stakeholders will include the University of Maryland (owner) with its students and faculties, Clark Construction, the Architect/Design team and Facility Management.

**Project Schedule**

The Capstone Project Schedule remains on track, with significant progress made toward the final RFP submission and project presentation in March 2025. The project began in September 2024 with team organization, faculty and industry partner meetings, and the collection of key documents such as the RFP. In October 2024, team roles were assigned, initial design research commenced, and the first version of the project schedule was developed, establishing design criteria. The following months focused on design refinement, site logistics planning, and the initiation of virtual design and construction (VDC) development, ensuring a structured approach to project execution. By December 2024, site logistics development continued, and the groundwater design documents were prepared for submission to the industry partner and faculty advisor. Additionally, the steel vs. concrete structural analysis was initiated, marking a critical step in evaluating material feasibility.

Moving into January 2025, the schedule and pricing will be finalized, with a strong focus on refining the groundwater design, completing the steel vs. concrete analysis (including cost evaluation), and developing safety and MBE documentation. February 2025 will be dedicated to finalizing pricing, preparing the capstone presentation, and conducting a safety walk at Darden to apply practical insights. By March 2025, the formal RFP response and project presentation will be completed, ensuring a comprehensive and well-documented final submission. April 2025 will focus on refining the presentation through run-throughs with faculty and industry partners, ensuring alignment with professional expectations and project objectives. These structured milestones ensure steady progress and the successful completion of all deliverables within the established timeline. See Appendix A for the detailed project schedule.

## 2. Design

Design Recommendations

To formulate and justify recommendations, the team researched several alternatives for support of excavation, foundation, construction dewatering, waterproofing, and foundation drainage systems. To select a support of excavation system, soldier piles and lagging, sheet piles, secant piles, struts, and rakers were researched and evaluated. Additionally, spread footings, mat/raft slabs, rammed aggregate piers, driven steel piles, and drilled shafts were evaluated as options for the foundations design.

For the support of excavation and foundation design recommendations, the team developed criteria by which each option was evaluated and scored out of 100 points (higher scores being better) in the matrices attached in Appendix B. These apply quantitative reasoning to the research and are weighted based on perceived importance rankings for each criterion. The criteria and weighting are as follows: *Campus Impact (25/100), Schedule (20/100), Building Envelope (20/100), Cost (10/100), Maintainability (10/100), Sustainability (5/100), Labor Efficiency (5/100), and Material Availability (5/100)*. These matrices and their written justifications, provided in Appendix B, prompted the selection of sheet piles and the use of a mat foundation for this project.

Groundwater Mitigation

*Construction Dewatering:*

To ensure the constructability of these recommendations, a construction dewatering plan was developed to manage the high-water table based on the Geotechnical Report produced by GeoConcepts Engineering, Inc. (provided in Appendix C). Based on these site conditions, a deep well point drawdown dewatering plan with a maximum well spacing of 85' around the perimeter of the site is recommended, as shown in the calculations and site plan included in Appendices B and D. After the groundwater level has decreased at least 3’ below the excavations, subgrades will be evaluated and a 4” mud slab will be placed to prevent disruptions and give a level work surface for placement of formwork and rebar for the mat footings shown in Appendix B.

*Waterproofing and Subgrade Drainage:*

Due to the high-water table present at the IDEA Factory’s site, we recommend using a ‘belt and suspenders’ approach for groundwater mitigation. This approach will be two systems: a subgrade drainage system below the mat foundation and the application of blindside waterproofing for the foundation walls and mat foundation. The two design systems will offer complementary advantages to the limitations of each. The threat of the upward hydrostatic pressure that the blindside waterproofing faces ultimately leads to the decision to add a subgrade groundwater drainage system. This also ensures the quality and integrity of the building groundwater mitigation system, as a blindside waterproofing system is difficult for a subcontractor to perfect the application and ensure the membrane is intact after concrete is poured. There is a risk in the groundwater management system, especially for the laboratory spaces occupying the basement level. The project team recommends the following design considerations and has proposed a design to be used for the IDEA Factory.

Plumbing System Details:

- Sump Pumps: Sump pumps will be installed under the slab to manage any water that accumulates in the subgrade drainage system.
- Perforated Piping: Perforated piping will be used for the subgrade groundwater drainage system to effectively channel water away from the foundation.
- Drainage Board: A drainage board will be installed to create an even application surface for the blindside waterproofing and to facilitate water movement towards the drainage system.
- French Drains: French drains will be installed primarily under the basement slab, between the mat foundation and the basement slab, to manage groundwater and prevent hydrostatic pressure buildup.

- Sheet Piles: Sheet piles will be used for the support of excavation during the early stages of construction.

Additionally, a typical foundation detail and subdrainage plan included in Appendix D were developed to fit the unique needs of this project. To prevent water intrusion into the basement, exterior blindside waterproofing and drainage board along the foundation walls were selected. Aggregate fill will be placed around these excavations, with a semi-pervious drainage line to collect the extra groundwater from intruding into the building. To mitigate intrusion, waterproofing will extend below the mat foundation and a slotted 4” corrugated polyethylene drainage grid will be implemented, sloping towards a sump pit, to prevent uplift pressures from hydrostatic forces. Finally, a floating slab floor system atop a layer of compacted stone and the mat foundation will provide additional resistance to vibrations that impact the performance of the sensitive equipment required in the building’s laboratory spaces.

Our plan, based on the evaluation of the support of excavation during early stages, is to use sheet piles. Blindside waterproofing will require an even substrate to be applied, so we recommend adding a layer of drainage board to make an even application surface. Construction phasing will require the support of excavation being installed, excavation, subsurface drainage, and piping for under the mat slab. At this stage, the blindside waterproofing will be applied to the bottom of the excavation pit and support of excavation, where the concrete contractor can begin installing rebar and pouring concrete.

The team recognizes the associated risk of a pre-applied product, especially for the occupied basement. Risks include punctures during construction activities or non-compliant bonding/sealing, with a product that may be sensitive to temperature and UV exposure. To address this risk, the team has evaluated different products and recommended the SikaProof-808 FPO system for use as a pre-applied, blindside waterproofing membrane. This product offers superior puncture resistance and is a proven product for blindside applications. The Sika product line has a fully bonded layer between the concrete and the waterproofing layer. The team also considered several alternatives, including the Henry Systems of MiraWELD and Blueskin. The team also recommends the addition of the SikaFuko-VT1 reinjectable hose system. The injection hoses offer flexibility throughout the building lifecycle to provide the owner the opportunity to re-seal the waterproofing system from the interior in the event of any future ground movement at the diaphragm walls.

## 3D Site Utilization Plan

Another design element of our project includes the development of a multiphase 3D site logistics plan. Each logistics plan will be tailored to the physical state of the site at the excavation, structural erection and build out, and building envelope installation phases of the project.

The objective of the 3D logistics plan is to provide a guide for the project team and trade partners that manages site space safely, responsibly, and efficiently at different stages of the project. Design standards include adhering to OSHA standards for safety and best practice for various aspects of construction management and materials storage. For the IDEA Factory project site that includes management of excavation activities, mindful placement of materials on the site, and a recommended material delivery route through the University of Maryland campus to the project site.

Constraints faced by the site logistics design include maneuvering large equipment and material deliveries in an educational environment with heavy pedestrian foot traffic. Being mindful of student presence around the site and ongoing classes is a concern for the project team. Managing the site’s footprint and entry points helps manage those elements effectively by designing for efficiency and safety of the surrounding environment.

## Construction Schedule

The IDEA Factory Construction Schedule outlines the timeline for the design, procurement, and construction of the facility at the University of Maryland. The project follows a structured sequence, starting with preconstruction activities and material procurement, followed by foundation work, structural erection, and facade installation. As construction progresses, MEP systems and interior build-out are integrated, leading to final inspections and commissioning. A key milestone in the schedule is that permanent power is tied to the building achieving weather-tight status, ensuring that electrical systems can be safely and efficiently integrated into the facility. The project is set for substantial completion in December 2026 and final turnover in January 2027, with the schedule structured to ensure efficiency, risk management, and quality control. The detailed schedule can be found in Appendix A.

## Pricing

Finally, a project budget of $39,486,032 will be proposed encapsulating the entire cost of the project indicating the proposed GMP. The detailed estimate and estimate summary of the project budget is included in Appendix D, given that the budget is now finalized.

With our project budget some exclusions and assumptions were made. For the cost of the bridge to the Kim Building, contingency is included due to it being an indoor bridge. With this type of bridge comes uncertainty with things like demolition since it is inside of the building. We also are putting money towards the promotion of the building including hiring a social media team; this is accounted for in the “other” category. While the building is primarily concrete, we will also use miscellaneous materials and paneling on the facade like various types of metal panels. We are excluding demolition because the site is being delivered to us. Owner initiated scope changes and unforeseen site conditions are also excluded. Any hazardous materials that may be present are also excluded from this budget. We are also not taking into account the cost of dirt disposal and the associated cost for operation of the dirt truck; we are assuming this will be a cost taken on by the owner. However, we are also willing to cover the cost for an increased GMP.

## RFP Response and Presentation

A formal response to the Request for Proposal will be produced to submit to the client to be awarded the IDEA Factory. This is to follow a professional format from examples provided from the Construction and Engineering Management program within the Department of Civil and Environmental Engineering. This RFP was created by the team and is to be provided in the appendix. A presentation was then made to present to the client and can also be found in the appendix.

## 3. Conclusion and Recommendations

Based on our review of the various elements of the IDEA project, we propose about $40 million for cost of work. Compared with the project's proposed GMP of $50 million, our current projected budget is a considerable amount less than that. With this in mind our team has taken into account the exclusions and assumptions made regarding our project budget, as explained in the pricing section under the design tab. Additionally, the schedule remains a critical factor in cost management, as procurement lead times and construction sequencing will impact overall project efficiency. This schedule will align with the industry expectations and project feasibility.

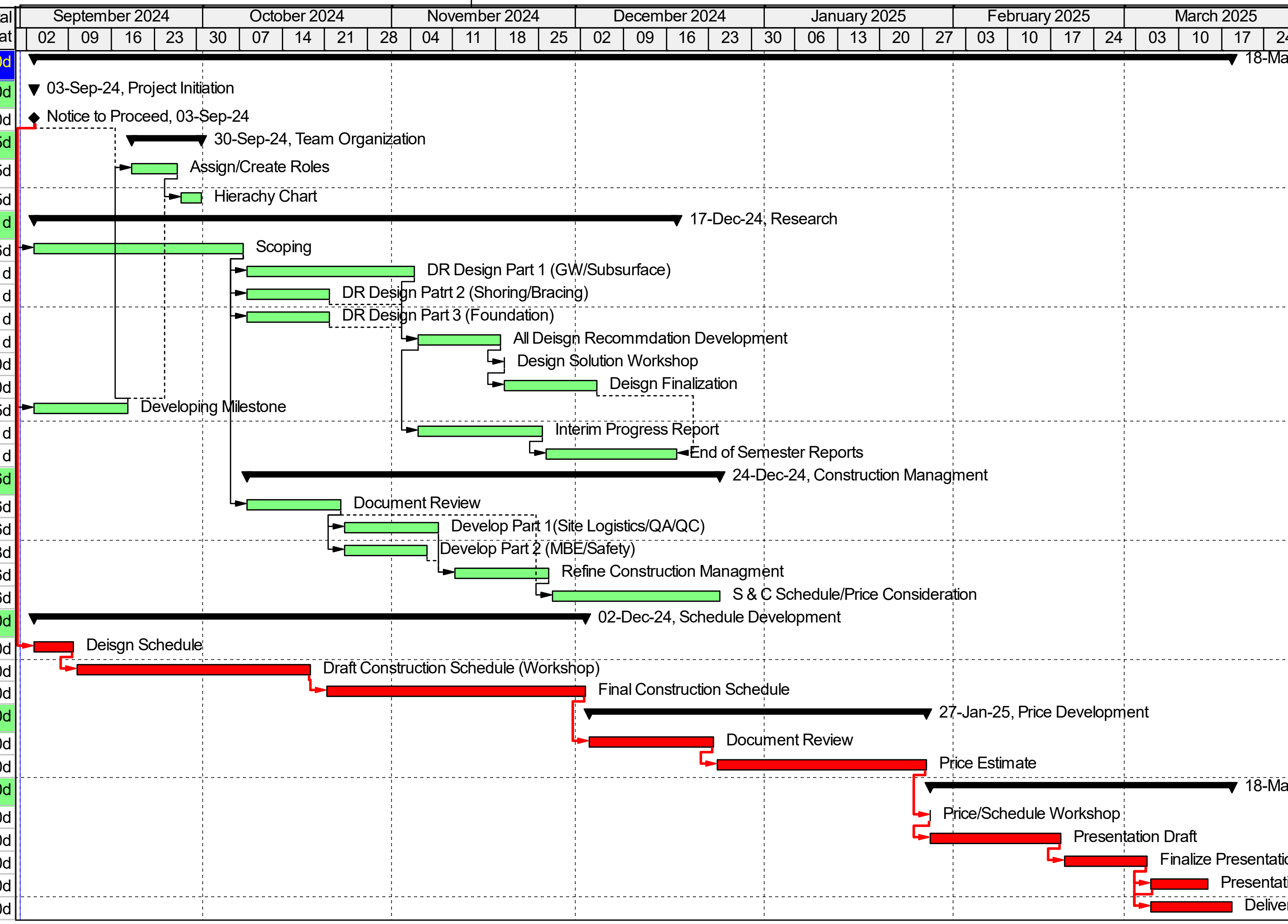
From the design exercises outlined in the RFP for the IDEA Factory, the team gained deeper insights into the role of a general contractor within a design-build contract. The team explored all aspects of preconstruction services provided by a general contractor, as well as the process of awarding contracts. The team looked into the interactions between structural considerations and construction engineering, examining the applicability of various design solutions.

The development of detailed waterproofing plans allowed the team to investigate different options and strategies used in practice. This also allowed the team to deliver a set of proposed Construction Documents to be used for groundwater management, with input and feedback from the industry professionals. If this design were chosen, some future work could be the investigation of the success of the proposed waterproofing and groundwater plumbing system. This could have metrics for the cost of operation and maintenance to determine the success over the lifetime of the building. The findings from this future work could be used by UMD Facilities Management to determine what groundwater mitigation needs are required for future projects.

## Appendix A – Schedules

### Index

| Activity ID | Activity Type | Activity Name | Original Duration | Early Start | Early Finish | Predecessors | Successors | Total Float |
|---|---|---|---|---|---|---|---|---|
| **IDEA Factory Captsone Project** | | | 135d | 03-Sep-24 | 18-Mar-25 | | | 0d |
| **Project Initiation** | | | 0d | 03-Sep-24 | 03-Sep-24 | | | 0d |
| A100 | Start Milesto | Notice to Proceed | 0d | 03-Sep-24 | | | A200, A1000, A1700, | 0d |
| **Team Organization** | | | 8d | 19-Sep-24 | 30-Sep-24 | | | 115d |
| A200 | Task Depen | Assign/Create Roles | 6d | 19-Sep-24 | 26-Sep-24 | A100, A1700 | A300 | 115d |
| A300 | Task Depen | Hierachy Chart | 2d | 27-Sep-24 | 30-Sep-24 | A200, A1700 | | 115d |
| **Research** | | | 74d | 03-Sep-24 | 17-Dec-24 | | | 61d |
| A1000 | Task Depen | Scoping | 25d | 03-Sep-24 | 07-Oct-24 | A100 | A1100, A1200, A130( | 56d |
| A1100 | Task Depen | DR Design Part 1 (GW/Subsurfa | 20d | 08-Oct-24 | 04-Nov-24 | A1000 | A1400 | 61d |
| A1200 | Task Depen | DR Design Patrt 2 (Shoring/Brac | 10d | 08-Oct-24 | 21-Oct-24 | A1000 | A1400 | 71d |
| A1300 | Task Depen | DR Design Part 3 (Foundation) | 10d | 08-Oct-24 | 21-Oct-24 | A1000 | A1400 | 71d |
| A1400 | Task Depen | All Deisgn Recommdation Deve | 10d | 05-Nov-24 | 18-Nov-24 | A1100, A1200, A1300 | A1500, A1800 | 61d |
| A1500 | Task Depen | Design Solution Workshop | 0d | 19-Nov-24 | 19-Nov-24 | A1400 | A1600 | 70d |
| A1600 | Task Depen | Deisgn Finalization | 10d | 19-Nov-24 | 04-Dec-24 | A1500 | A1900 | 70d |
| A1700 | Task Depen | Developing Milestone | 12d | 03-Sep-24 | 18-Sep-24 | A100 | A200, A300 | 115d |
| A1800 | Task Depen | Interim Progress Report | 15d | 05-Nov-24 | 25-Nov-24 | A1400 | A1900 | 61d |
| A1900 | Task Depen | End of Semester Reports | 14d | 26-Nov-24 | 17-Dec-24 | A1600, A1800 | | 61d |
| **Construction Managment** | | | 54d | 08-Oct-24 | 24-Dec-24 | | | 56d |
| A2000 | Task Depen | Document Review | 12d | 08-Oct-24 | 23-Oct-24 | A1000 | A2100, A2200, A240( | 56d |
| A2100 | Task Depen | Develop Part 1(Site Logistics/QA | 12d | 24-Oct-24 | 08-Nov-24 | A2000 | A2300 | 56d |
| A2200 | Task Depen | Develop Part 2 (MBE/Safety) | 10d | 24-Oct-24 | 06-Nov-24 | A2000 | A2300 | 58d |
| A2300 | Task Depen | Refine Construction Managmen | 12d | 11-Nov-24 | 26-Nov-24 | A2100, A2200 | A2400 | 56d |
| A2400 | Task Depen | S & C Schedule/Price Considera | 18d | 27-Nov-24 | 24-Dec-24 | A2000, A2300 | | 56d |
| **Schedule Development** | | | 63d | 03-Sep-24 | 02-Dec-24 | | | 0d |
| A3000 | Task Depen | Deisgn Schedule | 5d | 03-Sep-24 | 09-Sep-24 | A100 | A3100 | 0d |
| A3100 | Task Depen | Draft Construction Schedule (W | 29d | 10-Sep-24 | 18-Oct-24 | A3000 | A3200 | 0d |
| A3200 | Task Depen | Final Construction Schedule | 29d | 21-Oct-24 | 02-Dec-24 | A3100 | A4000 | 0d |
| **Price Development** | | | 37d | 03-Dec-24 | 27-Jan-25 | | | 0d |
| A4000 | Task Depen | Document Review | 15d | 03-Dec-24 | 23-Dec-24 | A3200 | A4100 | 0d |
| A4100 | Task Depen | Price Estimate | 22d | 24-Dec-24 | 27-Jan-25 | A4000 | A5000 | 0d |
| **Presentation Development** | | | 35d | 28-Jan-25 | 18-Mar-25 | | | 0d |
| A5000 | Task Depen | Price/Schedule Workshop | 0d | 28-Jan-25 | 28-Jan-25 | A4100 | A5100 | 0d |
| A5100 | Task Depen | Presentation Draft | 15d | 28-Jan-25 | 18-Feb-25 | A5000 | A5200 | 0d |
| A5200 | Task Depen | Finalize Presentation | 10d | 19-Feb-25 | 04-Mar-25 | A5100 | A5300, A5400 | 0d |
| A5300 | Task Depen | Presentation Review | 8d | 05-Mar-25 | 14-Mar-25 | A5200 | A5400 | 0d |
| A5400 | Task Depen | Deliverable Review | 10d | 05-Mar-25 | 18-Mar-25 | A5200, A5300 | | 0d |

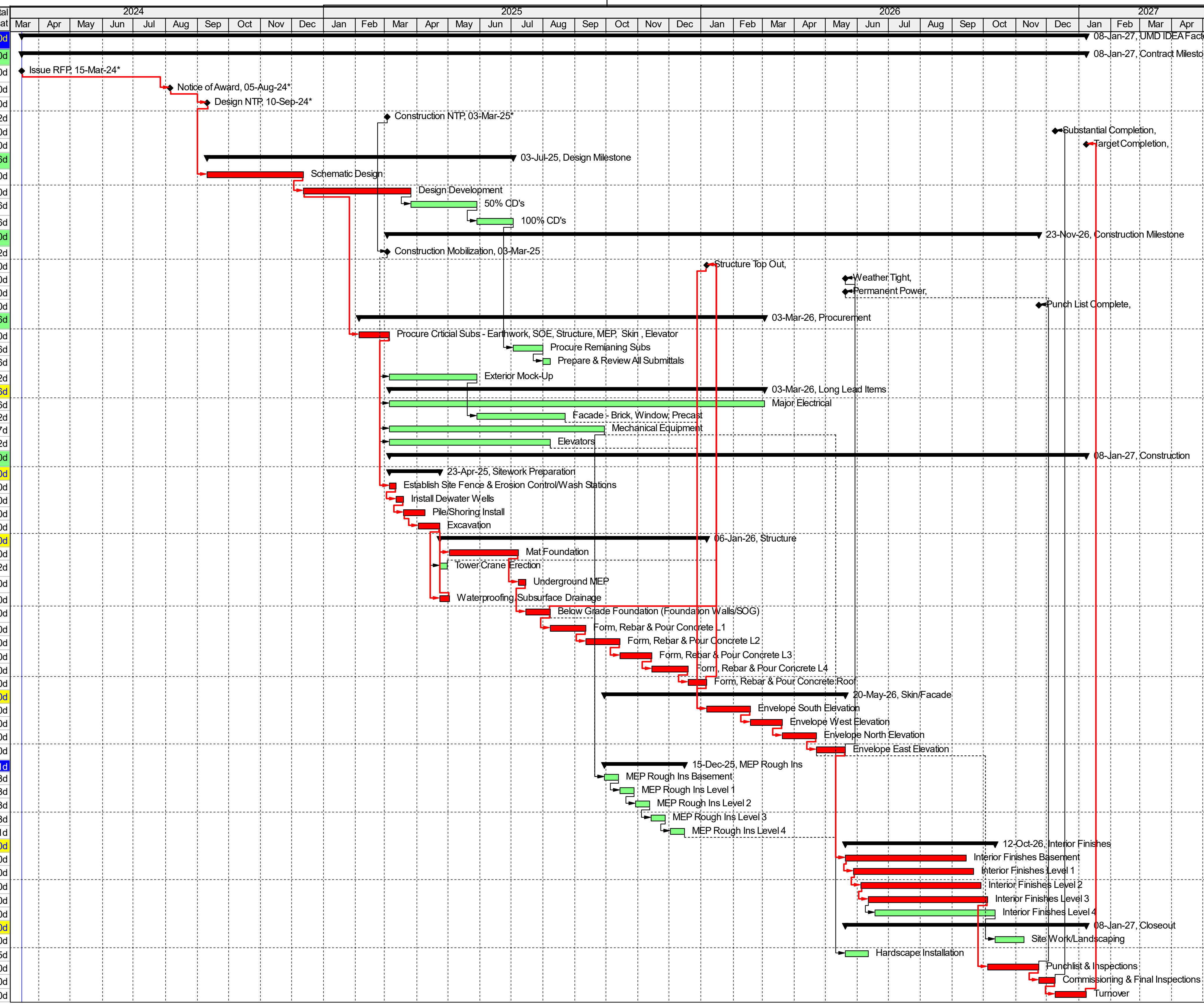



Actual Level of Effort | Remaining Work | ◆ Milestone
Actual Work | Critical Remaining Work | summary



TASK filter: All Activities

| Activity ID | Activity Name | Original | Early Start | Early Finish | Predecessors | Successors | Total Float |
|---|---|---|---|---|---|---|---|
| **UMD IDEA Factory Project Develc** | | 710d | 15-Mar-24 | 08-Jan-27 | | | 0d |
| **Contract Milestone** | | 710d | 15-Mar-24 | 08-Jan-27 | | | 0d |
| MILE100 | Issue RFP | 0d | 15-Mar-24 | | | MILE110 | 0d |
| MILE110 | Notice of Award | 0d | 05-Aug-24 | | MILE100 | MILE120 | 0d |
| MILE120 | Design NTP | 0d | 10-Sep-2 | | MILE110 | DES100 | 0d |
| MILE130 | Construction NTP | 0d | 03-Mar-25 | | | MILE160 | 2d |
| MILE140 | Substantial Completion | 0d | | 09-Dec-26 | A1440 | | 20d |
| MILE150 | Target Completion | 0d | | 08-Jan-27 | A1445 | | 0d |
| **Design Milestone** | | 205d | 10-Sep-2 | 03-Jul-25 | | | 356d |
| DES100 | Schematic Design | 65d | 10-Sep-2 | 12-Dec-24 | MILE120 | DES110 | 0d |
| DES110 | Design Development | 70d | 12-Dec-2 | 26-Mar-25 | DES100 | DES120, A1000 | 0d |
| DES120 | 50% CD's | 45d | 26-Mar-25 | 29-May-25 | DES110 | DES130 | 356d |
| DES130 | 100% CD's | 25d | 29-May-2 | 03-Jul-25 | DES120 | A1010 | 356d |
| **Construction Milestone** | | 438d | 03-Mar-25 | 23-Nov-26 | | | 30d |
| MILE160 | Construction Mobilization | 0d | 03-Mar-25 | | MILE130 | A1190 | 2d |
| MILE170 | Structure Top Out | 0d | | 06-Jan-26 | A1310, A1240, A126C | A1320 | 0d |
| MILE180 | Weather Tight | 0d | | 20-May-26 | A1350 | MILE190 | 160d |
| MILE190 | Permanent Power | 0d | | 20-May-26 | MILE180 | MILE200 | 160d |
| MILE200 | Punch List Complete | 0d | | 23-Nov-26 | A1430, MILE190 | | 30d |
| **Procurement** | | 270d | 04-Feb-25 | 03-Mar-26 | | | 216d |
| A1000 | Procure Crticial Subs - Earthwork, SOE, | 20d | 04-Feb-25 | 05-Mar-25 | DES110 | A1190, A1030, A106C | 0d |
| A1010 | Procure Remianing Subs | 20d | 03-Jul-25 | 01-Aug-25 | DES130 | A1020 | 356d |
| A1020 | Prepare & Review All Submittals | 5d | 01-Aug-25 | 08-Aug-25 | A1010 | | 356d |
| A1030 | Exterior Mock-Up | 60d | 05-Mar-25 | 29-May-25 | A1000 | A1070 | 92d |
| **Long Lead Items** | | 250d | 05-Mar-25 | 03-Mar-26 | | | 216d |
| A1060 | Major Electrical | 250d | 05-Mar-25 | 03-Mar-26 | A1000 | | 216d |
| A1070 | Facade - Brick, Window, Precast | 60d | 29-May-2 | 22-Aug-25 | A1030 | A1320 | 92d |
| A1080 | Mechanical Equipment | 145d | 05-Mar-25 | 29-Sep-25 | A1000 | A1450, A1360 | 107d |
| A1090 | Elevators | 110d | 05-Mar-25 | 08-Aug-25 | A1000 | A1320, A1450 | 102d |
| **Construction** | | 466d | 05-Mar-25 | 08-Jan-27 | | | 0d |
| **Sitework Preparation** | | 35d | 05-Mar-25 | 23-Apr-25 | | | 0d |
| A1190 | Establish Site Fence & Erosion Control/V | 5d | 05-Mar-25 | 12-Mar-25 | MILE160, A1000 | A1200 | 0d |
| A1200 | Install Dewater Wells | 5d | 12-Mar-25 | 19-Mar-25 | A1190 | A1210 | 0d |
| A1210 | Pile/Shoring Install | 15d | 19-Mar-25 | 09-Apr-25 | A1200 | A1220 | 0d |
| A1220 | Excavation | 15d | 02-Apr-25 | 23-Apr-25 | A1210 | A1230, A1240, A125ξ | 0d |
| **Structure** | | 177d | 23-Apr-25 | 06-Jan-26 | | | 0d |
| A1230 | Mat Foundation | 45d | 02-May-2 | 08-Jul-25 | A1220, A1255 | A1250 | 0d |
| A1240 | Tower Crane Erection | 5d | 23-Apr-25 | 30-Apr-25 | A1220 | MILE170 | 172d |
| A1250 | Underground MEP | 5d | 08-Jul-25 | 15-Jul-25 | A1230 | A1260 | 0d |
| A1255 | Waterproofing/Subsurface Drainage | 7d | 23-Apr-25 | 02-May-25 | A1220 | A1230 | 0d |
| A1260 | Below Grade Foundation (Foundation V | 18d | 15-Jul-25 | 08-Aug-25 | A1250 | A1270, A1450, MILE1 | 0d |
| A1270 | Form, Rebar & Pour Concrete L1 | 23d | 08-Aug-25 | 11-Sep-25 | A1260 | A1280 | 0d |
| A1280 | Form, Rebar & Pour Concrete L2 | 23d | 11-Sep-2 | 14-Oct-25 | A1270 | A1290 | 0d |
| A1290 | Form, Rebar & Pour Concrete L3 | 23d | 14-Oct-25 | 14-Nov-25 | A1280 | A1300 | 0d |
| A1300 | Form, Rebar & Pour Concrete L4 | 23d | 14-Nov-2 | 19-Dec-25 | A1290 | A1310 | 0d |
| A1310 | Form, Rebar & Pour Concrete Roof | 10d | 19-Dec-2 | 06-Jan-26 | A1300 | MILE170, A1320 | 0d |
| **Skin/Facade** | | 161d | 29-Sep-2 | 20-May-26 | | | 0d |
| A1320 | Envelope South Elevation | 28d | 06-Jan-26 | 17-Feb-26 | A1310, MILE170, A1C | A1330 | 0d |
| A1330 | Envelope West Elevation | 23d | 17-Feb-26 | 20-Mar-26 | A1320 | A1340 | 0d |
| A1340 | Envelope North Elevation | 23d | 20-Mar-26 | 22-Apr-26 | A1330 | A1350 | 0d |
| A1350 | Envelope East Elevation | 20d | 22-Apr-26 | 20-May-26 | A1340 | MILE180, A1410, A14 | 0d |
| **MEP Rough Ins** | | 56d | 29-Sep-2 | 15-Dec-25 | | | 111d |
| A14 | MEP Rough Ins Basement | 10d | 29-Sep-2 | 13-Oct-25 | A1260, A1080, A109C | A1460 | 113d |
| A14 | MEP Rough Ins Level 1 | 10d | 14-Oct-25 | 28-Oct-25 | A1450 | A1470 | 113d |
| A14 | MEP Rough Ins Level 2 | 10d | 29-Oct-25 | 12-Nov-25 | A1460 | A1480 | 113d |
| A14 | MEP Rough Ins Level 3 | 10d | 13-Nov-2 | 27-Nov-25 | A1470 | A1490 | 113d |
| A14 | MEP Rough Ins Level 4 | 10d | 02-Dec-2 | 15-Dec-25 | A1480 | A1360 | 111d |
| **Interior Finishes** | | 100d | 20-May-2 | 12-Oct-26 | | | 40d |
| A1360 | Interior Finishes Basement | 80d | 20-May-2 | 14-Sep-26 | A1490, A1080, A135C | A1370 | 0d |
| A1370 | Interior Finishes Level 1 | 80d | 28-May-2 | 21-Sep-26 | A1360 | A1380 | 0d |
| A1380 | Interior Finishes Level 2 | 80d | 04-Jun-26 | 28-Sep-26 | A1370 | A1390 | 0d |
| A1390 | Interior Finishes Level 3 | 80d | 11-Jun-26 | 05-Oct-26 | A1380 | A1400, A1430 | 0d |
| A1400 | Interior Finishes Level 4 | 80d | 18-Jun-26 | 12-Oct-26 | A1390 | A1410 | 40d |
| **Closeout** | | 160d | 20-May-2 | 08-Jan-27 | | | 0d |
| A1410 | Site Work/Landscaping | 20d | 12-Oct-26 | 09-Nov-26 | A1350, A1400 | | 40d |
| A1415 | Hardscape Installation | 15d | 20-May-2 | 11-Jun-26 | A1350 | | 145d |
| A1430 | Punchlist & Inspections | 35d | 05-Oct-26 | 23-Nov-26 | A1390 | A1440, MILE200 | 0d |
| A1440 | Commissioning & Final Inspections | 10d | 23-Nov-2 | 09-Dec-26 | A1430 | A1445, MILE140 | 0d |
| A1445 | Turnover | 20d | 09-Dec-2 | 08-Jan-27 | A1440 | MILE150 | 0d |




Actual Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | summary



TASK filter: All Activities

**Appendix B – Design Evolution**

**Index**

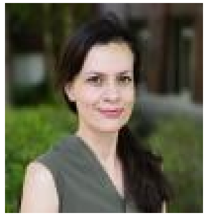
1. Team Organization – Defined team structure and member roles
2. Design Matrices and Recommendations – Researched and evaluated potential solutions
3. Previous Design Examples – Developed simple sketches of potential design options

# IDEA Factory Project Team

**University of Maryland**
Owner

**EYP Architecture & Engineering**
Architect

**Ryan Knox**
Project Executive



**Diana Duran**
Faculty Advisor

**Mike Rogerson**
Project Manager

**Logan Holsapple**
Design Manager

**Faythe Way**
Cost Estimator

**Katy Dominguez**
Superintendent

**Zubaidah Al Jumaili**
Scheduler

**Tony Tran**
Project Engineer

**Appendix B: Design Matrices and Recommendations**

**Decision Matrix Explanation**

1. Campus Impact (Max Score: 25 points)

The project's location is within an active university campus, making minimal disruption a top priority. An option that has a low level of noise, vibration, and disturbance would be given the highest weight. Ensuring smooth campus operations while maintaining construction efficiency is important.

2. Schedule (Max Score: 20 points)

Time efficiency is also crucial to meeting project deadlines. Some options require longer installation times due to labor-intensive processes or curing periods, impacting overall project timeline. Faster methods that allow for quicker construction would receive higher scores.

3. Building Envelope (High Water Table) (Max Score: 20)

Due to the presence of a high groundwater table, there is a strong need to focus on water management. The selected options need to provide structural stability while preventing water infiltration. Options that effectively mitigate hydrostatic pressure and ensure durability would score higher.

4. Cost (Max Score: 10)

Cost-effectiveness is also a key consideration to maintain the project budget. Options that optimize materials, reduce labor-intensive processes, and minimize the need for special equipment were rated higher. Moreover, cost was weighted lower than schedule and performance criteria to ensure long-term value over short-term savings.

5. Maintainability (Max Score: 10)

Long-term maintenance requirements would impact project efficiency and lifecycle costs. Options that require minimal future repairs, allow for easy inspection, and require less frequent interventions would be scored higher in this category.

6. Environmental Sustainability (Max Score: 5)

Environmental considerations play an important role in material selection and construction procedure. Options with low environmental impact, minimal material waste, and potential for reuse would be given higher ratings.

7. Labor Efficiency (Max Score: 5)

The complexity of installation directly affects labor demands. Options requiring specialized skills, long work hours, or additional safety measures would be rated lower, while options allowing for simple labor processes received higher scores.

**Appendix B: Design Matrices and Recommendations**

8. Material Availability (Max Score: 5)

Delays due to material availability can affect overall project timelines. Readily available materials that reduce lead times and supply chain risks would be rated higher, ensuring uninterrupted construction progress.

## Design Recommendations

For shoring and bracing design:

**Shoring and Bracing Decision Matrix**

| Criteria | Max Possible Score | Soldier Piles/Lagging | Sheet Piles | Secant Piles | Struts | Rakers |
|---|---|---|---|---|---|---|
| Campus Impact | *25* | 23 | 21 | 12 | 23 | 19 |
| Schedule | *20* | 18 | 20 | 8 | 18 | 15 |
| Building Envelope (High Water Table) | *20* | 8 | 20 | 20 | 8 | 8 |
| Cost | *10* | 8 | 8 | 3 | 8 | 7 |
| Maintainability | *10* | 5 | 8 | 8 | 6 | 7 |
| Sustainability | *5* | 3 | 4 | 2 | 4 | 4 |
| Labor Efficiency | *5* | 4 | 4 | 2 | 4 | 3 |
| Material Availability | *5* | 5 | 5 | 3 | 5 | 4 |
| **Total Score** | 100 | 74 | 90 | 58 | 76 | 67 |

- Campus Impact - 21

Driving sheet piles into the ground creates noise and vibration, which can disturb the campus environment. However, with appropriate scheduling and planning, the impact can be minimized

- Schedule - 20

Quick installation, but installation speed may vary based on soil conditions, which can delay progress.

- Building envelope (High Water Table) - 20

The interlocking design of sheet piles provides a nearly watertight barrier, making them ideal for excavations in high water table areas or where water control is critical

- Cost - 8

Can be costly, particularly when using steel piles or in projects requiring specialized driving equipment.

- Maintainability - 8

While durable, steel sheet piles can corrode, especially in wet environments, necessitating periodic maintenance.

- Sustainability - 4

Can be reused, especially in temporary applications, enhancing sustainability over multiple projects

**Appendix B: Design Matrices and Recommendations**

- Labor Efficiency - 4

Sheet pile installation often requires skilled labor and specialized equipment, slightly reducing labor efficiency

- Material Availability - 5

Standard sheet piles are generally available, though custom shapes or types may require special orders

Based on this matrix and the research found on the shoring and bracing system options, Jefferson Contracting recommends implementing sheet piles for the shoring and bracing design. Sheet piles emerge as the best option for this project, particularly due to their performance in critical criteria such as building envelope (high water table). Their interlocking design offers a nearly watertight barrier, making sheet piles particularly effective for managing high water tables, where water control is essential. While sheet piles may have a moderate impact on campus and require skilled labor and specialized equipment, these aspects can be managed with careful scheduling and experienced labor, respectively. Additionally, their reusability enhances sustainability, which is beneficial for projects with a focus on environmental considerations. Although sheet piles may involve higher costs and moderate maintenance due to potential corrosion, their strong performance in water control and adaptability make them an optimal choice for this project's needs. Overall, sheet piles balance essential requirements, providing an adaptable and sustainable solution for the IDEA Factory.

For foundation design:

**Foundations Decision Matrix**

| Criteria | Max Possible Score | Spread/Strip Footings | Mat Slab | Rammed Aggregate Piers | Driven Steel Piles | Drilled Shafts (Caissons) |
|---|---|---|---|---|---|---|
| Campus Impact | *25* | 25 | 23 | 20 | 20 | 18 |
| Schedule | *20* | 20 | 17 | 16 | 15 | 10 |
| Building Envelope (High Water Table) | *20* | 10 | 20 | 18 | 10 | 20 |
| Cost | *10* | 9 | 10 | 8 | 4 | 3 |
| Maintainability | *10* | 8 | 10 | 4 | 3 | 6 |
| Environmental Sustainability | *5* | 3 | 2 | 4 | 2 | 2 |
| Labor Efficiency | *5* | 5 | 3 | 4 | 4 | 2 |
| Material Availability | *5* | 5 | 5 | 4 | 4 | 2 |
| **Total Score** | 100 | 85 | 90 | 78 | 62 | 63 |

- Campus Impact – 23

Heavy machinery and large concrete pours are required for the mat slab, which can be noisy. However, the disruption can be mitigated by scheduling work to be done at times in which construction is less of a bother to the community.

- Schedule - 17

**Appendix B: Design Matrices and Recommendations**

With the mat slab, curing times must be considered, and due to the size and complexity of this system, installation will likely take a few weeks. Weather may also impact the timeline of the mat slab installation.

- Building Envelope (High Water Table) - 20

It acts well with a high water table as it provides stability at the base of the structure, especially due to the way in which it evenly distributes loads. This foundation in addition to a dewatering system will act very well in an area with a high water table.

- Cost - 10

For larger structures, they are very cost-efficient since you only need the one mat slab to cover the land where the foundation will be placed rather than multiple (i.e. multiple spread footings).

- Maintainability - 10

Given the way in which mat slabs provide an even distribution of loads, they require very minimal maintenance unless settlement issues occur.

- Sustainability - 2

To make a mat slab, a large amount of concrete is required, which results in a large carbon footprint. However, implementation of more sustainable concrete alternatives may mitigate the negative environmental impacts.

- Labor Efficiency - 3

Formwork, reinforcement, and concrete placement are required for a mat slab. These tasks are more complex and require more skilled labor.

- Material Availability - 5

The primary materials required are concrete and rebar, which are easy to acquire. Proper planning for acquiring materials will need to be done given the larger scale of this project, but as long as this is done, material acquirement should be simple.

Based on this matrix and the research found on the foundation options, Clark Construction recommends implementing the mat slab for the foundation design. A mat slab foundation is an ideal choice for this construction project due to its stability, cost-efficiency, and ability to handle challenging conditions like high water tables. Its large, continuous concrete slab distributes loads evenly across the entire structure, which is particularly beneficial in areas with unstable or weak soils. This even load distribution can also minimize the need for multiple smaller footings, making it a more cost-effective solution for larger buildings. Although the installation process is slightly complex and time-consuming, requiring skilled labor and careful planning for materials, the benefits of durability and low long-term maintenance needs often outweigh these challenges. In addition, while the environmental impact of using large quantities of concrete is a concern, the use of sustainable materials can help mitigate this. Overall, the mat slab is a reliable and strong foundation type that, when planned and executed correctly, provides excellent support for large-scale structures like the IDEA Factory.

**Appendix B**

**<u>Previous Design Examples</u>**

Based on the geotechnical report's classification of existing site conditions, a dewatering solution will be developed that could incorporate foundation and underfloor subdrainage, geocomposite lining of foundation walls, a perimeter subdrainage system, and a sump and pump system.

1. Construction Groundwater Mitigation – After pumping out the ground water for the excavations for the shallow foundations, a mud slab will be placed to prevent water intrusion and give a level surface to place rebar and pour the mat footings and pile caps.

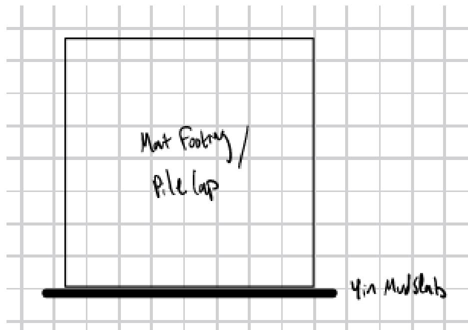



*Figure 1: Tentative Design for Construction Groundwater*

2. Building Groundwater Mitigation – For the basement, the exterior will be fully waterproofed, with drainage board to prevent hydrostatic pressure. Aggregate fill will be placed around these excavations, with a semi-pervious drainage line to collect the extra groundwater from intruding into the building. We have not determined the areas these lines will need to run. We are currently considering running these subsurface drainage lines into the needed sump pits for the elevator foundations, as elevators require a sump pit. See the attached tentative designs for details, that will be developed in software later in the progress

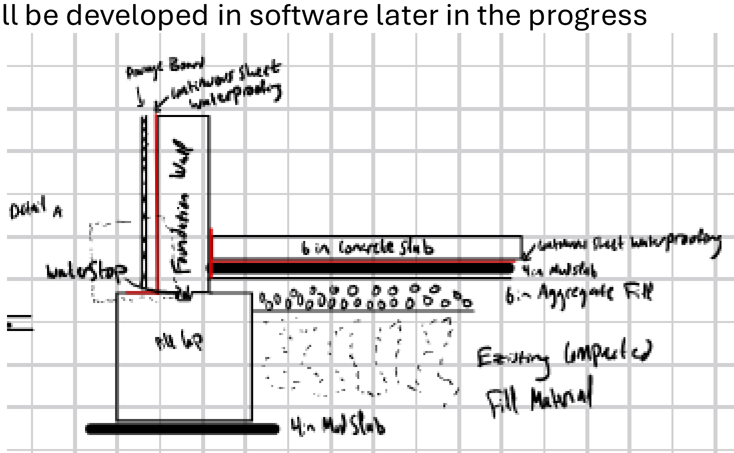



*Figure 2: Tentative Design for Building Groundwater*

**Appendix B**

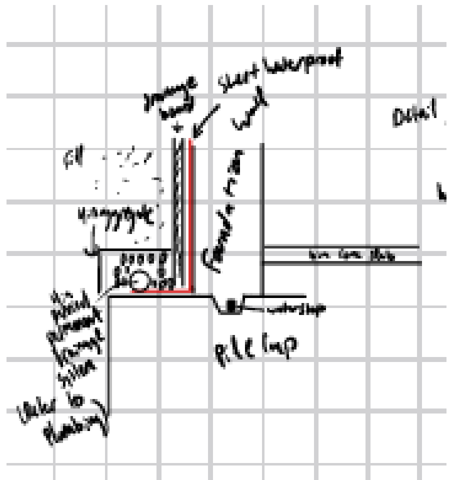



*Figure 3: Tentative Design for Construction Groundwater Detail*

**Appendix C – Engineering Standards**

**Index**

**Engineering Standards:**

1. The design standards implemented are based on Maryland Building Code, the provided construction documents, and the site-specific conditions specified in the Geotechnical Report (in Appendix C).
    a. Maryland Stormwater Design Manual
    b. Maryland Building Performance Standards (Baltimore County)
    c. Geotechnical Report
        i. 3-4” concrete work mat
        ii. Groundwater drawn-down a minimum of 3’ below the lowest excavation
        iii. 4” diameter corrugated polyethylene with a maximum slot width of 1/8” spaced at 25’ c-c for subdrainage
        iv. AASHTO No. 7 stone should be used as an aggregate filter and should be wrapped in filter fabric with an equivalent opening size not larger than the U.S. Standard No. 70 sieve.
        v. Minimum 6” of aggregate material between foundation and drainage pipe; Minimum 2” between drainage pipe and filter fabric
    d. Construction Documents
        i. General building footprint and elevations
        ii. Mat Foundation of 4’ 6”
        iii. Sump pit 11’ 3” below basement surface
    e. Additional design specifications based on the engineering judgment of capstone members under advisor guidance.
2. We will also follow the industry standard for the creation of an RFP.

Maryland
Department of
the Environment

**Larry Hogan**, Governor
**Boyd K. Rutherford**, Lt. Governor

**Horacio Tablada**, Secretary
**Suzanne E. Dorsey**, Deputy Secretary

# GENERAL PERMIT FOR STORMWATER DISCHARGE ASSOCIATED WITH CONSTRUCTION ACTIVITY

General NPDES Permit Number MDRC0000
State Discharge Permit Number 20CP0000
EFFECTIVE DATE: April 1, 2023 EXPIRATION DATE: March 31, 2028

**Table of Contents**

- Between 8AM and 5PM at 410-537-3510
- All other hours at (866) 633-4686

You must also, within seven (7) calendar days of knowledge of the release, provide a description of the release, the circumstances leading to the release, and the date of the release to the Department's compliance program. Local requirements may necessitate additional reporting of spills or discharges to local emergency response, public health, or drinking water supply agencies. No condition of this general permit releases the permittee from any responsibility or requirements under other environmental statutes or regulations.

**4. Construction Dewatering Requirements**

Comply with the following requirements to minimize the discharge of pollutants from dewatering operations, in accordance with Part I.C.2.

a. Route dewatering water through a sediment control designed to minimize discharges of pollutants and prevent discharges with visual turbidity (as defined in Appendix A). Appropriate controls are identified in the ESC Handbook Section F and may require additional use of chemical additives as provided in this permit that are designed to remove sediment.
b. Do not discharge visible floating solids or foam;
c. Use an oil-water separator or suitable filtration device (such as a cartridge filter) that is designed to remove oil, grease, or other products if dewatering water is found to contain these materials;
d. To the extent feasible, use well-vegetated, upland areas of the site to infiltrate dewatering water before discharge. You are prohibited from using Waters of this State as part of the treatment area;
e. To prevent dewatering-related erosion and related sediment discharges;
   i. Use stable, erosion-resistant surfaces (e.g.,well-vegetated grassy areas, clean filter stone, geotextile underlayment) to discharge from dewatering controls;
   ii. Do not place dewatering controls, such as pumped water filter bags, on steep slopes; and
   iii. At all points where dewatering water is discharged, comply with the velocity dissipation requirements of Part III.A.2.l;
f. With backwash water, either haul it away for disposal or return it to the beginning of the treatment process;
g. For any approved manufactured treatment systems, replace and clean the filter media used in dewatering devices when the pressure differential equals or exceeds the manufacturer's specifications; and
h. Comply with dewatering-specific inspection requirements in Part C.

## B. Water Quality-Based Limits.

**1. General Effluent Limitation to Meet Applicable Water Quality Standards**

Discharges must be controlled as necessary to meet applicable water quality standards. In the absence of information demonstrating otherwise, the Department expects that compliance with the conditions in this permit will result in stormwater discharges being controlled as necessary to meet applicable water quality standards. If at any time you become aware, or the Department determines, that discharges are not being controlled as necessary to meet applicable water quality standards, you must take corrective action as required in Parts III.D.1 and III.D.2, and document the corrective actions as required in Part III.D.3.

The narrative surface water quality criteria in Maryland's water quality standards (COMAR 26.08.02) include floating debris, oil, grease, scum, sludge, and other floating materials in amounts sufficient to cause the receiving water(s) to be unsightly; change the existing color to produce objectionable color for aesthetic purposes, or interfere directly or indirectly with designated uses; or elevate temperature which interfere directly or indirectly with designated uses.

The Department may require that you install additional controls (to meet the narrative water quality-based effluent limit above) on a site-specific basis or require you to obtain coverage under an individual permit, if information in your NOI or from other sources indicates that your discharges are

# Geotechnical Engineering Report

## University of Maryland IDEA Factory
College Park, Maryland

December 19, 2018

GeoConcepts Engineering, Inc.

A Terracon COMPANY

19955 Highland Vista Drive, Suite 170 w Ashburn, Virginia 20147 w 703-726-8030

GeoConcepts Engineering, Inc.
A Terracon COMPANY

19955 Highland Vista Dr., Suite 170
Ashburn, Virginia 20147
(703) 726-8030
www.geoconcepts-eng.com

December 19, 2018

Ms. Sandra Dee Williams
FM Planning & Construction
University of Maryland, College Park

Subject: Geotechnical Engineering Report
University of Maryland IDEA Factory (Our JD185262)
College Park, Maryland

Dear Ms. Williams:

GeoConcepts Engineering, Inc. (GeoConcepts) is pleased to present the following geotechnical engineering report prepared for the University of Maryland IDEA Factory at College Park, Maryland.

We appreciate the opportunity to serve as your geotechnical consultant on this project. Please do not hesitate to contact me if you have any questions or want to meet to discuss the findings and recommendations contained in the report.

Sincerely,

GEOCONCEPTS ENGINEERING, INC.

Paul Burkart

Paul Burkart, PE
Senior Principal
paul.burkart@terracon.com

# Table of Contents

# 1.0 Scope of Services

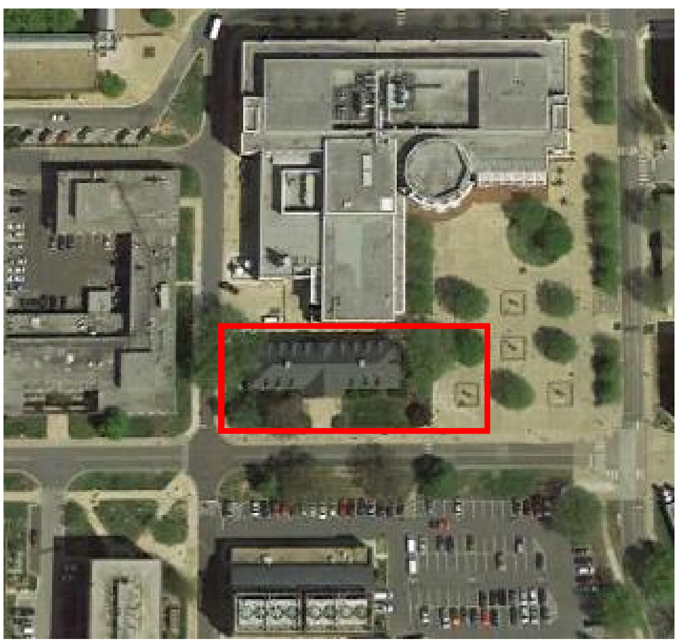
This geotechnical engineering report presents the results of the field investigation, soil laboratory testing, and engineering analysis of the geotechnical data. This report specifically addresses the following:

- An evaluation of subsurface conditions within the area of the proposed site development, including a seismic site classification per the International Building Code.
- Foundation recommendations for support of the proposed building and lower floor slab on grade.
- Lateral earth pressures for use in design of basement walls.
- Subdrainage recommendations for handling of groundwater during construction and final design.
- An assessment of subgrade conditions for support of pavements, including recommended flexible and rigid pavement sections.
- Earthwork recommendations for construction of loadbearing fills, including an assessment of on-site soils to be excavated for re-use as fill.

Services not specifically identified in the contract for this project are not included in the scope of services.

# 2.0 Site Description and Proposed Construction

The site is located on the University of Maryland, College Park campus. Specifically, the site is located at the previous Potomac Building site that has been razed. The elevation (EL) at the site ranges from approximately EL 77 to EL 73, sloping downward towards the east.



Imagery provided by Google Earth dated 2017.

Based on plans provided to us, the proposed construction consists of a four-story building with a basement. We understand that the proposed plans include a finished floor elevation at EL 75 and a basement slab elevation at EL 57. Typical column loads are 1,000 kips, with a maximum column load at approximately 1,750 kips.

# 3.0 Subsurface Conditions

Subsurface conditions were investigated by drilling a total of eight Standard Penetration Test (SPT) borings, in the proposed building area. The SPT borings were completed by Terracon Drilling Services between November 19 and 27, 2018 utilizing 2-¼ inch inside diameter hollow stem auger with automatic hammer. The sampler was advanced by driving the spoon into undisturbed soil under the impact of a 140-lbf hammer free-falling from 30 inches height per ASTM D1586-11. The borings were staked by GeoConcepts Engineering in advance of our work. Ground surface elevations of the test borings were determined by GeoConcepts from the site topographic plans. Test boring logs and a boring location plan are presented in Appendix A of this report.

## 3.1 Geology

The site is located within the Coastal Plain Physiographic Province of Maryland. The Coastal Plain consists of a seaward thickening wedge of unconsolidated to semi-consolidated sedimentary deposits from the Cretaceous Geologic Period to the Holocene Geologic Epoch. These deposits represent marginal-marine to marine sediments consisting of interbedded sands and clays. The Coastal Plain is bordered to the east by the Atlantic Ocean and to the west by the Piedmont Physiographic Province. The dividing line between the Coastal Plain and the Piedmont is locally referred to as the “Fall Line”. This name comes from the waterfalls that form as a result of the differential erosion that occurs as streams cross the Piedmont/Coastal Plain contact.

Specifically, according to local geologic maps, the site is mapped in the Lowland Deposits of the Quaternary geologic period. The Lowland Deposits overlies the Potomac Group Formation of the Cretaceous geologic period. The Potomac Group sediments are the oldest sedimentary deposits in the Washington, DC area. These soils are known to be highly over-consolidated as a result of the weight of a substantial thickness of overlying soils that have since been eroded away. As a result of over-consolidation, Potomac Group soils have been pre-loaded and are capable of supporting substantial loads.

Based on our subsurface investigation, the sediments and strata correspond favorably to the geologic publications.

## 3.2 Stratification

The subsurface materials encountered have been stratified for purposes of our discussions herein. These stratum designations do not imply that the materials encountered are continuous across the site. Stratum designations have been established to characterize similar subsurface conditions based on material gradations and parent geology. The generalized subsurface materials encountered in the test borings completed at the site have been assigned to the following strata:

| | |
|---|---|
| Stratum A (Existing Fill) | loose to dense, CLAYEY SAND WITH GRAVEL, SILTY SAND, FILL, moist, brown, orange |
| Stratum B1 (Alluvial – Fine-Grained) | firm to hard, SANDY LEAN CLAY (CL), SILTY CLAY WITH SAND (CL-ML), SANDY SILT (ML), moist, brown, gray, red |
| Stratum B2 (Alluvial – Coarse-Grained) | medium dense to dense, CLAYEY SAND (SC), POORLY GRADED SAND WITH GRAVEL (SP), POORLY GRADED GRAVEL WITH SAND (GP), moist, brown, gray, orange |
| Stratum C (Potomac Group) | stiff to hard, LEAN CLAY (CL), SANDY LEAN CLAY (CL), FAT CLAY (CH) moist, brown, gray, red |

The two letter designations included in the strata descriptions presented above and on the test boring logs represent the Unified Soil Classification System (USCS) group symbol and group name for the samples based on laboratory testing per ASTM D2487 and visual classifications per ASTM D2488. It should be noted that visual classifications per ASTM D2488 may not match classifications determined by laboratory testing per ASTM D2487.

## 3.3 Groundwater

Groundwater level observations were made in the field during drilling and up to one day after the completion of the test borings. A summary of the water level readings rounded off to the nearest 0.5 feet elevation is presented below in Table 3.3-1.

Table 3.3-1: Groundwater Readings

| Test Boring No. | Depth to Groundwater (ft) | Groundwater Elevation (ft) |
|---|---|---|
| B-1 | 20.0 | 56.0 |
| B-2 | 12.0 | 64.0 |
| B-3 | 24.0 | 52.0 |
| B-6 | 11.0 | 64.0 |
| B-7 | 13.5 | 59.0 |
| B-8 | 15.0 | 58.0 |

Groundwater was typically encountered at depths of about 10 to 15 feet below the existing ground surface, or as high as about EL 64. The groundwater observations presented herein are considered to be an indication of the groundwater levels at the dates and times indicated. Where more impervious Stratum B1 and Stratum C clay soils are encountered, the amount of water seepage into the borings is limited, and it is generally not possible to establish the location of the groundwater table through short term water level observations. Accordingly, the groundwater information presented herein should be used with caution. Also, fluctuations in groundwater levels should be expected with seasons of the year, construction activity, changes to surface grades, precipitation, or other similar factors.

## 3.4 Soil Laboratory Test Results

Selected soil samples obtained from the field investigation were tested for grain size distribution, Atterberg limits, and natural moisture contents. A summary of soil laboratory test results is presented below in Table 3.4-1, and the results of natural moisture content tests are presented on the test boring logs in Appendix A.

Table 3.4-1: Summary of Soil Laboratory Test Results

| Test Boring No. | Depth (ft) | Sample Type | Stratum | Description of Soil Specimen | Sieve Results | | Atterberg Limits | | | Natural Moisture Content (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Percent Retained #4 Sieve | Percent Passing #200 Sieve | LL | PL | PI | |
| B-6 | 8.5-10.0 | Jar | B1 | SILTY CLAY WITH SAND (CL-ML) | 1.2 | 72.1 | 25 | 19 | 6 | 24.4 |
| B-6 | 13.5-15.0 | Jar | B2 | POORLY GRADED GRAVEL WITH SAND (GP) | 50.1 | 4.2 | NP | NP | NP | 7.4 |

| Test Boring No. | Depth (ft) | Sample Type | Stratum | Description of Soil Specimen | Sieve Results | | Atterberg Limits | | | Natural Moisture Content (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Percent Retained #4 Sieve | Percent Passing #200 Sieve | LL | PL | PI | |
| B-6 | 18.5-20.0 | Jar | B1 | SANDY LEAN CLAY (CL) | 1.0 | 63.8 | 32 | 16 | 16 | 19.4 |
| B-6 | 23.5-25.0 | Jar | C | FAT CLAY (CH) | 0.0 | 93.0 | 74 | 25 | 49 | 23.5 |
| B-6 | 33.5-35.0 | Jar | C | FAT CLAY (CH) | 0.0 | 93.5 | 65 | 25 | 37 | 23.8 |
| B-6 | 48.5-50.0 | Jar | C | FAT CLAY (CH) | 0.0 | 99.3 | 52 | 25 | 27 | 22.5 |

Notes:
1. Soil tests are in accordance with applicable ASTM standards
2. Soil classification symbols are in accordance with Unified Soil Classification System
3. Visual identification of samples is in accordance with ASTM D2488
4. Key to abbreviations: LL = liquid limit; PL = plastic limit; PI = plasticity index; NP = nonplastic

## 3.5 Pavement Cores

GeoConcepts performed pavement coring at boring locations B-7 to B-9. The pavement section thicknesses are presented below in Table 3.5-1.

Table 3.5-1: Pavement Section Thicknesses

| Location | Concrete Thickness (inches) | Gravel Base Thickness (inches) |
|---|---|---|
| B-7 | 6 | 0 |
| B-8 | 6 | 17.5 |
| B-9 | 9.5 | 3 |

## 3.6 Seismic Site Classification

Based on the results of the subsurface investigation and our knowledge of local geologic conditions, the site soils have been assigned to a site class D per the International Building Code (IBC).

# 4.0 Engineering Analysis

Recommendations regarding foundations, lower floor slabs, lateral earth pressures, subdrainage, pavements, and earthwork are presented herein.

## 4.1 Foundations

Both shallow and deep foundations have been evaluated for support of the proposed building construction. We have evaluated spread footings, a mat foundation, and drilled shafts (caissons). Due to the structural loads, we do not recommend spread footings due to estimated excessive settlement. We recommend a mat foundation for support of the proposed building, and caissons as an alternate foundation system. The final selection of a foundation system should be based on an economic/construction schedule comparison of these options by the general contractor. Detailed recommendations for each foundation system are presented below.

### 4.1.1 Mat Foundation

A mat foundation is recommended for support of the proposed building. The mat may be designed based on a modulus of subgrade reaction $k_s$ of 75 pounds per cubic inch (pci) based on a one-foot square plate, or 20 pounds per cubic inch (pci) based on the actual building footprint. The mat is expected to have a contact pressure less than 4,000 psf, which is acceptable. Hydrostatic uplift pressures are not expected in the mat design assuming the use of permanent subdrainage under the mat foundation, as further discussed in Section 4.4 of this report.

We have reviewed the consolidation test results from previous geotechnical reports provided to us for building projects along Paint Branch Drive, and have used the following consolidation soil design parameters for the Stratum C clay in our analyses and recommendations, as presented below in Table 4.1.1-1.

Table 4.1.1-1: Estimated Consolidation Soil Design Parameters

| $e_O$ | OCR | Cc | Cr | Ca |
|---|---|---|---|---|
| 0.7 | 2.5 | 0.25 | 0.025 | 0.004 |

$e_O$ = initial void ratio; OCR = overconsolidation ratio; Cc = compression index; Cr = recompression index; Ca = secondary consolidation index.

Strict quality control should be provided during construction of the mat to ensure that the mat is placed on undisturbed subgrade soils immediately after excavations are complete. The excavation should be performed using equipment that can reach out and cut down to the subgrade without tracking across the subgrade and disturbing the underlying material. A 3- to 4-inch thick concrete work mat should be placed on the freshly excavated subgrade, to allow for installation of reinforcing steel prior to the final mat pour. Excavations should not be performed in inclement weather that causes the excavated subgrade to become disturbed, and excavations should not be left open overnight without placing a concrete work mat on the subgrade. Also, the prepared subgrade must be prevented from freezing if work is performed in the winter months.

The mat may be placed in sections or in one continuous concrete pour. If the mat is placed in one continuous pour, we recommend that super plasticizers be used in the concrete mix design to decrease the water to cement ratio, which will in turn, reduce the potential for shrinkage cracks in the mat. Cold joints should not be permitted during placement of the mat concrete. If the mat is placed in sections, we recommend that the construction joints be designed so as to ensure that the joints are water tight. We recommend that the mat be placed in a checkerboard fashion so that every other square is placed to minimize shrinkage effects. If internal braces (rakers) are utilized for the support of the earth retention system, box-outs within the mat will be required due to penetration of the rakers for the mats. The joints in the mat around the rakers should also be constructed using a water tight seal.

### 4.1.2 Drilled Shafts (Caissons)

Drilled shafts consist of circular, straight shaft, cast-in-place reinforced concrete elements designed to develop their load carrying capacity from a combination of frictional resistance and end bearing resistance. The recommended soil design parameters, and allowable frictional and end bearing design parameters that were used for the axial bearing calculations, are presented below in Table 4.1.2-1. Plots of allowable drilled shaft axial capacities for 4 to 7 feet diameter shafts are presented in Appendix C for use in selecting foundation sizes based on structural loading. Shaft center-to-center spacing of at least three times the shaft diameter is recommended.

Table 4.1.2-1: Soil Design Parameters for Drilled Shafts Bearing Calculations

| Soil Type/ Elevation Range | Friction Angle (degrees) | Cohesion (psf) | Allowable Side Resistance (psf)* | Allowable End Bearing (tsf)* |
|---|---|---|---|---|
| Clay/EL 55 to EL 40 | -- | 3000 | 425 | -- |

| Soil Type / Elevation Range | Friction Angle (degrees) | Cohesion (psf) | Allowable Side Resistance (psf)* | Allowable End Bearing (tsf)* |
|---|---|---|---|---|
| Clay/EL 40 to EL 20 | -- | 4500 | 550 | 12 |
| Sand/Below EL 20** | 38 | -- | 375 | 12 |

* Based on safety factor of 2.5
** Elevation of Sand based on adjacent geotechnical reports

Drilled shafts should be constructed as straight shafts at least 30 inches in diameter, to facilitate cleaning of the bottoms and to facilitate observations of caisson end bearing materials. Prior to concrete placement, drilled shaft subgrades should be observed by a representative of the geotechnical engineer in order to verify that subgrades are suitable for support of design bearing pressures, and to ensure that subgrades are free of loose or disturbed material. Alternative methods to downhole visual inspection are recommended, such as the miniature drilled Shaft Inspection Device (mini-SID) or the Ding Inspection Device (DID), to avoid the need for workers to enter the excavated shaft.

Belled drilled shafts caissons are also feasible at this site, but we understand that the use of belled caissons have significantly declined over the last 5 or 10 years due to concerns related to proper cleaning of loose materials under the bells, since entry into the shaft is generally not permitted due to safety awareness.

Drilled shafts should extend down to adequate bearing materials as described herein. Bases of drilled shafts should be essentially level, although steps up to 1 foot high may be used at the caisson base. After the shaft is advanced to suitable bearing material, the subgrade should be hand cleaned or suitably mechanically cleaned prior to observation. Pumping of water at the bottom of the caisson may be required to control groundwater during construction.

Steel casings extending to the bottom of the drilled shafts should be used to seal out groundwater and to aid in preventing sidewalls from caving. The casing may be extracted as the concrete is poured; however, a sufficient head of concrete should be maintained above the bottom casing during withdrawal to seal off groundwater, and to prevent infiltration of soil into the shaft.

Concrete should not be placed in standing water in excess of 2 inches in depth. The concrete should have a minimum slump of 5 inches. Concrete may be placed using the free fall method, as long as the concrete does not strike the sides of the casing or any reinforcing steel. If concrete free falls and strikes obstructions, it may segregate and result in zones of low strength concrete. Drilled shafts should be concreted the same day they are drilled and should not be concreted to intermediate depths due to insufficient amounts of concrete at the site.

Drilled shafts should not be allowed to stand open overnight. A minimum of 16 hours should be allowed between concrete placement in one drilled shaft before drilling an adjacent drilled shaft. All drilled shaft construction should be performed in general conformance with ACI 336.1 “Standard Specifications for Construction of Drilled Piers”, and in accordance with appropriate OSHA standards.

## 4.2 Lower Floor Slabs on Grade (Drilled Shaft Option)

Lower floor slabs supported by natural soils are considered feasible at the site. The lower floor slab may be designed based on a modulus of subgrade reaction $K_S$ of 75 pounds per cubic inch (pci). All debris and soft soils near the final floor slab subgrade as a result of construction operations should be stripped and removed prior to placement of underfloor stone. A 6-inch minimum thickness of washed gravel or crushed stone meeting the requirement of AASHTO No. 57 should be placed below floor slabs on grade to serve as a capillary break. This gravel layer will also serve as part of the underfloor subdrainage system. An impermeable plastic membrane should be placed on top of the crushed stone layer to assist as a moisture barrier. Special attention should be given to the surface curing of the slab in order to minimize uneven drying of the slab and associated cracking.

We recommend that mesh (fiber or welded wire fabric) reinforcement be included in the design of the floor slab to minimize the development of any shrinkage cracks near the surface of the slab. If welded wire fabric is used, the mesh should be located in the top half of the slab.

## 4.3 Lateral Earth Pressures

Basement walls should be designed to withstand lateral earth pressures. An equivalent fluid pressure of 60H (psf) should be used for design of basement walls, where H refers to the height of the wall. The design should account for any surcharge loads within a 45-degree slope from the base of the wall. A recommended lateral earth pressure diagram for use in the design of basement walls are presented as Figure 2 at the end of this report. Hydrostatic pressures are not included in the lateral earth pressure diagram assuming the use of drainage geocomposites against basement walls or relatively free draining backfill as applicable. Recommendations for backfill against walls below grade are presented in Section 4.6 of this report.

## 4.4 Subdrainage

Based on the groundwater observations and proposed lower floor elevation, temporary construction dewatering and permanent subdrainage is recommended, as presented below.

### 4.4.1 Temporary Construction Dewatering

Based on the groundwater data, we recommend that the contractor be prepared to provide temporary dewatering during construction, consisting of both an aggressive system of individual sumps and pumps during excavation and possibly deep well point construction around the perimeter of the excavation to intercept and lower the groundwater table, prior to excavation. To help maintain bottom stability of excavations, groundwater levels should be drawn-down a minimum of 3 feet below the lowest portion of the excavation, including foundation subgrades.

Due to the imbedded nature of the sands and clays of the Potomac Group, seeps and/or springs may be encountered during excavations. The volume of water generated by seeps or springs, if present, can vary significantly.

It is critical that as soon as water seepage is observed, the contractor should excavate surface trenches from the observed water seepage to a sump pit and sump pump. If the water is allowed to saturate subgrades, softening of the subgrade will occur very quickly and extra costs will be incurred. However, if the contractor can channel the water to a sump pit and keep the majority of the subgrade from getting saturated, extra costs due to water softening should be significantly reduced. The temporary dewatering system should remain in place until the floor slab subgrades are approved and the permanent underfloor subdrainage system is installed and operational.

It should be understood that the groundwater information presented herein should be used with caution. Also, fluctuations in groundwater levels should be expected with seasons of the year, construction activity, changes to surface grades, precipitation, or other similar factors. Therefore, water levels presented in this report may not be representative of those encountered at the time of construction. It should be the responsibility of the contractor to verify groundwater conditions and evaluate dewatering requirements prior to bidding and/or construction.

### 4.4.2 Permanent Subdrainage

The permanent subdrainage should consist of foundation and underfloor subdrainage. Any building elements extending below the subdrainage system should be designed for hydrostatic and uplift pressures and be waterproofed.

Subdrainage piping should be placed below the lower floor slab at a spacing of about 25 feet on center. Subdrainage piping should consist of 4-inch diameter corrugated polyethylene tubing per ASTM F405, with a maximum slot width of ⅛-inch. This tubing should be placed using straight sections, with standard available connections at the junctions or along continuous lines. Pipes may be placed essentially level with inverts at least 12 inches below the final slab grade. To minimize infiltration of silt-size fines into the pipes, the pipes should be placed with at least 6 inches of filter material on both sides and bottom, and 2 inches of filter material above the pipe under slabs. For footings AASHTO No. 7 stone should be used for the aggregate filter. For added protection against siltation, the aggregate filter material should be wrapped in filter fabric with an equivalent opening size not larger than the U.S. Standard No. 70 sieve. Cleanouts should be incorporated into the system after every second right angle bend in the subdrainage pipe, to facilitate flushing of the system. The 6-inch layer of crushed stone below the floor slab will also serve as part of the subdrainage system.

It is expected that collected groundwater will outlet to a sump pit installed below the lower floor level, for outlet by pumping. Pumps with capacities of about 100 gpm per pump should be initially selected. However, flow measurements of the temporary dewatering system during construction should be made by the Contractor. Using this data, the size of the pumps should be adjusted, if necessary, based on the results of field measurements during construction. Two sources of power should be used to operate the pumping system and back-up pumping capabilities should be provided in the event of a power failure.

Prefabricated drainage geocomposites should be placed against the outside of basement walls and extend up to exterior grades. A layer of filter fabric equivalent to the filter fabric recommended for the subdrainage system should be used between the drainage geocomposite and the soil backfill. Water that collects on the geocomposite should be collected in the perimeter subdrainage system installed at the base of the basement walls, and then be discharged to the interior sump pit by solid piping (weepholes) through the base of the wall. Below grade walls should also be waterproofed to minimize the migration of water through below grade walls. Details regarding waterproofing should be provided by a waterproofing specialist and are beyond the scope of this report.

## 4.5 Pavements

Pavement subgrades are expected to consist of generally medium dense existing fill. These materials are generally considered suitable for support of the planned pavement areas. However, where pavement subgrades consist of existing fill, we recommend budgeting for undercutting the existing fill to a depth of at least 2 feet and backfilling with new compacted fill. The decision to undercut the existing fill should be based on a thorough proofroll of the pavement subgrades under the observation of the geotechnical engineer.

Based on the soil laboratory test results for the materials expected at pavement subgrades, an estimated design CBR value of 5 is recommended for pavement design purposes. If fill placed at the site is generated from off-site borrow areas, the actual CBR value for the pavement subgrades may be significantly different from the preliminary value presented herein. Therefore, CBR tests should be performed on the in-place subgrade after rough grading and installation of utilities within roadways. Final pavement sections should be based on CBR tests taken on subgrade soils at the time of construction. Concrete pavements should be utilized in loading dock areas and for dumpster pads.

### 4.5.1 Pavement Design Recommendations

Three pavement designs were analyzed for this site: 1) Light Duty Flexible Pavement, 2) Heavy Duty Flexible Pavement, and 3) Hardstand Rigid Pavement. Based on the estimated design CBR/resilient modulus value, the following flexible and rigid pavement sections as presented below in Tables 4.5.1-1 through 4.5.1-3 may be considered at this site.

Table 4.5.1-1: Light Duty Flexible Pavement Section

| Flexible Pavement Layers | Thickness (inches) |
|---|---|
| Asphalt Surface | 1.5 inches |

| Flexible Pavement Layers | Thickness (inches) |
|---|---|
| Asphalt Base | 2.5 inches |
| Graded Aggregate Subbase | 6.0 inches |

Table 4.5.1-2: Heavy Duty Flexible Pavement Section

| Flexible Pavement Layers | Thickness (inches) |
|---|---|
| Asphalt Surface | 1.5 inches |
| Asphalt Base | 5.5 inches |
| Graded Aggregate Subbase | 6.0 |

Table 4.5.2-3: Hardstand Rigid Concrete Section

| Jointed Reinforced Concrete Pavement (JRCP)* | |
|---|---|
| Concrete Flexural Strength (psi) | 650 |
| Concrete Thickness, T (inches) | 7.0 |
| Minimum Percent Steel Reinforcement Required | 0.1 (WWF placed at mid-depth of the concrete) |
| Dowel Requirements | 1-inch diameter smooth dowel along transverse joints, 18-inch length, 12-inch O.C., placed at mid-height of concrete |
| Graded Aggregate Subbase (inches) | 6.0 |

* A maximum 17.5 feet transverse joint spacing is recommended, with sawcut depths at T/3 (2.3 inches).

## 4.6 Earthwork

Fill may be required for site grading in building and pavement areas, and as backfill against walls below grade. Unsuitable existing fill, soft or loose natural soils, organic material, and rubble should be stripped to approved subgrades as determined by the geotechnical engineer. All subgrades should be proofrolled with a minimum 20 ton, loaded dump truck or suitable rubber tire construction equipment approved by the geotechnical engineer, prior to the placement of new fill.

Fill material should be placed in lifts not exceeding 8 inches loose thickness, with fill materials compacted by hand operated tampers or light compaction equipment placed in maximum 4-inch thick loose lifts. Fill should be compacted at +/- 2% of the optimum moisture content to at least 95 percent of the maximum dry density per ASTM D698. The upper 6 inches of pavement subgrades should be compacted to at least 100 percent of the maximum dry density per the same standard.

Materials used for compacted fill should consist of soils classifying SC, SM, SP, SW, GC, GM, GP, or GW per ASTM D2487, with a maximum dry density greater than 105 pcf. Materials used for backfill against walls below grade should consist of soils classifying SM, SP, SW, GM, GP, or GW, with a liquid limit and plasticity index less than 40 and 15, respectively. It is expected that portions of soils excavated at the site will be suitable for re-use as fill based on classification. However, the Stratum A existing fill may not be suitable for re-use as new compacted fill due to deleterious man-made materials in the fill. In addition, drying of excavated soils by spreading and aerating may be necessary to obtain proper compaction. This may not be practical during the wet period of the year. Accordingly, earthwork operations should be planned for early spring through late fall, when drier weather conditions can be expected. Individual borrow areas, both from

on-site and off-site sources, should be sampled and tested to verify classification of materials prior to their use as fill.
Fill materials should not be placed on frozen or frost-heaved soils, and/or soils that have been recently subjected to precipitation. All frozen or frost-heaved soils should be removed prior to continuation of fill operations. Borrow fill materials should not contain frozen materials at the time of placement.

Compaction equipment that is compatible with the soil type used for fill should be selected. Theoretically, any equipment type can be used as long as the required density is achieved; however, sheepsfoot roller equipment are best suited for fine-grained soils and vibratory smooth drum rollers are best suited for granular soils. Ideally, a smooth drum roller should be used for sealing the surface soils at the end of the day or prior to upcoming rain events. In addition, compaction equipment used adjacent to walls below grade should be selected so as to not impose undesirable surcharge on walls. All areas receiving fill should be graded to facilitate positive drainage of any water associated with precipitation and surface run-off.

For utility excavation backfill, we recommend that open graded stone be used to backfill the pipe trench to the spring line of the pipe. Backfill should be compacted in lifts not exceeding 6 inches loose thickness, to at least 95 percent of the maximum dry density per ASTM D698. Hand operated compaction equipment should be used until the backfill has reached a level 1 foot above the top of the pipe to prevent damaging the pipe. Also, backfill material within 2 feet of the top of the pipe should not contain rock fragments or gravel greater than 1-inch in diameter.

After completion of compacted fill operations in building or pavement areas, construction of building elements or asphalt should begin immediately, or the finished subgrade should be protected from exposure to inclement weather conditions. Exposure to precipitation and freeze/thaw cycles will cause the finished subgrade to soften and become excessively disturbed. If development plans require that finished subgrades remain exposed to weather conditions after completion of fill operations, additional fill should be placed above finished grades to protect the newly placed fill. Alternatively, a budget should be established for reworking of the upper 1 to 2 feet of previously placed compacted fill.

# 5.0 General Limitations

Recommendations contained in this report are based upon the data obtained from the relatively limited number of test borings. This report does not reflect conditions that may occur between the points investigated, or between sampling intervals in test borings. The nature and extent of variations between test borings and sampling intervals may not become evident until the course of construction. Therefore, it is essential that on-site observations of subgrade conditions be performed during the construction period to determine if re-evaluation of the recommendations in this report must be made. It is critical to the successful completion of this project that GeoConcepts be retained during construction to observe the implementation of the recommendations provided herein.

This report has been prepared to aid in the evaluation of the site and to assist your office and the design professionals in the design of this project. It is intended for use with regard to the specific project as described herein. Changes in proposed construction, grading plans, structural loads, etc. should be brought to our attention so that we may determine any effect on the recommendations presented herein.

An allowance should be established for additional costs that may be required for foundation and earthwork construction as recommended in this report. Additional costs may be incurred for various reasons including wet fill materials, soft subgrade conditions, unexpected groundwater problems, etc.

This report should be made available to bidders prior to submitting their proposals to supply them with facts relative to the subsurface conditions revealed by our investigation and the results of analyses and studies that have been performed for this project. In addition, this report should be given to the successful contractor and subcontractors for their information only.

We recommend the project specifications contain the following statement: "A geotechnical engineering report has been prepared for this project by GeoConcepts Engineering, Inc. This report is for informational purposes only and should not be considered part of the contract documents. The opinions expressed in this report are those of the geotechnical engineer and represent their interpretation of the subsoil conditions, tests and results of analyses that they performed. Should the data contained in this report not be adequate for the contractor's purposes, the contractor may make their own investigations, tests and analyses prior to bidding."

This report was prepared in accordance with generally accepted geotechnical engineering practices. No warranties, expressed or implied, are made as to the professional services included in this report.

We appreciate the opportunity to be of service for this project. Please contact the undersigned if you require clarification of any aspect of this report.

Sincerely,

GEOCONCEPTS ENGINEERING, INC.

Rebecca L. Smith-Zakowicz, PG
Senior Associate

Paul E. Burkart, PE
Senior Principal

STATE OF MARYLAND
PAUL E. BURKART
No. 17355
PROFESSIONAL ENGINEER

DJA/RSZ/PEB/shm
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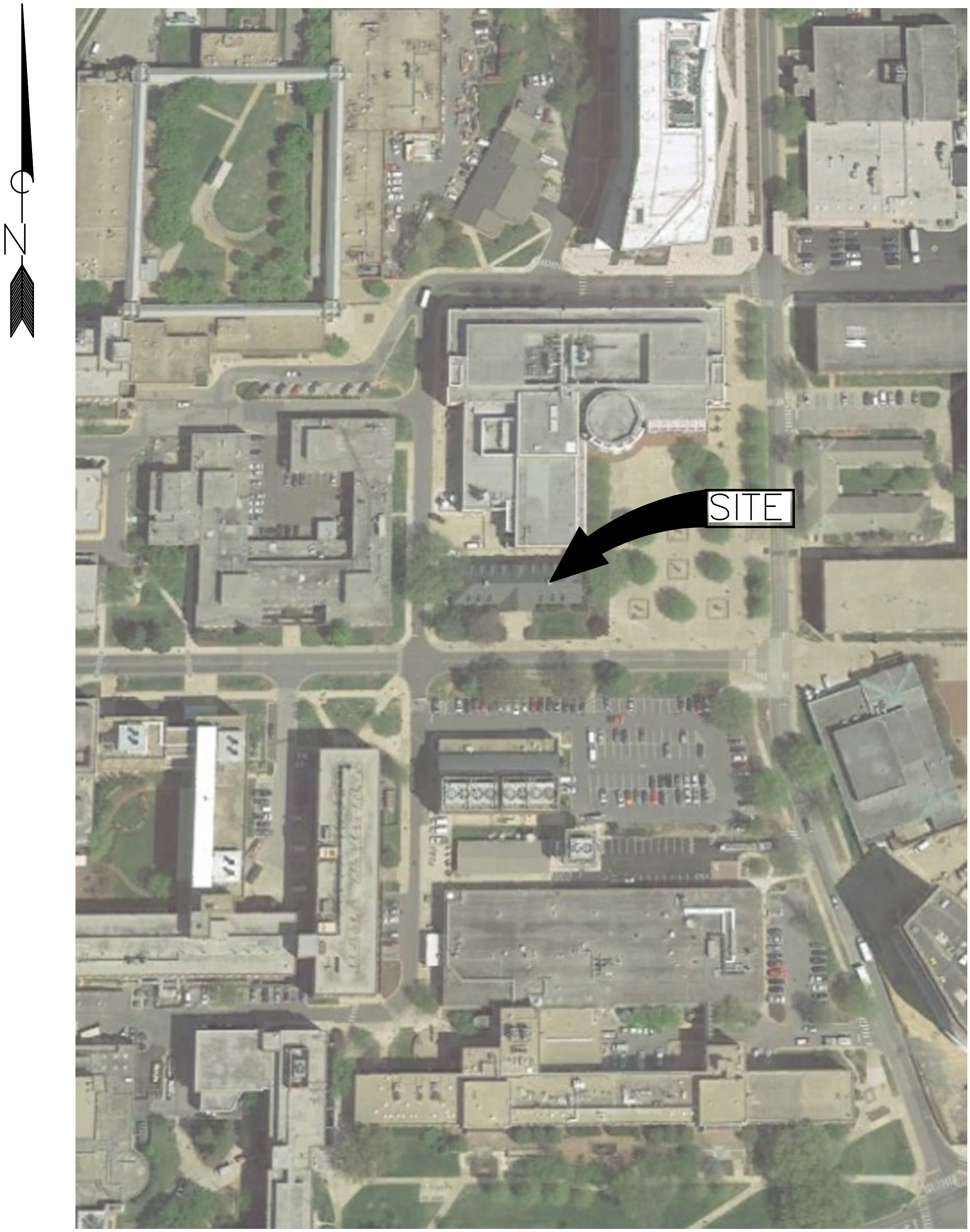




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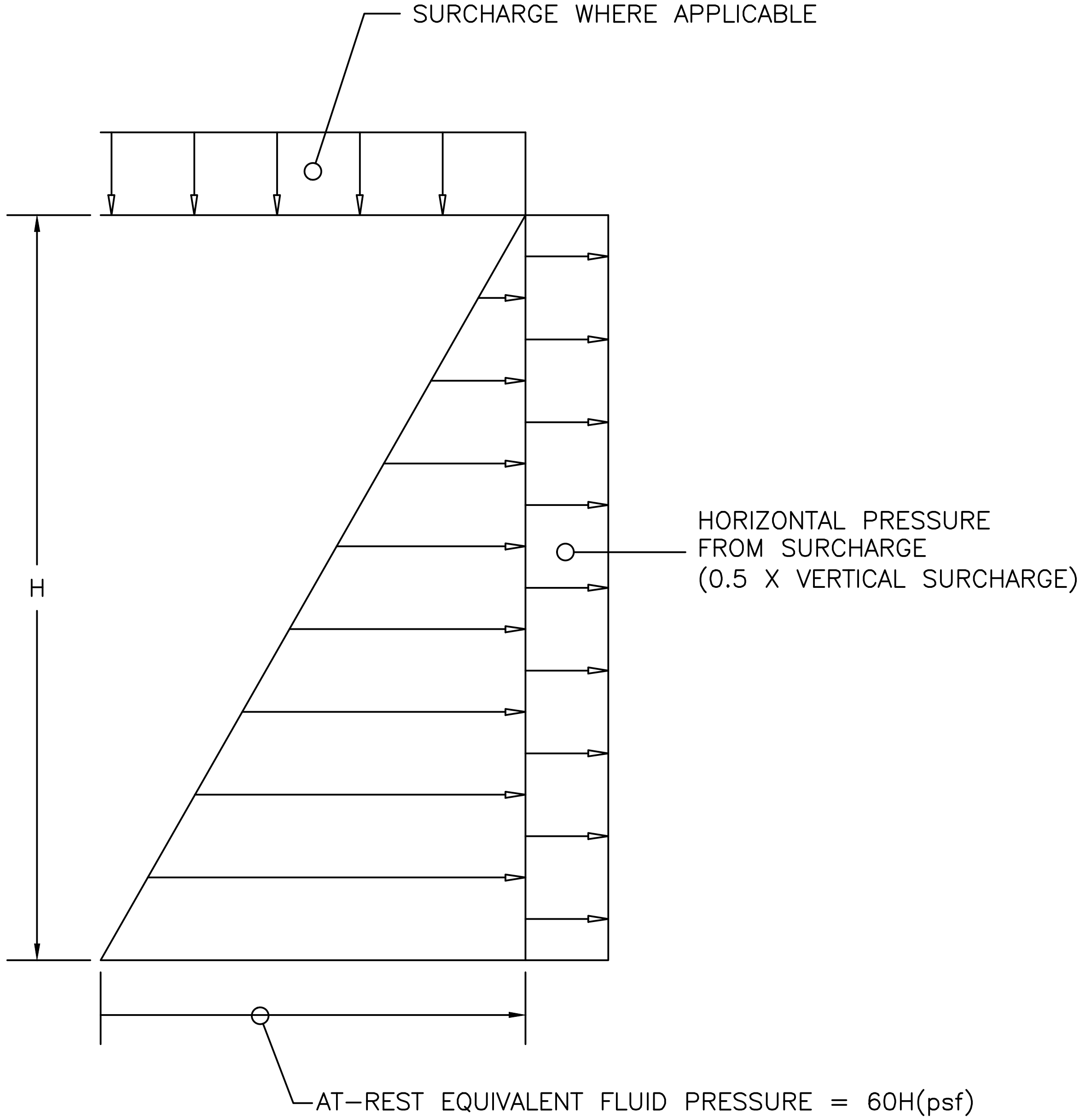
| | | | | | |
|---|---|---|---|---|---|
| SITE VICINITY MAP | | | | Scale: N.T.S. | Fig. 1 |
| Date: DEC 2018 | Drawn By: D.J.A | Checked By: P.E.B | | Project No.: JD185262 | |




NOTES:
1) PRESSURE DIAGRAM SHOWN ASSUMES HORIZONTAL GROUND BEHIND WALL AND FULL DRAINAGE OF HYDROSTATIC PRESSURES (SEE FIGURE 3 SUBDRAINAGE DESIGN RECOMMENDATIONS).
2) BACKFILL SHOULD CONSIST OF MATERIAL CLASSIFIED AS SM, SP, SW, GM, GP, OR GW PER ASTM D-2487. THE LIQUID LIMIT AND PLASTICITY INDEX OF BACKFILL MATERIAL SHOULD NOT EXCEED 40 AND 15, RESPECTIVELY.

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DESIGN EARTH PRESSURES FOR BASEMENT WALLS

| Scale: | Fig. |
|---|---|
| N.T.S. | 2 |

| Date: | Drawn By: | Checked By: | Project No.: |
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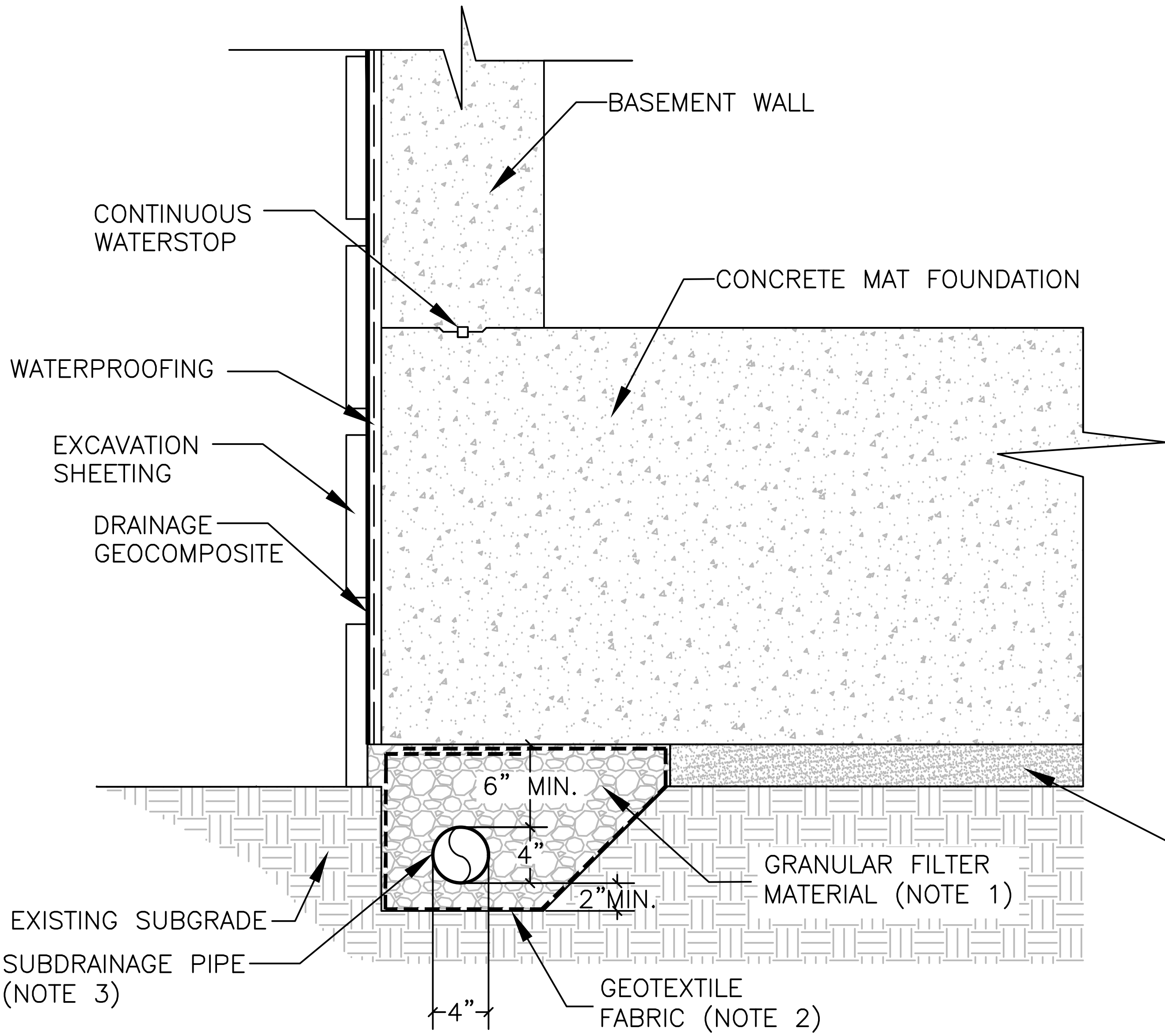
| DEC 2018 | D.J.A | P.E.B | JD185262 |




NOTES:

1) FILTER MATERIAL SHALL SATISFY REQUIREMENTS FOR AASHTO SIZE NO. 7.

2) PERMEABLE GEOTEXTILE FABRIC SHOULD HAVE EQUIVALENT OPENING SIZE NOT GREATER THAN THE NO. 70 U.S. STANDARD SIEVE SIZE.

3) SUBDRAINAGE PIPING SHALL BE 4 INCH DIAMETER SLOTTED CORRUGATED POLYETHYLENE (PE) TUBING ACCORDING TO ASTM F–405 WITH MAXIMUM 1/8 INCH SLOT WIDTH.

4) SUBDRAINAGE SHOULD BE SPACED AT 25 FEET ON CENTER UNDER THE MAT FOUNDATION, AND BE COLLECTED IN A SUMP FOR DISPOSAL.

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| | | | |
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| MAT FOUNDATION SUBDRAINAGE<br>DESIGN RECOMMENDATIONS | | Scale: N.T.S. | Fig. 3 |
| Date: DEC 2018 | Drawn By: D.J.A | Checked By: P.E.B | Project No.: JD185262 |

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# Appendix A
# Subsurface Investigation

# Subsurface Investigation Procedures

## 1. Test Borings – Hollow Stem Augers

The borings are advanced by turning an auger with a center opening of 2-¼ inches. A plug device blocks off the center opening while augers are advanced. Cuttings are brought to the surface by the auger flights. Sampling is performed through the center opening in the hollow stem auger, by standard methods, after removal of the plug. Usually, no water is introduced into the boring using this procedure.

## 2. Standard Penetration Tests

Standard penetration tests are performed by driving a 2-inch O.D., 1-⅜ inch I.D. sampling spoon with a 140-pound hammer falling 30 inches, according to ASTM D1586. After an initial 6 inches penetration to assure the sampling spoon is in undisturbed material, the number of blows required to drive the sampler an additional 12 inches is generally taken as the N value. In the event 30 or more blows are required to drive the sampling spoon the initial 6-inch interval, the sampling spoon is driven to a total penetration resistance of 100 blows or 18 inches, whichever occurs first.

## 3. Test Boring Stakeout

The test boring stakeout was provided by GeoConcepts personnel using available site plans. Ground surface elevations were estimated from publicly available topographic maps and should be considered approximate. If the risk related to using approximate boring locations and elevations is unacceptable, we recommend an as-drilled survey of boring locations and elevations be completed by a licensed surveyor.

# Identification of Soil

## I. DEFINITION OF SOIL GROUP NAMES

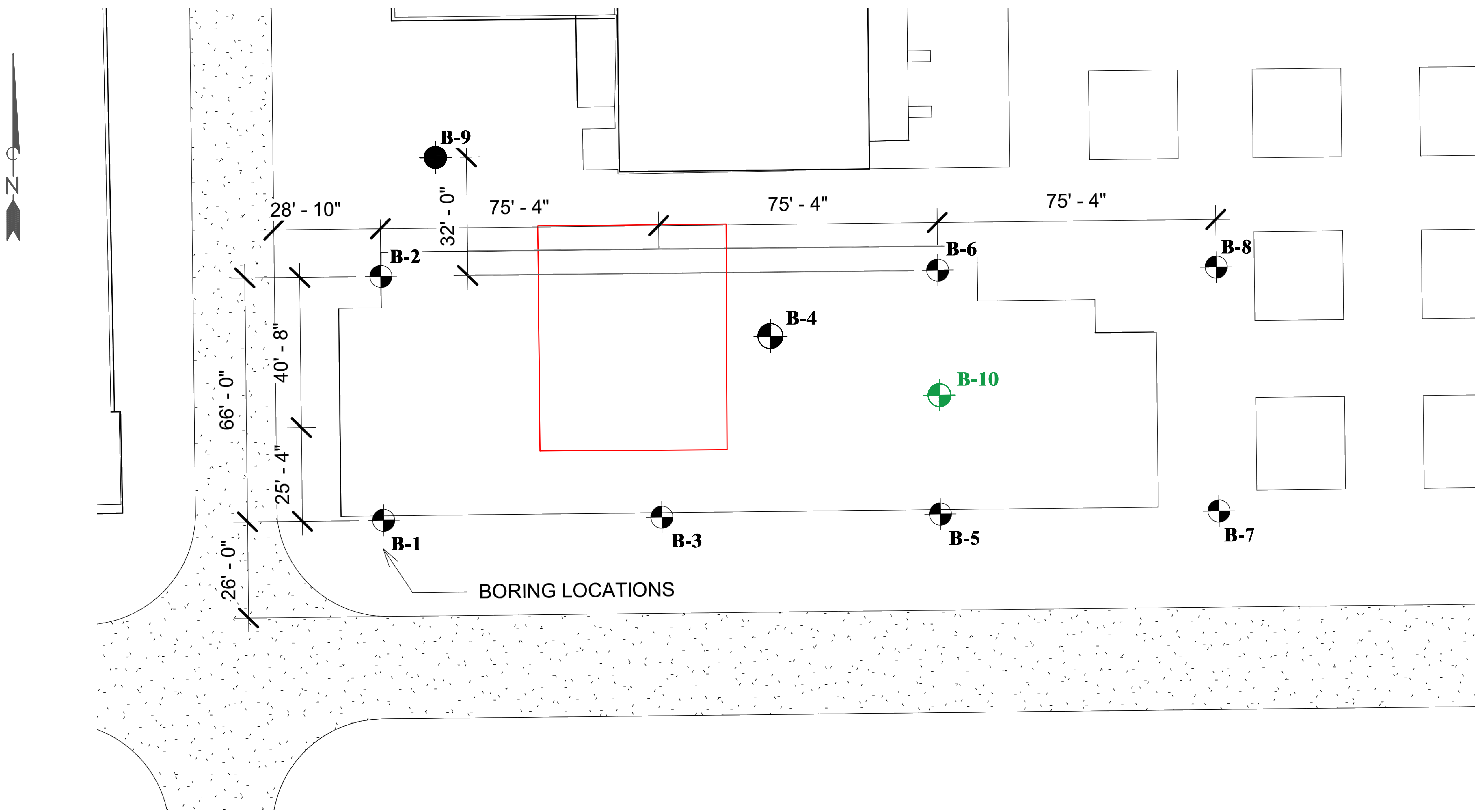
| | | ASTM D2487 | Symbol | Group Name |
|---|---|---|---|---|
| Coarse-Grained Soils More than 50% retained on No. 200 sieve | Gravels More than 50% of coarse fraction retained on No. 4 sieve | Clean Gravels Less than 5% fines | *GW* | WELL GRADED GRAVEL |
| | | | *GP* | POORLY GRADED GRAVEL |
| | | Gravels with Fines More than 12% fines | *GM* | SILTY GRAVEL |
| | | | *GC* | CLAYEY GRAVEL |
| | Sands 50% or more of coarse fraction passes No. 4 sieve | Clean Sands Less than 5% fines | *SW* | WELL GRADED SAND |
| | | | *SP* | POORLY GRADED SAND |
| | | Sands with fines More than 12% fines | *SM* | SILTY SAND |
| | | | *SC* | CLAYEY SAND |
| Fine-Grained Soils 50% or more passes the No. 200 sieve | Silts and Clays Liquid Limit less than 50 | Inorganic | *CL* | LEAN CLAY |
| | | | *ML* | SILT |
| | | Organic | *OL* | ORGANIC CLAY |
| | | | | ORGANIC SILT |
| | Silts and Clays Liquid Limit 50 or more | Inorganic | *CH* | FAT CLAY |
| | | | *MH* | ELASTIC SILT |
| | | Organic | *OH* | ORGANIC CLAY |
| | | | | ORGANIC SILT |
| Highly Organic Soils | Primarily organic matter, dark in color, and organic odor | | *PT* | PEAT |

## II. DEFINITION OF MINOR COMPONENT PROPORTIONS

| Minor Component | Approximate Percentage of Fraction by Weight |
|---|---|
| Gravelly, Sandy (adjective) | 30% or more coarse grained |
| Sand, Gravel | 15% to 29% coarse grained |
| Silt, Clay | 5% to 12% fine grained |

## III. GLOSSARY OF MISCELLANEOUS TERMS

| | |
|---|---|
| SYMBOLS | Unified Soil Classification Symbols are shown above as group symbols. Use "A" Line Chart for laboratory identification. Dual symbols are used for borderline classification. |
| BOULDERS & COBBLES | Boulders are considered pieces of rock larger than 12 inches, while cobbles range from 3 to 12 inches. |
| WEATHERED ROCK | Residual rock material with a standard penetration test (SPT) resistance of at least 50 blows per 6 inches. |
| ROCK/SPOON REFUSAL | Rock material with a standard penetration test (SPT) resistance of 50 blows for 1 inch. |
| ROCK FRAGMENTS | Angular pieces of rock which have separated from original vein or strata and are present in a soil matrix. Only used in residual soils |
| QUARTZ | A hard silicate mineral often found in residual soils. Only used when describing residual soils. |
| CEMENTED SAND | Usually localized rock-like deposits within a soil stratum composed of sand grains cemented by calcium carbonate, iron oxide, or other minerals. Commonly encountered in Coastal Plain sediments, primarily in the Potomac Group sands (Kps). |
| MICACEOUS | A term used to describe soil that "glitters" or is shiny. Most commonly encountered in fine-grained soils. |
| ORGANIC MATERIALS (Excluding Peat) | Topsoil - Surface soils that support plant life and contain organic matter.<br>Lignite - Hard, brittle decomposed organic matter with low fixed carbon content (a low grade of coal). |
| FILL | Man-made deposit containing soil, rock, and other foreign matter. |
| CONTAINS | This is used when a soil contains a secondary component that does not apply to a USCS classification. |
| WITH | This is used when a residual soil contains a secondary component that is included in the USCS classification. |
| PROBABLE FILL | Soils which contain no visually detected foreign matter but which are suspect with regard to origin. |
| LAYERS | ½ to 12 inch seam of minor soil component. |
| COLOR | Two most predominant colors present should be described. |
| MOISTURE CONDITIONS | Wet, moist, or dry to indicate visual appearance of specimen. |
| GRAIN SIZE | Fine-medium-coarse |




NOTE: BASE PLAN PROVIDED BY EYP DATED OCTOBER 2018.

GRAPHICAL SCALE

30' 0 30' 60'

L E G E N D

| | | | |
|---|---|---|---|
| B-1 | TEST BORING LOCATION | B-9 | PAVEMENT CORE LOCATION |
| B-10 | AUGER PROBE FOR VIBRATION MONITORING BY OTHERS | | APPROXIMATE BOUNDARY OF EXISTING BASEMENT |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UNIVERSITY OF MARYLAND IDEA FACTORY
UNIVERSITY OF MARYLAND, COLLEGE PARK

BORING LOCATION PLAN

| | | | | | |
|---|---|---|---|---|---|
| Date: DEC. 2018 | Drawn By: R.K.S. | Checked By: P.E.B | Scale: AS SHOWN | Project No.: JD185262 | Fig. 4 |

n:\projects\2018\jd185262\working files\diagrams-drawings-figures\blp\alt blp.dwg

# Test Boring Notes

1. Classification of soil is by visual inspection and is in accordance with the Unified Soil Classification System.

2. Estimated groundwater levels are indicated on the logs. These are only estimates from available data and may vary with precipitation, porosity of soil, site topography, etc.

3. Sampling data presents standard penetrations for 6-inch intervals or as indicated with graphic representations adjacent to the sampling data.

4. The energy applied to the split-spoon sampler using the automatic hammer is about 33 percent greater than the applied energy using the standard safety hammer. The hammer blows shown on the boring logs are uncorrected for the higher energy.

5. The logs and related information depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at the test locations. Also, the passage of time may result in a change in the subsurface conditions at the test locations.

6. The stratification lines represent the approximate boundary between soil types as determined in the sampling operation. Some variation may be expected vertically between samples taken. The soil profile, groundwater level observations and penetration resistances presented on the logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.

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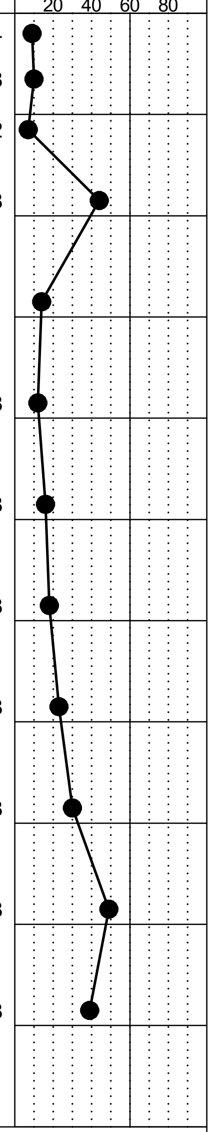
| PROJECT: UMD IDEA Factory | | LOGGED BY: D. Corum | | BORING NUMBER: B-1 |
|---|---|---|---|---|
| LOCATION: College Park, Prince George's County, Maryland | | DRILLING CONTRACTOR: J. Labas | | SHEET 1 OF 1 |
| OWNER/CLIENT: University of Maryland | | DRILLER: Terracon | DATES DRILLED: 11/19/18 - 11/19/18 | |
| PROJECT NUMBER: JD185262 | GROUND SURFACE ELEVATION (ft.): 76.0 ± | DRILLING METHOD: 2-1/4" HSA; Automatic Hammer | DRILL RIG: Track Diedrich D50 | |

| ELEV. (ft.) | DEPTH (ft.) | SAMPLE TYPE | STRATUM | MATERIAL DESCRIPTION | SPT BLOW COUNTS | REC (in) |
|---|---|---|---|---|---|---|
| 76.0 | 0 | SPT | A | 6-inches TOPSOIL | 2+4+5+16 | 24 |
| 75.5 | 0.5 | | | *Fill*, brown, SILTY SAND, medium dense, moist, **SM** | | |
| 73.5 | 2.5 | SPT | B2 | *Alluvial*, light brown, POORLY GRADED SAND WITH GRAVEL, medium dense, moist, **SP** | 2+5+5 | 18 |
| 71.0 | 5 | SPT | | Loose | 1+3+4 | 12 |
| 67.5 | 8.5 | SPT | B1 | *Alluvial*, SANDY LEAN CLAY, hard, moist, **CL** | 4+16+28 | 18 |
| 62.5 | 13.5 | SPT | | Very stiff | 9+5+9 | 0 |
| 57.5 | 18.5 | SPT | | Blue-gray | 4+5+7 | 18 |
| 52.5 | 23.5 | SPT | C | *Potomac group*, gray, SANDY LEAN CLAY, very stiff, moist, **CL** | 4+6+10 | 18 |
| | 28.5 | SPT | | | 6+7+11 | 18 |
| 42.5 | 33.5 | SPT | | Mottled red-gray | 7+10+13 | 18 |
| 37.5 | 38.5 | SPT | | Gray, hard | 8+13+17 | 18 |
| 32.5 | 43.5 | SPT | | Gray brown, very hard | 12+20+29 | 18 |
| 27.5 | 48.5 | SPT | | Hard | 11+15+24 | 18 |
| 26.0 | 50 | | | Bottom of Borehole at 50.0 ft. | | |

SOIL — STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80



GROUND WATER LEVELS:

NOT ENCOUNTERED DURING DRILLING

NOT ENCOUNTERED UPON COMPLETION

▼ 11/20/2018 20.0 ft. ELEV. 56.0

SAMPLE TYPES:

☒ SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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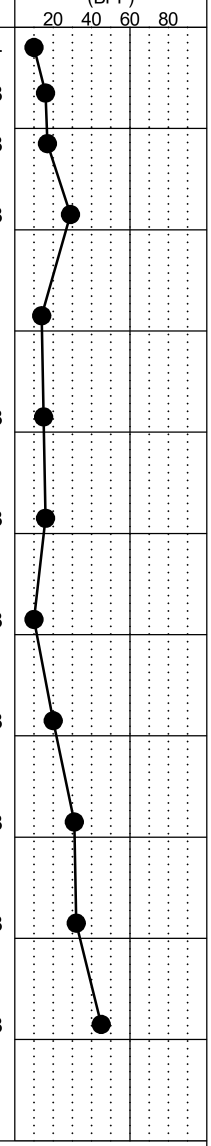
| | | |
|---|---|---|
| PROJECT: **UMD IDEA Factory** | LOGGED BY: **D. Corum** | BORING NUMBER: **B-2** SHEET 1 OF 1 |
| LOCATION: **College Park, Prince George's County, Maryland** | DRILLING CONTRACTOR: **J. Labas** | |
| OWNER/CLIENT: **University of Maryland** | DRILLER: **Terracon** | DATES DRILLED: **11/19/18 - 11/19/18** |
| PROJECT NUMBER: **JD185262** / GROUND SURFACE ELEVATION (ft.): **76.0 ±** | DRILLING METHOD: **2-1/4" HSA; Automatic Hammer** | DRILL RIG: **Track Diedrich D50** |

| ELEV. (ft.) | DEPTH (ft.) | SAMPLE TYPE | STRATUM | MATERIAL DESCRIPTION | SPT BLOW COUNTS | REC (in) |
|---|---|---|---|---|---|---|
| 76.0<br>75.5<br>74.0 | | SPT | A | 6-inches TOPSOIL<br>*Fill*, brown, SILTY SAND, medium dense, moist, **SM**<br>*Alluvial*, brown, SILTY SAND, medium dense, moist, **SM** | 1+4+6+9 | 24 |
| | | SPT | | | 5+7+9 | 18 |
| | 5 | SPT | | | 6+8+9 | 18 |
| 67.5 | 10 | SPT | B2 | *Alluvial*, orange, POORLY GRADED SAND WITH GRAVEL, medium dense, moist, contains quartz fragments, **SP** | 11+17+12 | 18 |
| | 15 | SPT | | | 5+7+7 | 0 |
| 57.5 | 20 | SPT | B1 | *Alluvial*, gray, SANDY LEAN CLAY, very stiff, moist, **CL** | 5+8+7 | 18 |
| 52.5 | 25 | SPT | C | *Potomac group*, gray, SANDY LEAN CLAY, very stiff, moist, **CL** | 5+6+10 | 18 |
| 47.5 | 30 | SPT | | *Potomac group*, gray, FAT CLAY, stiff, moist, **CH** | 4+5+5 | 18 |
| 42.5 | 35 | SPT | | *Potomac group*, mottled red-gray, LEAN CLAY, very stiff, moist, **CL** | 4+8+12 | 18 |
| 37.5 | 40 | SPT | | Gray and red, hard | 8+13+18 | 18 |
| 32.5 | 45 | SPT | | *Potomac group*, gray, SANDY SILT, hard, moist, **ML** | 6+14+18 | 18 |
| 27.5 | | SPT | | Brown and red, very hard | 14+20+25 | 18 |
| 26.0 | 50 | | | Bottom of Borehole at 50.0 ft. | | |

SOIL — STANDARD PENETRATION TEST RESISTANCE (BPF)




GROUND WATER LEVELS:

| | | | | |
|---|---|---|---|---|
| ENCOUNTERED: | 18.5 ft. | ELEV. 57.5 | | |
| UPON COMPLETION: | 29.0 ft. | ELEV. 47.0 | CAVED: 38.0 ft. | ELEV. 38.0 |
| 11/20/2018 | 12.0 ft. | ELEV. 64.0 | | |

SAMPLE TYPES: SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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| PROJECT: UMD IDEA Factory | LOGGED BY: D. Corum | BORING NUMBER: **B-3** |
|---|---|---|
| LOCATION: College Park, Prince George's County, Maryland | DRILLING CONTRACTOR: J. Labas | SHEET 1 OF 1 |
| OWNER/CLIENT: University of Maryland | DRILLER: Terracon | DATES DRILLED: 11/20/18 - 11/20/18 |
| PROJECT NUMBER: JD185262 / GROUND SURFACE ELEVATION (ft.): 76.0 ± | DRILLING METHOD: 2-1/4" HSA; Automatic Hammer | DRILL RIG: Track Diedrich D50 |

| ELEV. (ft.) | DEPTH (ft.) | SAMPLE TYPE | STRATUM | MATERIAL DESCRIPTION | SPT BLOW COUNTS | REC (in) |
|---|---|---|---|---|---|---|
| 76.0 / 74.0 | | SPT | A | *Fill*, brown and orange, SILTY SAND, contains construction debris, medium dense, moist, **SM** | 2+2+2+4 | 6 |
| | | SPT | A | | 2+5+5 | 12 |
| | 5 | SPT | A | | 3+4+4 | 12 |
| 67.5 | 10 | SPT | A | Contains construction debris, loose | 2+2+2 | 18 |
| 62.5 | 15 | SPT | B1 | *Alluvial*, mottled red-brown, SANDY LEAN CLAY, very stiff, moist, **CL** | 4+7+8 | 18 |
| 57.5 | 20 | SPT | B2 | *Alluvial*, light brown, CLAYEY SAND, medium dense, moist, **SC** | 4+4+7 | 18 |
| 52.5 | 25 | SPT | C | *Potomac group*, gray, FAT CLAY, very stiff, moist, **CH** | 4+6+9 | 18 |
| | 30 | SPT | C | | 4+9+8 | 18 |
| 42.5 | 35 | SPT | C | *Potomac group*, mottled purple-gray, SANDY LEAN CLAY, very stiff, moist, **CL** | 4+7+7 | 18 |
| 37.5 | 40 | SPT | C | Light brown and red, hard | 8+11+15 | 18 |
| 32.5 | 45 | SPT | C | Gray | 7+14+20 | 18 |
| 27.5 | 50 | SPT | C | Gray and red, hard | 8+13+14 | 18 |
| 26.0 | | | | Bottom of Borehole at 50.0 ft. | | |

SOIL — STANDARD PENETRATION TEST RESISTANCE (BPF): 20 40 60 80

GROUND WATER LEVELS:

ENCOUNTERED: 24.0 ft. ELEV. 52.0

NOT ENCOUNTERED UPON COMPLETION — CAVED: 28.0 ft. ELEV. 48.0

11/21/2018 24.0 ft. ELEV. 52.0

SAMPLE TYPES: SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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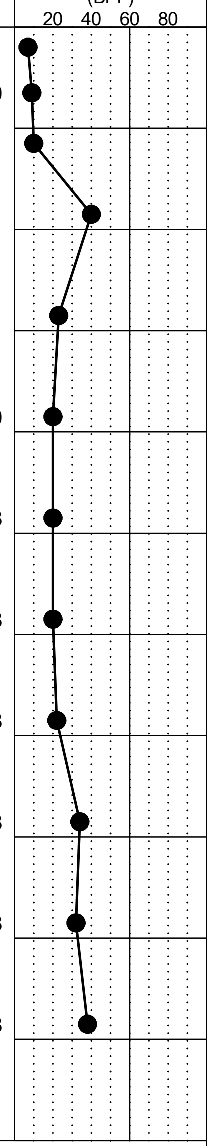
| | | |
|---|---|---|
| PROJECT: **UMD IDEA Factory** | LOGGED BY: **D. Corum** | BORING NUMBER: **B-4** |
| LOCATION: **College Park, Prince George's County, Maryland** | DRILLING CONTRACTOR: **J. Labas** | SHEET 1 OF 1 |
| OWNER/CLIENT: **University of Maryland** | DRILLER: **Terracon** | DATES DRILLED: **11/20/18 - 11/20/18** |
| PROJECT NUMBER: **JD185262** / GROUND SURFACE ELEVATION (ft.): **76.0 ±** | DRILLING METHOD: **2-1/4" HSA; Automatic Hammer** | DRILL RIG: **Track Diedrich D50** |

| ELEV. (ft.) | DEPTH (ft.) | SAMPLE TYPE | STRATUM | MATERIAL DESCRIPTION | SPT BLOW COUNTS | REC (in) |
|---|---|---|---|---|---|---|
| 76.0 | | SPT | | 1-inch TOPSOIL | 2+3+4+3 | 6 |
| 75.9 | | | A | *Fill*, light brown, SILTY SAND, loose, moist, **SM** | | |
| 73.5 | | SPT | | Contains gravel, medium dense | 2+4+5 | 10 |
| 71.0 | 5 | SPT | | *Alluvial*, light brown, CLAYEY SAND, medium dense, moist, **SC** | 4+4+6 | 8 |
| 67.5 | 10 | SPT | | *Alluvial*, light brown, POORLY GRADED SAND WITH GRAVEL, very dense, moist, contains quartz fragments, **SP** | 12+23+17 | 6 |
| 62.5 | 15 | SPT | B2 | Dense | 7+11+12 | 3 |
| 57.5 | 20 | SPT | | *Alluvial*, gray, CLAYEY SAND, medium dense, moist, **SC** | 4+8+12 | 10 |
| 52.5 | 25 | SPT | | *Potomac group*, gray, FAT CLAY, very stiff, moist, **CH** | 8+9+11 | 18 |
| 47.5 | 30 | SPT | | Mottled red-gray | 7+8+12 | 18 |
| 42.5 | 35 | SPT | C | *Potomac group*, mottled red-gray, LEAN CLAY, very stiff, moist, **CL** | 5+10+12 | 18 |
| 37.5 | 40 | SPT | | Gray and red, hard | 12+16+18 | 18 |
| 32.5 | 45 | SPT | | *Potomac group*, gray, SANDY SILT, hard, moist, **ML** | 7+11+21 | 18 |
| 27.5 | | SPT | | *Potomac group*, dark brown, SANDY LEAN CLAY, hard, moist, **CL** | 9+13+25 | 18 |
| 26.0 | 50 | | | Bottom of Borehole at 50.0 ft. | | |

SOIL — STANDARD PENETRATION TEST RESISTANCE (BPF)




GROUND WATER LEVELS:

NOT ENCOUNTERED DURING DRILLING

NOT ENCOUNTERED UPON COMPLETION — CAVED: 27.0 ft. ELEV. 49.0

11/21/2018: NOT ENCOUNTERED

SAMPLE TYPES: SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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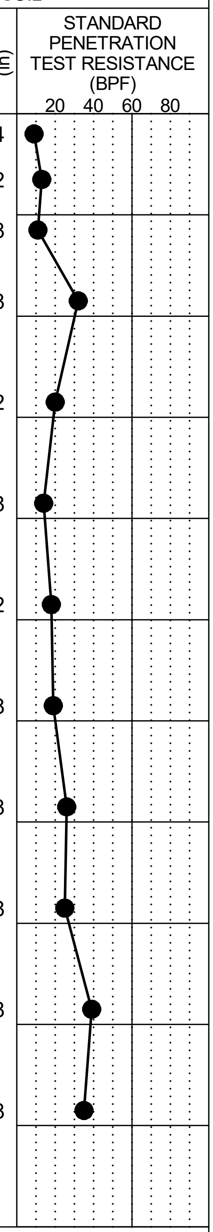
| PROJECT: UMD IDEA Factory | LOGGED BY: D. Corum | BORING NUMBER: B-5 |
|---|---|---|
| LOCATION: College Park, Prince George's County, Maryland | DRILLING CONTRACTOR: J. Labas | SHEET 1 OF 1 |
| OWNER/CLIENT: University of Maryland | DRILLER: Terracon | DATES DRILLED: 11/20/18 - 11/20/18 |
| PROJECT NUMBER: JD185262 / GROUND SURFACE ELEVATION (ft.): 74.0 ± | DRILLING METHOD: 2-1/4" HSA; Automatic Hammer | DRILL RIG: Track Diedrich D50 |

| ELEV. (ft.) | DEPTH (ft.) | SAMPLE TYPE | STRATUM | MATERIAL DESCRIPTION | SOIL: SPT BLOW COUNTS | REC (in) |
|---|---|---|---|---|---|---|
| 74.0 | 0 | SPT | A | 3-inches TOPSOIL | 4+3+6+5 | 24 |
| 73.8 | | | | *Fill*, dark brown, SILTY SAND, medium dense, moist, **SM** | | |
| 71.5 | | SPT | B2 | *Alluvial*, light brown, SILTY SAND, medium dense, moist, **SM** | 6+6+7 | 12 |
| | 5 | SPT | | | 6+6+5 | 18 |
| 65.5 | | SPT | | *Alluvial*, light brown, POORLY GRADED SAND WITH GRAVEL, dense, moist, **SP** | 17+16+16 | 18 |
| 60.5 | 15 | SPT | B1 | *Alluvial*, gray, SANDY LEAN CLAY, very stiff, moist, **CL** | 6+9+11 | 12 |
| 55.5 | 20 | SPT | | Brown, very stiff | 4+6+8 | 18 |
| 50.5 | 25 | SPT | C | *Potomac group*, gray and brown, SANDY LEAN CLAY, very stiff, moist, **CL** | 6+8+10 | 12 |
| 45.5 | 30 | SPT | | Dark gray | 5+8+11 | 18 |
| 40.5 | 35 | SPT | | *Potomac group*, gray, SANDY LEAN CLAY, hard, moist, **CL** | 7+10+16 | 18 |
| 35.5 | 40 | SPT | | Gray and red | 8+11+14 | 18 |
| 30.5 | 45 | SPT | | *Potomac group*, gray, SANDY SILT, hard, moist, **ML** | 8+18+21 | 18 |
| 25.5 | | SPT | | *Potomac group*, dark brown, LEAN CLAY, hard, moist, **CL** | 11+13+22 | 18 |
| 24.0 | 50 | | | Bottom of Borehole at 50.0 ft. | | |

STANDARD PENETRATION TEST RESISTANCE (BPF)




GROUND WATER LEVELS:

NOT ENCOUNTERED DURING DRILLING

NOT ENCOUNTERED UPON COMPLETION

11/21/2018: NOT ENCOUNTERED

SAMPLE TYPES:

☒ SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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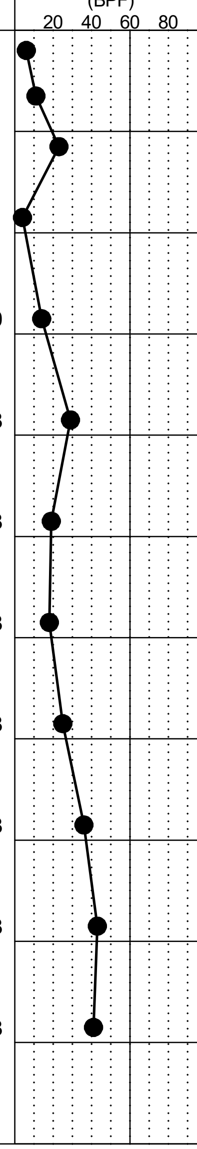
| | | | |
|---|---|---|---|
| PROJECT: **UMD IDEA Factory** | | LOGGED BY: **D. Corum** | BORING NUMBER: **B-6** SHEET 1 OF 1 |
| LOCATION: **College Park, Prince George's County, Maryland** | | DRILLING CONTRACTOR: **J. Labas** | |
| OWNER/CLIENT: **University of Maryland** | | DRILLER: **Terracon** | DATES DRILLED: **11/20/18 - 11/20/18** |
| PROJECT NUMBER: **JD185262** | GROUND SURFACE ELEVATION (ft.): **75.0 ±** | DRILLING METHOD: **2-1/4" HSA; Automatic Hammer** | DRILL RIG: **Track Diedrich D50** |

| ELEV. (ft.) | DEPTH (ft.) | SAMPLE TYPE | STRATUM | MATERIAL DESCRIPTION | SPT BLOW COUNTS | REC (in) | MC (%) |
|---|---|---|---|---|---|---|---|
| 75.0 / 74.8 | | SPT | A | *Topsoil*, 2-inches TOPSOIL<br>*Fill*, orange, CLAYEY SAND WITH GRAVEL, loose, moist, **SC** | 2+2+4+4 | 6 | 11.5 |
| 72.5 | | SPT | B1 | *Alluvial*, red and brown, SANDY SILT, stiff, moist, **ML** | 5+5+6 | 3 | 16.8 |
| 70.0 | 5 | SPT | | Very stiff | 10+12+11 | 0 | |
| 66.5 | 10 | SPT | | *Alluvial*, dark gray, SILTY CLAY WITH SAND, firm, moist, **CL-ML** | 1+2+2 | 8 | 24.4 |
| 61.5 | 15 | SPT | B2 | *Alluvial*, light brown, POORLY GRADED GRAVEL WITH SAND, medium dense, moist, **GP** | 6+7+7 | 10 | 7.4 |
| 56.5 | 20 | SPT | B1 | *Alluvial*, dark gray, SANDY LEAN CLAY, very stiff, moist, **CL** | 5+11+18 | 18 | 19.4 |
| 51.5 | 25 | SPT | C | *Potomac group*, gray, FAT CLAY, very stiff, moist, **CH** | 7+9+10 | 18 | 23.5 |
| 46.5 | 30 | SPT | | Dark gray | 5+7+11 | 18 | 24.5 |
| 41.5 | 35 | SPT | | Dark brown and purple, hard | 8+11+14 | 18 | 23.8 |
| | 40 | SPT | | | 7+18+18 | 18 | |
| 31.5 | 45 | SPT | | Gray | 11+19+24 | 18 | |
| 26.5 | 50 | SPT | | Gray and dark brown | 7+16+25 | 18 | 22.5 |
| 25.0 | | | | Bottom of Borehole at 50.0 ft. | | | |

SOIL — STANDARD PENETRATION TEST RESISTANCE (BPF)




GROUND WATER LEVELS:

| | | | | |
|---|---|---|---|---|
| ENCOUNTERED: | 13.0 ft. | ELEV. 62.0 | | |
| UPON COMPLETION: | 11.0 ft. | ELEV. 64.0 | CAVED: 28.0 ft. | ELEV. 47.0 |
| 11/21/2018 | 14.0 ft. | ELEV. 61.0 | | |

SAMPLE TYPES: SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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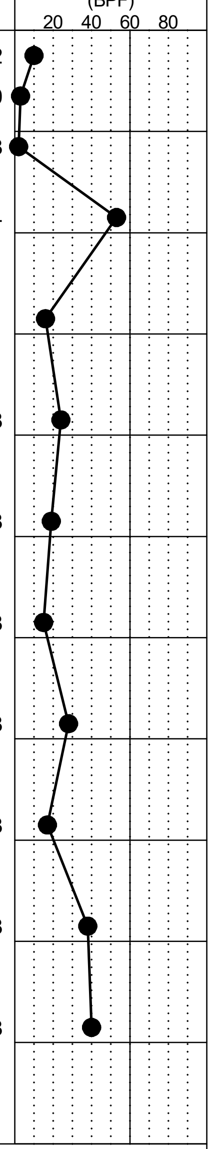
| PROJECT: UMD IDEA Factory | LOGGED BY: D. Corum | BORING NUMBER: **B-7** SHEET 1 OF 1 |
|---|---|---|
| LOCATION: College Park, Prince George's County, Maryland | DRILLING CONTRACTOR: J. Labas | |
| OWNER/CLIENT: University of Maryland | DRILLER: Terracon | DATES DRILLED: 11/27/18 - 11/27/18 |
| PROJECT NUMBER: JD185262 / GROUND SURFACE ELEVATION (ft.): 72.5 | DRILLING METHOD: 2-1/4" HSA; Automatic Hammer | DRILL RIG: Track Diedrich D50 |

| ELEV. (ft.) | DEPTH (ft.) | SAMPLE TYPE | STRATUM | MATERIAL DESCRIPTION | SPT BLOW COUNTS | REC (in) |
|---|---|---|---|---|---|---|
| 72.5 | | | | 6 inches CONCRETE | | |
| 72.0 | | SPT | A | *Fill*, gray-brown, CLAYEY SAND WITH GRAVEL, medium dense, moist, **SC** | 4+5+5+4 | 12 |
| 70.0 | | SPT | | Loose | 3+2+1 | 10 |
| 67.5 | 5 | SPT | B1 | *Alluvial*, gray-brown, SANDY SILT, soft, moist, **ML** | 1+1+1 | 18 |
| 64.0 | 10 | SPT | B2 | *Alluvial*, orange and white, POORLY GRADED SAND WITH GRAVEL, very dense, moist, **SP** | 19+30+23 | 14 |
| 59.0 ▼ | 15 | SPT | B1 | *Alluvial*, gray, SANDY SILT, very stiff, moist, **ML** | 3+6+10 | 11 |
| 54.0 | 20 | SPT | | Hard | 4+9+15 | 18 |
| 49.0 ▽ | 25 | SPT | C | *Potomac group*, gray, LEAN CLAY, hard, moist, **CL** | 5+7+12 | 18 |
| 44.0 | 30 | SPT | | *Potomac group*, dark gray, FAT CLAY, very stiff, moist, **CH** | 3+6+9 | 18 |
| 39.0 | 35 | SPT | | *Potomac group*, gray, LEAN CLAY, hard, moist, **CL** | 8+12+16 | 18 |
| 34.0 | 40 | SPT | | Brown-gray, SANDY LEAN CLAY, very stiff | 5+5+12 | 18 |
| 29.0 | 45 | SPT | | Gray, hard | 14+16+22 | 18 |
| 24.0 | | SPT | | *Potomac group*, brown-red, SILT, hard, moist, **ML** | 12+15+25 | 18 |
| 22.5 | 50 | | | Bottom of Borehole at 50.0 ft. | | |

SOIL — STANDARD PENETRATION TEST RESISTANCE (BPF)




GROUND WATER LEVELS:

▽ ENCOUNTERED: 23.5 ft. ELEV. 49.0

▼ UPON COMPLETION: 13.5 ft. ELEV. 59.0 CAVED: 26.0 ft. ELEV. 46.5

SAMPLE TYPES:

☒ SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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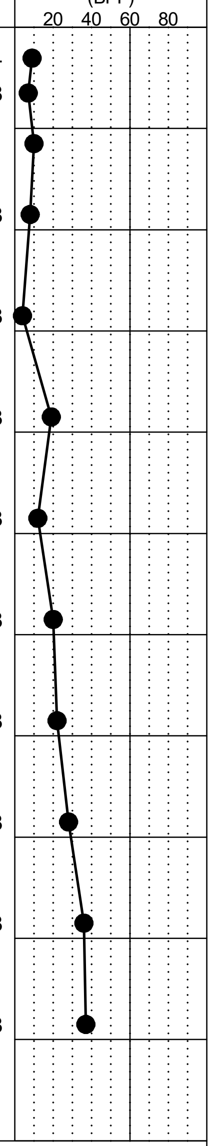
| | | |
|---|---|---|
| PROJECT: UMD IDEA Factory | LOGGED BY: D. Corum | BORING NUMBER: **B-8** SHEET 1 OF 1 |
| LOCATION: College Park, Prince George's County, Maryland | DRILLING CONTRACTOR: J. Labas | |
| OWNER/CLIENT: University of Maryland | DRILLER: Terracon | DATES DRILLED: 11/27/18 - 11/27/18 |
| PROJECT NUMBER: JD185262 / GROUND SURFACE ELEVATION (ft.): 73.0 ± | DRILLING METHOD: 2-1/4" HSA; Automatic Hammer | DRILL RIG: Track Diedrich D50 |

| ELEV. (ft.) | DEPTH (ft.) | SAMPLE TYPE | STRATUM | MATERIAL DESCRIPTION | SPT BLOW COUNTS | REC (in) |
|---|---|---|---|---|---|---|
| 73.0 | | SPT | A | 6.5-inches CONCRETE | 3+3+6+8 | 14 |
| 72.5 | | | A | 17.5-inches GRAVEL | | |
| 70.5 | | SPT | B1 | *Alluvial*, brown, SANDY LEAN CLAY, stiff, moist, **CL** | 2+3+4 | 18 |
| | 5 | SPT | B1 | | 5+5+5 | 2 |
| 64.5 | 10 | SPT | B1 | Contains gravel | 3+4+4 | 18 |
| 59.5 | 15 | SPT | B2 | *Alluvial*, gray, CLAYEY SAND, loose, moist, **SC** | 3+2+2 | 18 |
| 54.5 | 20 | SPT | B2 | Medium dense | 4+8+11 | 18 |
| 49.5 | 25 | SPT | C | *Potomac group*, gray, FAT CLAY, very stiff, moist, **CH** | 5+6+6 | 18 |
| 44.5 | 30 | SPT | C | | 7+9+11 | 18 |
| 39.5 | 35 | SPT | C | Gray and brown | 4+9+13 | 18 |
| 34.5 | 40 | SPT | C | *Potomac group*, gray, SANDY SILT, hard, moist, **ML** | 8+12+16 | 18 |
| 29.5 | 45 | SPT | C | Purple-gray | 9+16+20 | 18 |
| | 50 | SPT | C | | 8+18+19 | 18 |
| 23.0 | 50 | | | Bottom of Borehole at 50.0 ft. | | |

SOIL — STANDARD PENETRATION TEST RESISTANCE (BPF)




GROUND WATER LEVELS:

ENCOUNTERED: 18.5 ft. ELEV. 54.5

UPON COMPLETION: 15.0 ft. ELEV. 58.0 CAVED: 25.0 ft. ELEV. 48.0

SAMPLE TYPES: SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

# Appendix B
## Soil Laboratory Test Results

Liquid and Plastic Limit, and Grain Size Analysis Test Data (12 pages)

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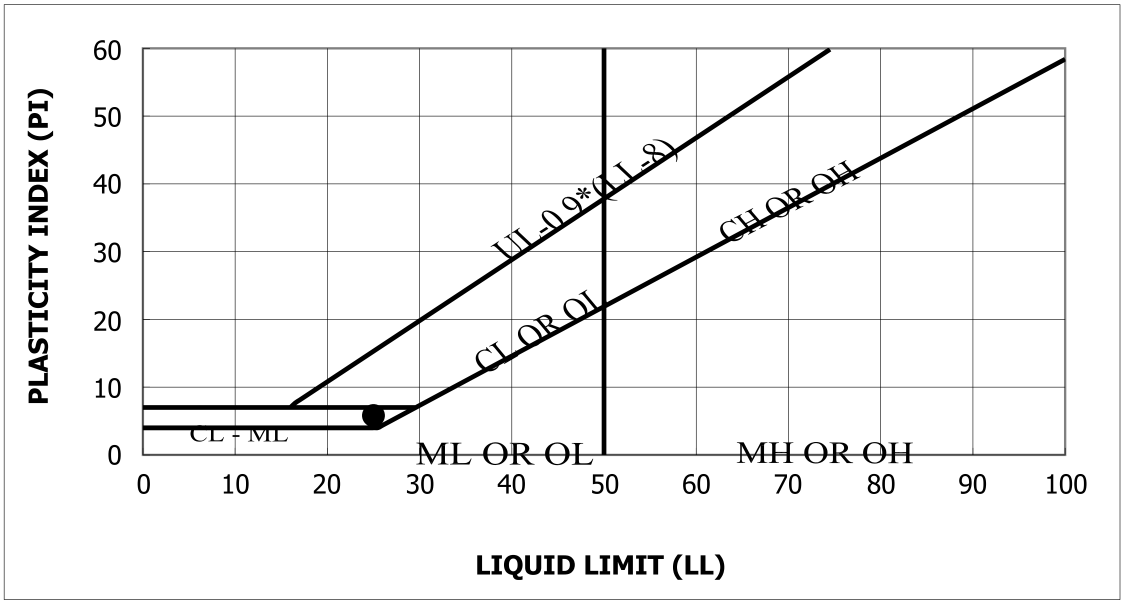
| LIQUID AND PLASTIC LIMIT - ASTM D4318 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 8.5-10.0 |
| **Lab Order No.** | 4474-3 | **Date** | 11/27/2018 |




| Material Description | LL | PL | PI | % Passing | | USCS | w (%) |
|---|---|---|---|---|---|---|---|
| | | | | #4 | #200 | | |
| **silty Clay with sand** | 25 | 19 | 6 | 98.8 | 72.1 | CL-ML | 24.4 |
| **Color** | Greyish Brown | | AASHTO Classification | | | A-4 | |

Test Method: ASTM D 4318
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by Lindsay Bartz

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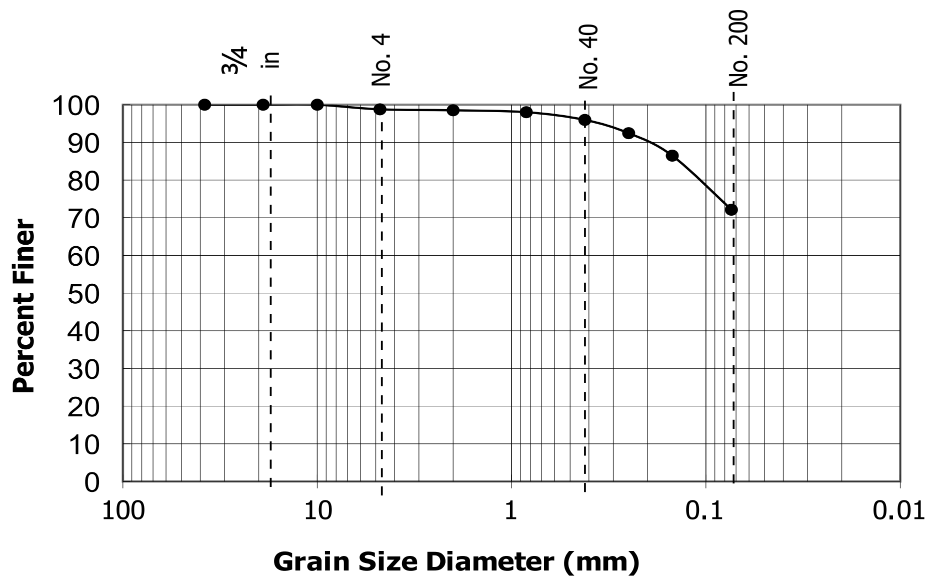
| GRAIN SIZE ANALYSIS - ASTM D422 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 8.5-10.0 |
| **Lab Order No.** | 4474-3 | **Date** | 11/27/2018 |




| SIEVE | % Passing |
|---|---|
| 1 ½ " | **100** |
| 3/4" | **100** |
| 3/8" | **100** |
| #4 | **99** |
| #10 | **99** |
| #20 | **98** |
| #40 | **96** |
| #60 | **92** |
| #100 | **86** |
| #200 | **72** |
| Pan | -- |

| **USCS Group Symbol** | **CL-ML** |
|---|---|
| **USCS Group Name** | **silty Clay with sand** |
| **Cu** | **---** |
| **Cc** | **---** |
| **LL** | **25** |
| **PI** | **6** |
| **Gravel** | **1.2** |
| **Sand** | **26.6** |
| **Fines** | **72.1** |
| **AASHTO Classification** | **A-4** |
| **Color** | **Greyish Brown** |

Test Method: ASTM D 422
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by: Lindsay Bartz

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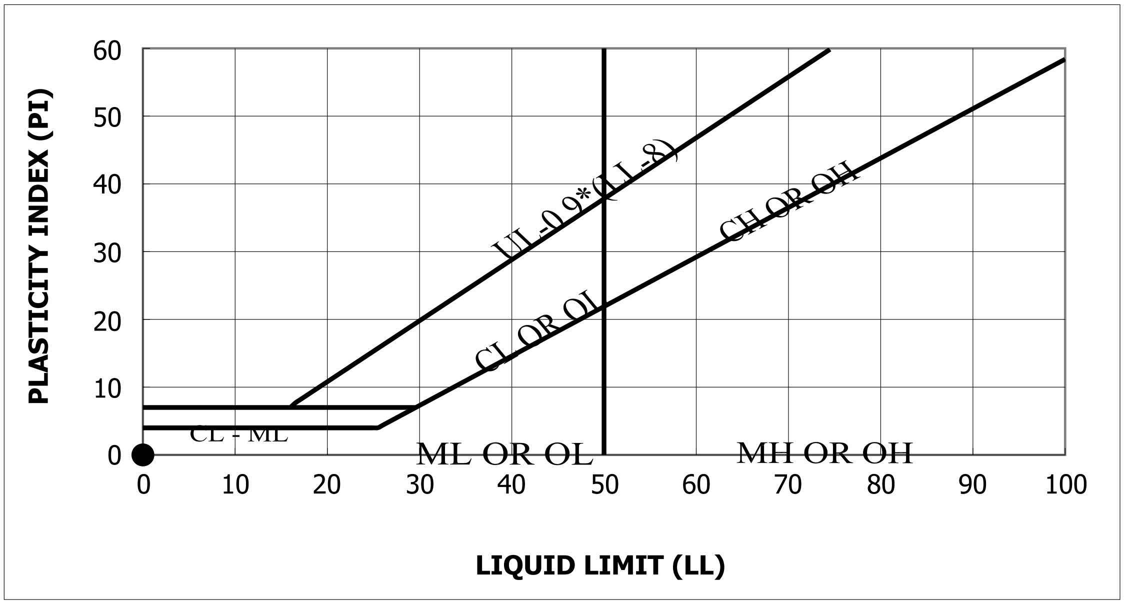
| LIQUID AND PLASTIC LIMIT - ASTM D4318 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 13.5-15.0 |
| **Lab Order No.** | 4474-4 | **Date** | 11/27/2018 |




| Material Description | LL | PL | PI | % Passing #4 | % Passing #200 | USCS | w (%) |
|---|---|---|---|---|---|---|---|
| **POORLY GRADED GRAVEL with sand** | NP | NP | NP | 49.9 | 4.2 | GP | 7.4 |
| **Color** | Brown | | AASHTO Classification | | A-1-a | | |

Test Method: ASTM D 4318
Soil Classification by ASTM D2487 and AASHTO M 145

Lindsay Bartz

Reviewed by ______________________

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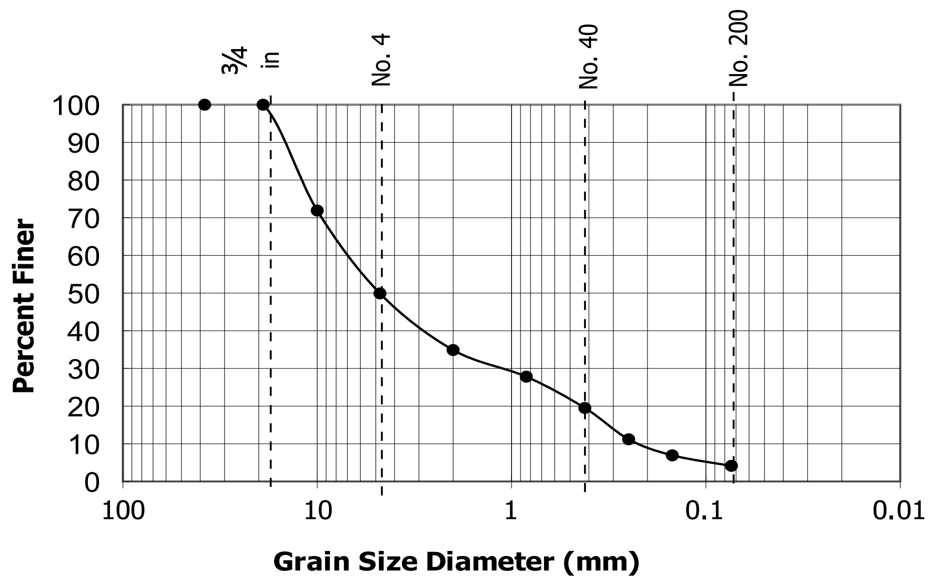
## GRAIN SIZE ANALYSIS - ASTM D422

| | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 13.5-15.0 |
| **Lab Order No.** | 4474-4 | **Date** | 11/27/2018 |




| SIEVE | % Passing |
|---|---|
| 1 ½ " | **100** |
| 3/4" | **100** |
| 3/8" | **72** |
| #4 | **50** |
| #10 | **35** |
| #20 | **28** |
| #40 | **20** |
| #60 | **11** |
| #100 | **7** |
| #200 | **4** |
| Pan | **--** |

| | |
|---|---|
| **USCS Group Symbol** | **GP** |
| **USCS Group Name** | **POORLY GRADED GRAVEL with sand** |
| **Cu** | **32.3** |
| **Cc** | **0.9** |
| **LL** | **NP** |
| **PI** | **NP** |
| **Gravel** | **50.1** |
| **Sand** | **45.8** |
| **Fines** | **4.2** |
| **AASHTO Classification** | **A-1-a** |
| **Color** | **Brown** |

Test Method: ASTM D 422
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by: Lindsay Bartz

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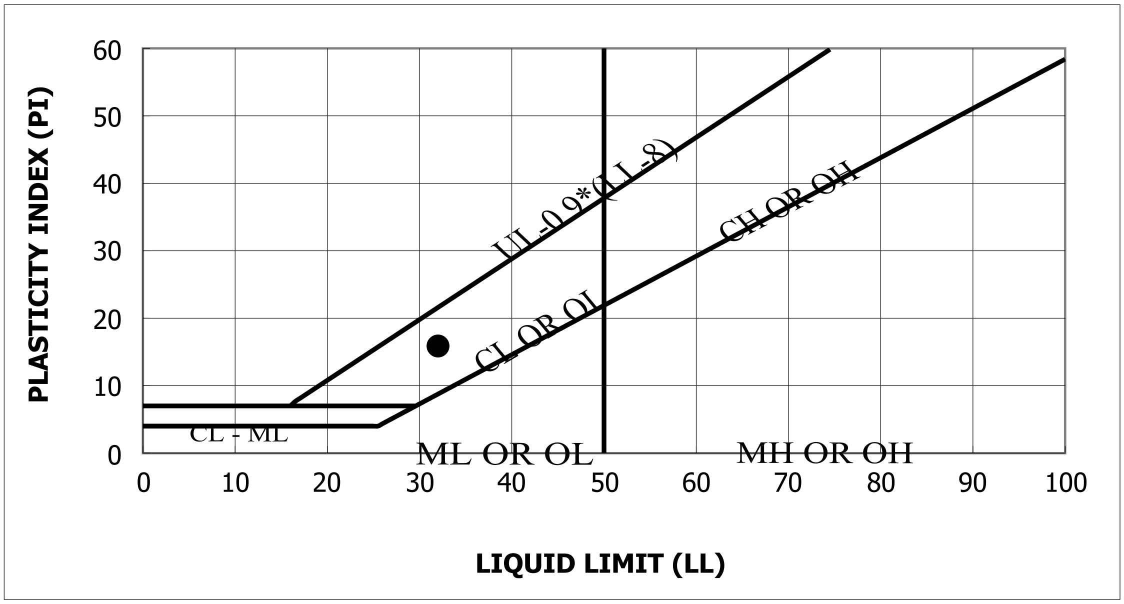
| LIQUID AND PLASTIC LIMIT - ASTM D4318 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 18.5-20.0 |
| **Lab Order No.** | 4474-5 | **Date** | 11/27/2018 |




| Material Description | LL | PL | PI | % Passing | | USCS | w (%) |
|---|---|---|---|---|---|---|---|
| | | | | #4 | #200 | | |
| **sandy Lean Clay** | 32 | 16 | 16 | 99.0 | 63.8 | CL | 19.4 |
| **Color** | Brown-Grey | | AASHTO Classification | | A-6 | | |

Test Method: ASTM D 4318
Soil Classification by ASTM D2487 and AASHTO M 145

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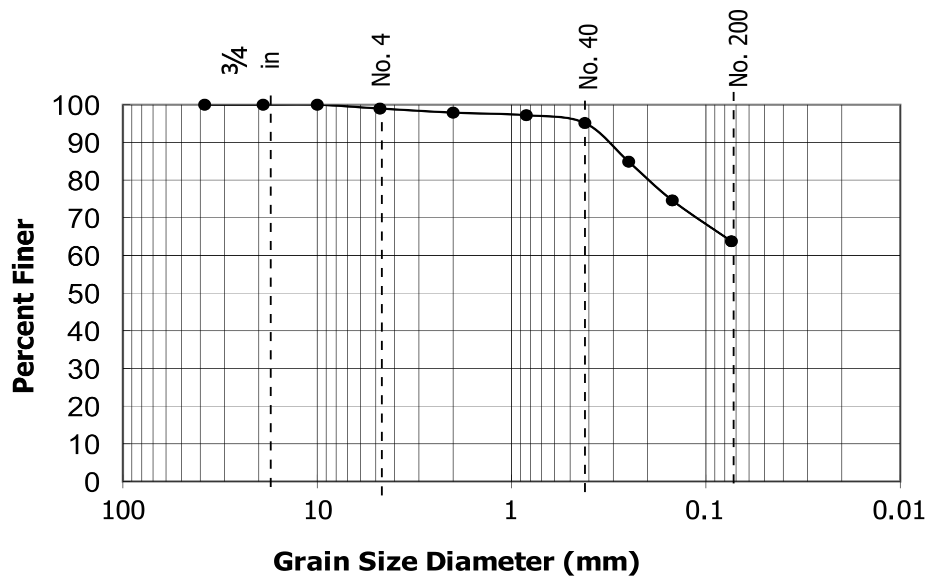
| GRAIN SIZE ANALYSIS - ASTM D422 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 18.5-20.0 |
| **Lab Order No.** | 4474-5 | **Date** | 11/27/2018 |




| SIEVE | % Passing |
|---|---|
| 1 ½ " | **100** |
| 3/4" | **100** |
| 3/8" | **100** |
| #4 | **99** |
| #10 | **98** |
| #20 | **97** |
| #40 | **95** |
| #60 | **85** |
| #100 | **75** |
| #200 | **64** |
| Pan | -- |

| | |
|---|---|
| **USCS Group Symbol** | **CL** |
| **USCS Group Name** | **sandy Lean Clay** |
| **Cu** | **---** |
| **Cc** | **---** |
| **LL** | **32** |
| **PI** | **16** |
| **Gravel** | **1.0** |
| **Sand** | **35.2** |
| **Fines** | **63.8** |
| **AASHTO Classification** | **A-6** |
| **Color** | **Brown-Grey** |

Test Method: ASTM D 422
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by: Lindsay Bartz

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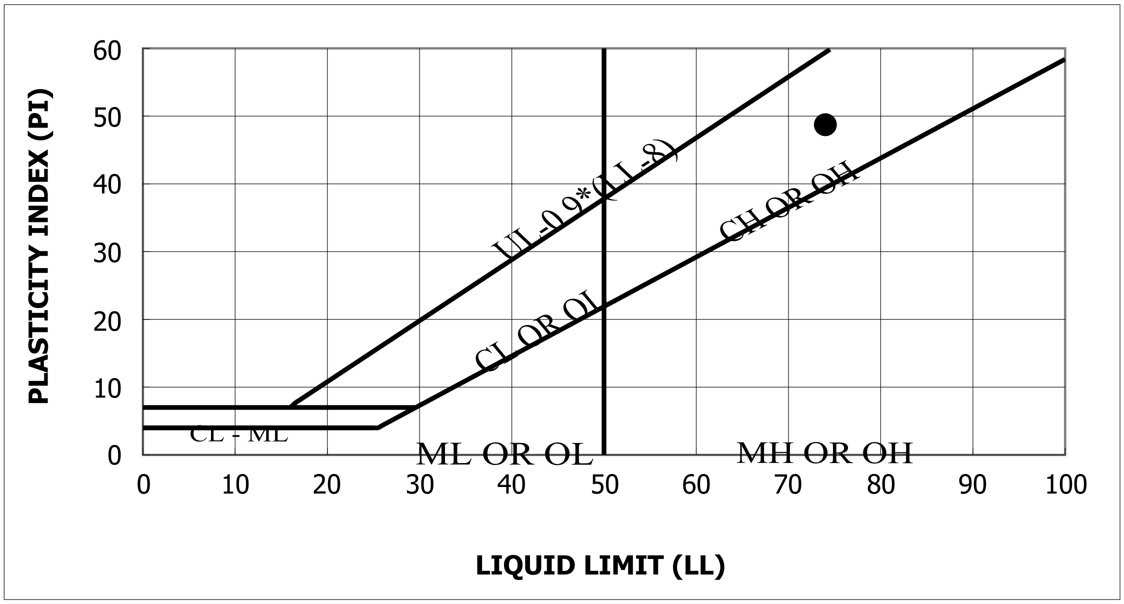
| LIQUID AND PLASTIC LIMIT - ASTM D4318 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 23.5-25.0 |
| **Lab Order No.** | 4474-6 | **Date** | 11/27/2018 |




| Material Description | LL | PL | PI | % Passing #4 | % Passing #200 | USCS | w (%) |
|---|---|---|---|---|---|---|---|
| **Fat Clay** | 74 | 25 | 49 | 100.0 | 93.0 | CH | 23.5 |
| **Color** | Light Grey with Red | | AASHTO Classification | | A-7-6 | | |

Test Method: ASTM D 4318
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by Lindsay Bartz

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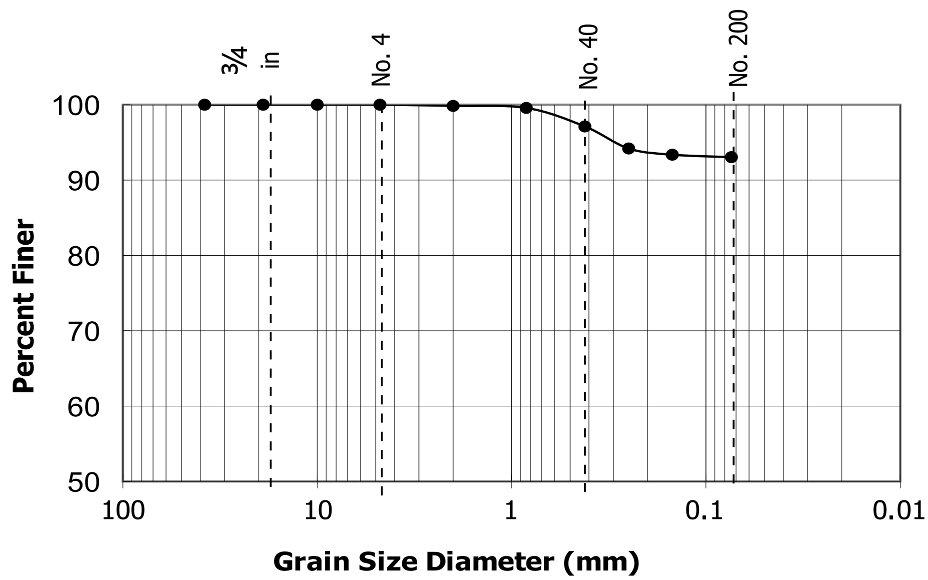
## GRAIN SIZE ANALYSIS - ASTM D422

| | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 23.5-25.0 |
| **Lab Order No.** | 4474-6 | **Date** | 11/27/2018 |




| SIEVE | % Passing |
|---|---|
| 1 ½ " | **100** |
| 3/4" | **100** |
| 3/8" | **100** |
| #4 | **100** |
| #10 | **100** |
| #20 | **100** |
| #40 | **97** |
| #60 | **94** |
| #100 | **93** |
| #200 | **93** |
| Pan | -- |

| | |
|---|---|
| **USCS Group Symbol** | **CH** |
| **USCS Group Name** | **Fat Clay** |
| **Cu** | **---** |
| **Cc** | **---** |
| **LL** | **74** |
| **PI** | **49** |
| **Gravel** | **0.0** |
| **Sand** | **7.0** |
| **Fines** | **93.0** |
| **AASHTO Classification** | **A-7-6** |
| **Color** | **Light Grey with Red** |

Test Method: ASTM D 422
Soil Classification by ASTM D2487 and AASHTO M 145

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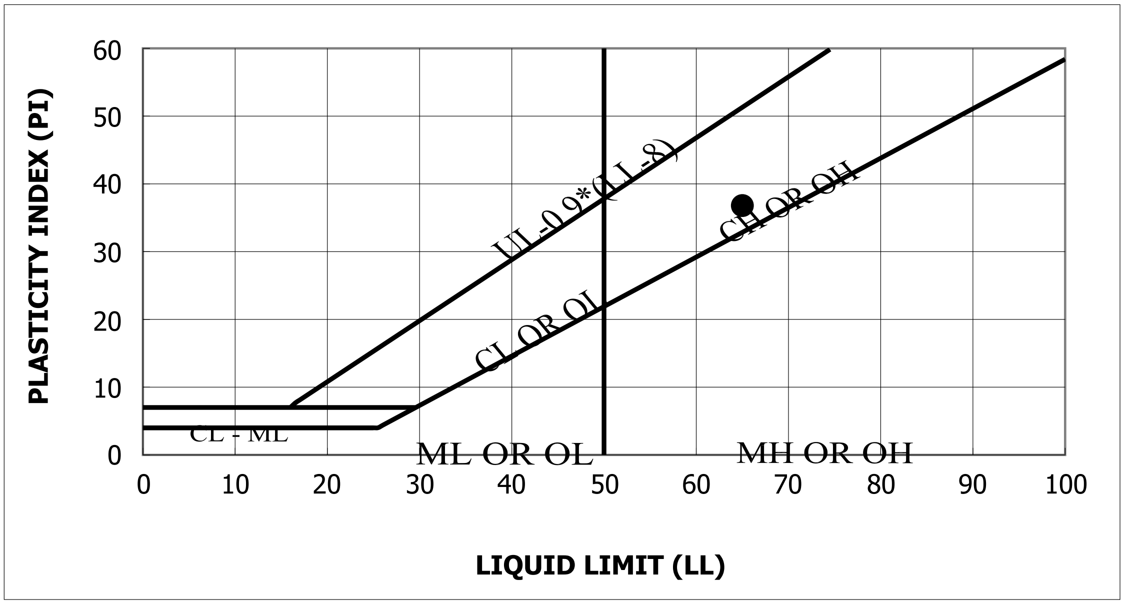
| LIQUID AND PLASTIC LIMIT - ASTM D4318 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 33.5-35.0 |
| **Lab Order No.** | 4474-8 | **Date** | 11/27/2018 |




| Material Description | LL | PL | PI | % Passing | | USCS | w (%) |
|---|---|---|---|---|---|---|---|
| | | | | #4 | #200 | | |
| **Fat Clay** | 65 | 28 | 37 | 100.0 | 93.5 | CH | 23.8 |
| **Color** | Red Brown | | AASHTO Classification | | A-7-6 | | |

Test Method: ASTM D 4318
Soil Classification by ASTM D2487 and AASHTO M 145

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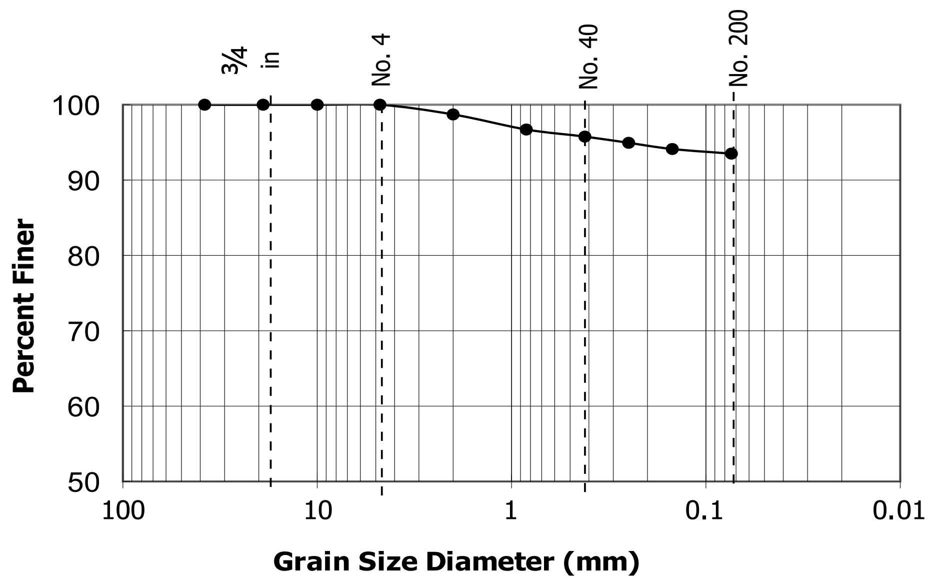
| GRAIN SIZE ANALYSIS - ASTM D422 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 33.5-35.0 |
| **Lab Order No.** | 4474-8 | **Date** | 11/27/2018 |




| SIEVE | % Passing |
|---|---|
| 1 ½ " | **100** |
| 3/4" | **100** |
| 3/8" | **100** |
| #4 | **100** |
| #10 | **99** |
| #20 | **97** |
| #40 | **96** |
| #60 | **95** |
| #100 | **94** |
| #200 | **94** |
| Pan | -- |

| | |
|---|---|
| **USCS Group Symbol** | **CH** |
| **USCS Group Name** | **Fat Clay** |
| **Cu** | **---** |
| **Cc** | **---** |
| **LL** | **65** |
| **PI** | **37** |
| **Gravel** | **0.0** |
| **Sand** | **6.5** |
| **Fines** | **93.5** |
| **AASHTO Classification** | **A-7-6** |
| **Color** | **Red Brown** |

Test Method: ASTM D 422
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by: Lindsay Bartz

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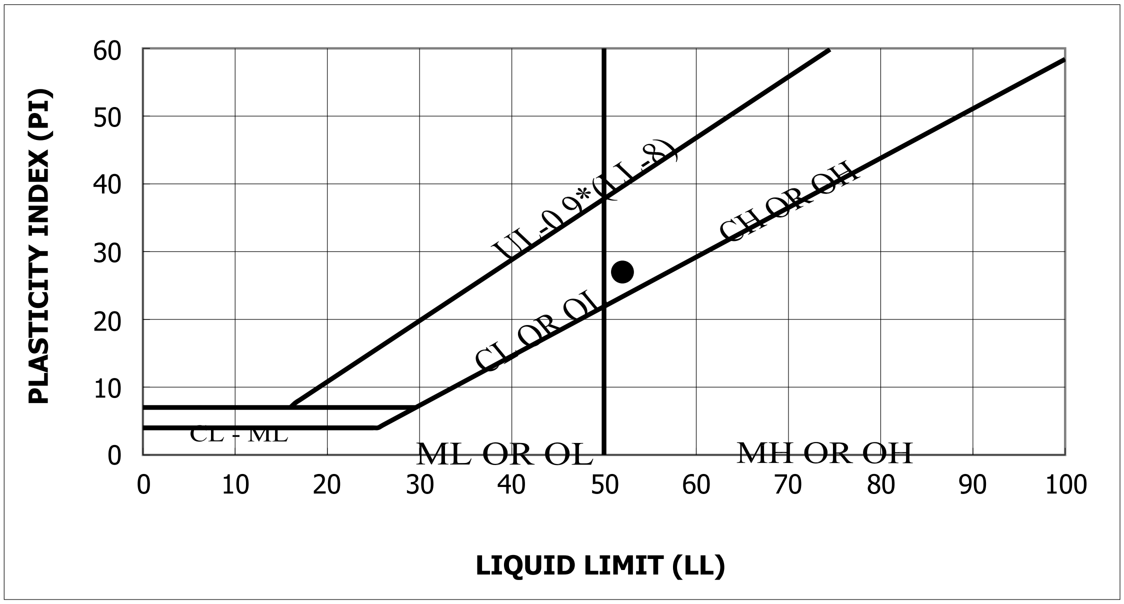
| LIQUID AND PLASTIC LIMIT - ASTM D4318 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 48.5-50.0 |
| **Lab Order No.** | 4474-9 | **Date** | 11/27/2018 |




| Material Description | LL | PL | PI | % Passing | | USCS | w (%) |
|---|---|---|---|---|---|---|---|
| | | | | #4 | #200 | | |
| **Fat Clay** | 52 | 25 | 27 | 100.0 | 99.3 | CH | 22.5 |
| **Color** | Brownish Red | | AASHTO Classification | | A-7-6 | | |

Test Method: ASTM D 4318
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by Lindsay Bartz

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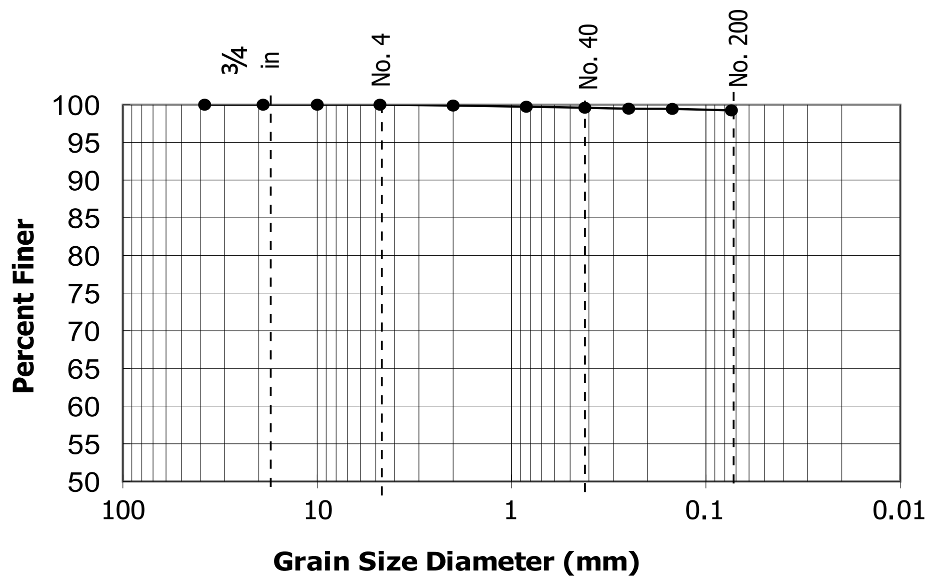
| GRAIN SIZE ANALYSIS - ASTM D422 | | | |
|---|---|---|---|
| **Project No.** | JD185262 | **Project Name** | UMD IDEA Factory |
| **Sample ID** | B-6 | **Depth (Feet)** | 48.5-50.0 |
| **Lab Order No.** | 4474-9 | **Date** | 11/27/2018 |




| SIEVE | % Passing |
|---|---|
| 1 ½ " | **100** |
| 3/4" | **100** |
| 3/8" | **100** |
| #4 | **100** |
| #10 | **100** |
| #20 | **100** |
| #40 | **100** |
| #60 | **99** |
| #100 | **99** |
| #200 | **99** |
| Pan | -- |

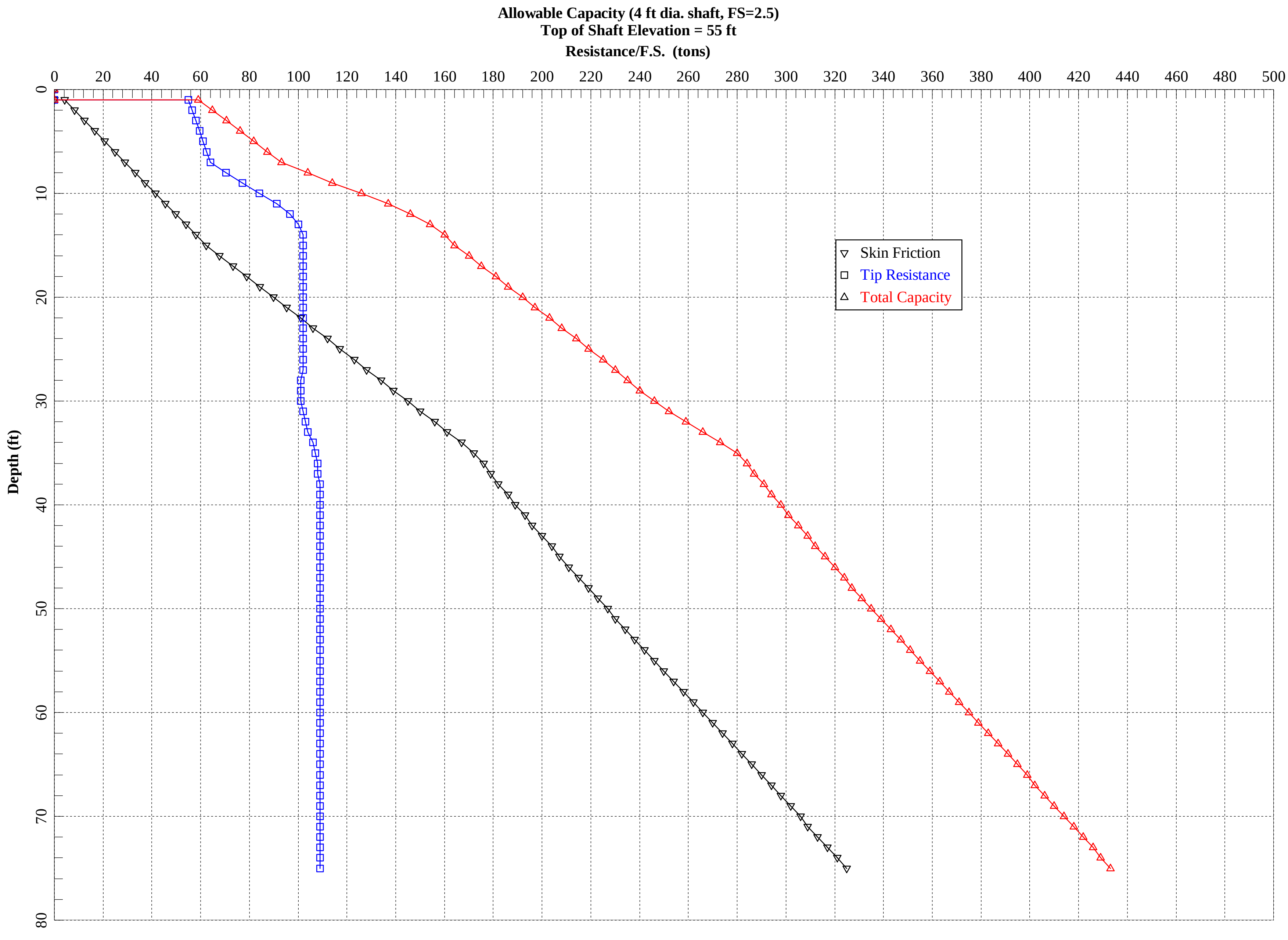
| | |
|---|---|
| **USCS Group Symbol** | **CH** |
| **USCS Group Name** | **Fat Clay** |
| **Cu** | **---** |
| **Cc** | **---** |
| **LL** | **52** |
| **PI** | **27** |
| **Gravel** | **0.0** |
| **Sand** | **0.7** |
| **Fines** | **99.3** |
| **AASHTO Classification** | **A-7-6** |
| **Color** | **Brownish Red** |

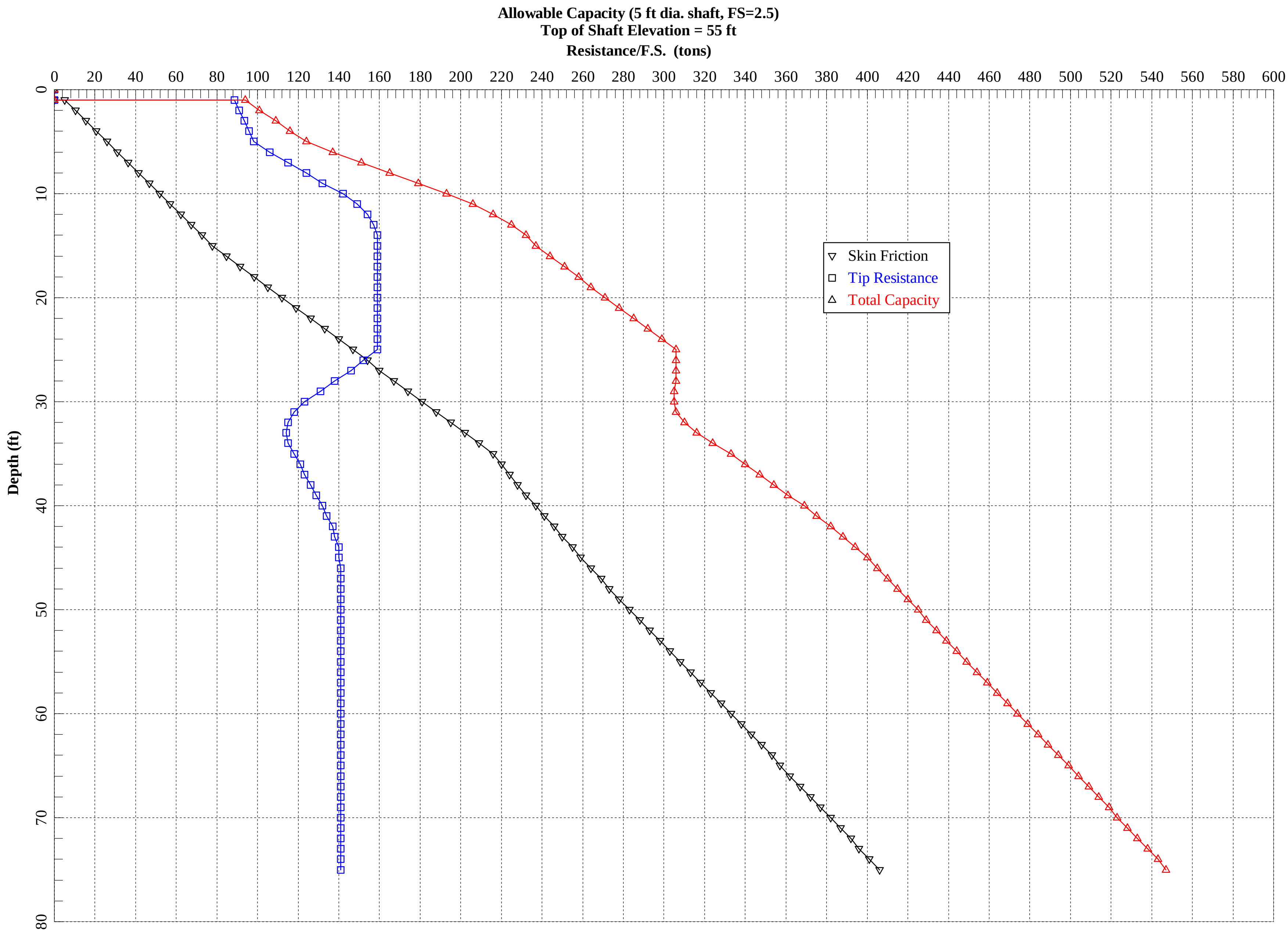
Test Method: ASTM D 422
Soil Classification by ASTM D2487 and AASHTO M 145

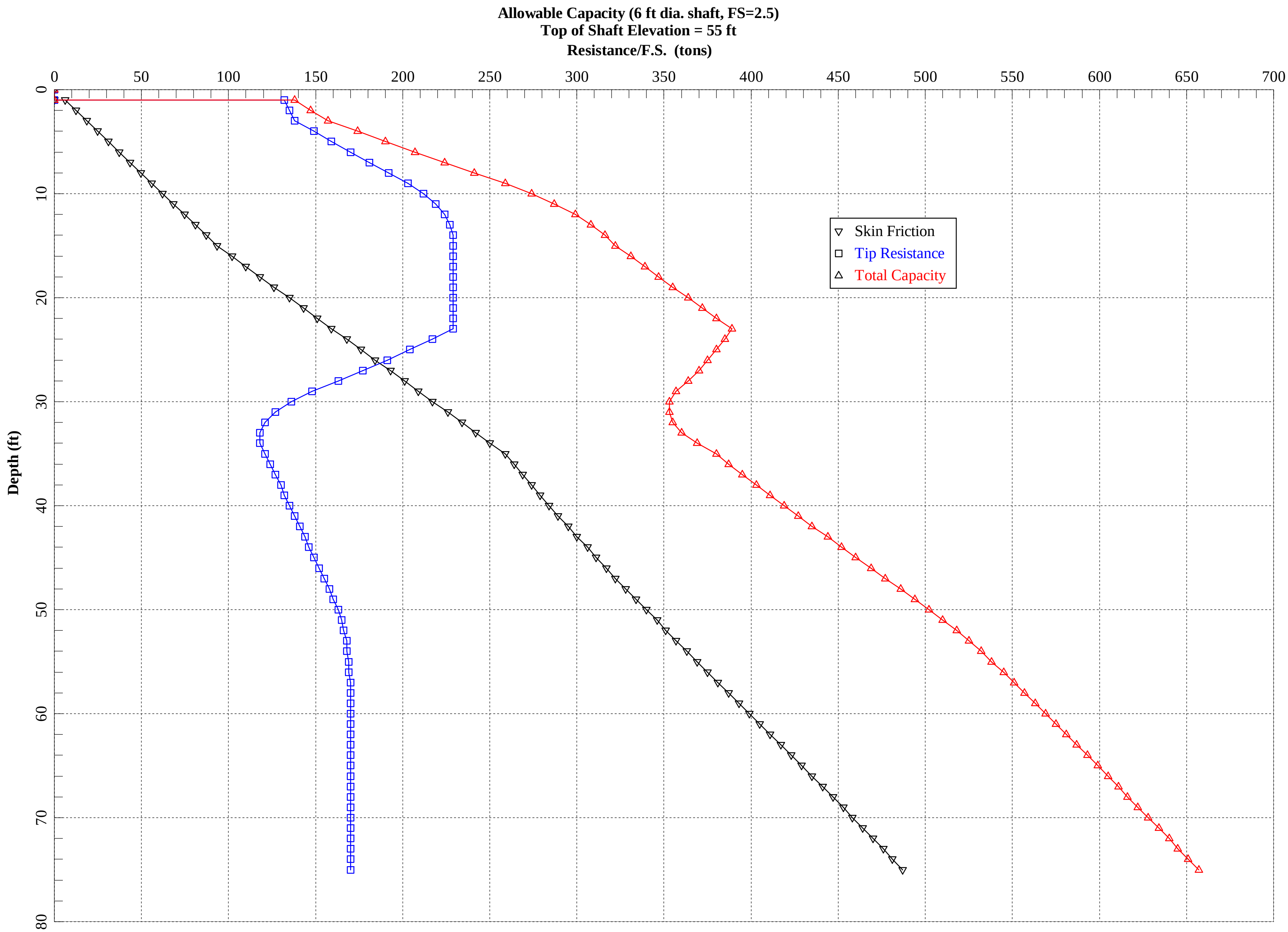
Reviewed by: Lindsay Bartz

# Appendix C
## Drilled Shaft Axial Bearing Calculations

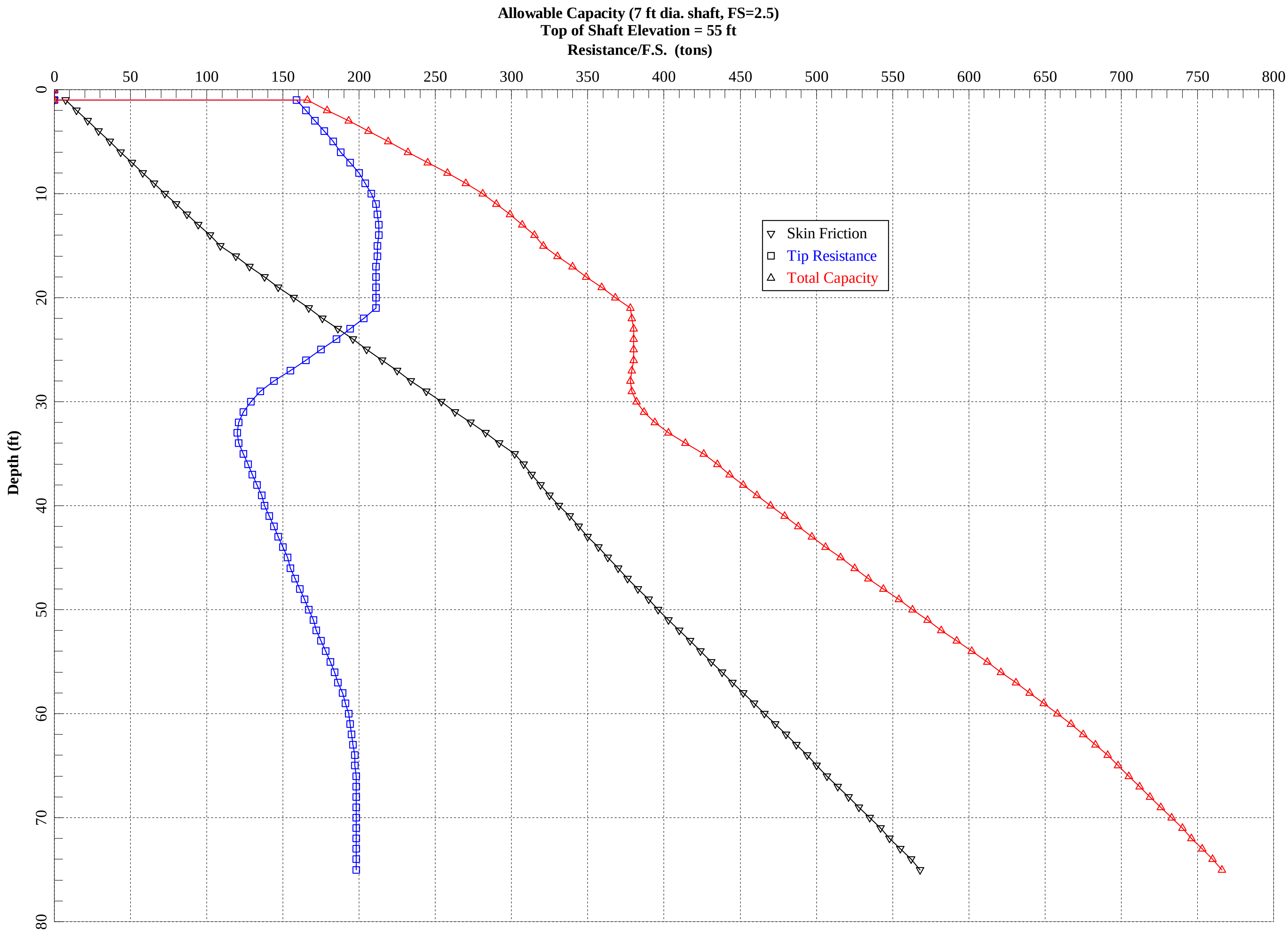
Drilled Shaft Axial Bearing Calculations (4 pages)


Allowable Capacity (4 ft dia. shaft, FS=2.5)
Top of Shaft Elevation = 55 ft
Resistance/F.S. (tons)
Depth (ft)
Skin Friction
Tip Resistance
Total Capacity


Allowable Capacity (5 ft dia. shaft, FS=2.5)
Top of Shaft Elevation = 55 ft
Resistance/F.S. (tons)
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600
Depth (ft)
0 10 20 30 40 50 60 70 80
Skin Friction
Tip Resistance
Total Capacity



Allowable Capacity (6 ft dia. shaft, FS=2.5)
Top of Shaft Elevation = 55 ft
Resistance/F.S. (tons)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Depth (ft)
0
10
20
30
40
50
60
70
80
Skin Friction
Tip Resistance
Total Capacity


Allowable Capacity (7 ft dia. shaft, FS=2.5)
Top of Shaft Elevation = 55 ft
Resistance/F.S. (tons)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
Depth (ft)
0
10
20
30
40
50
60
70
80
Skin Friction
Tip Resistance
Total Capacity

**Appendix D – Technical Deliverables**

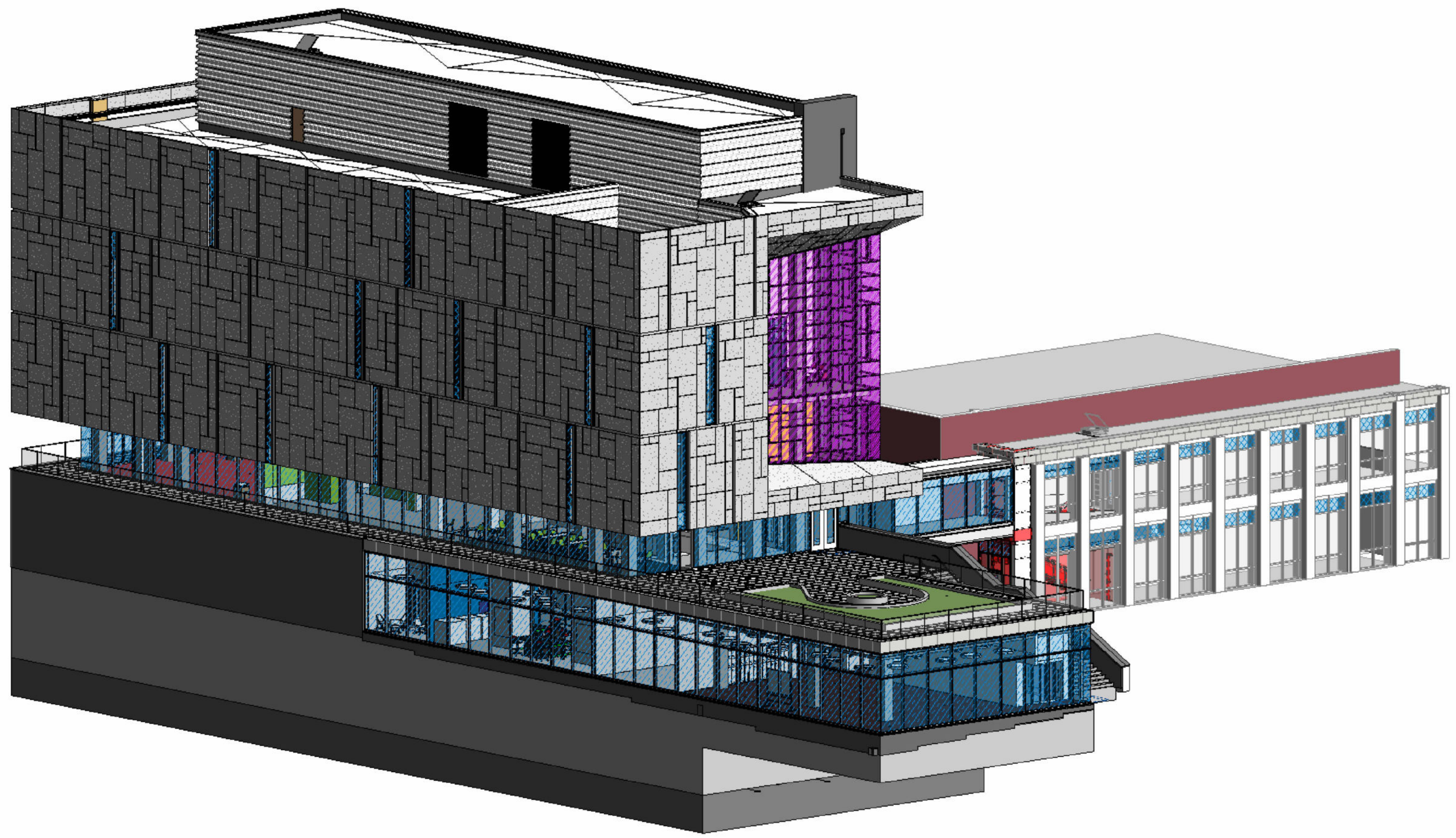
**Index**

1. Preliminary Design Drawings
2. Site Logistics Plan
3. IDEA Factory Cost Takeoffs
4. IDEA Factory Presentation
5. Response to RFP
6. Supporting Materials - IDEA Factory Files

University of Maryland

# E.A. Fernandez IDEA Factory Response to RFP

University of Virginia's Jefferson Contracting Capstone Team



**Sheet Index**

| Sheet Number | Sheet Name |
|---|---|
| General | |
| G-100 | Cover |
| Civil | |
| C-101 | SOE & Dewatering Plan |
| Architectural | |
| A-D01 | Typical Foundation Detail |
| Plumbing | |
| P-B01 | Subdrainage Plan |


UVA 2024-2025 Undergraduate Civil Engineering Capstone Team:

Katy Dominguez
Zubaidah Al Jumaili
Logan Holsapple
Michael Rogerson
Duy Tran
Faythe Way

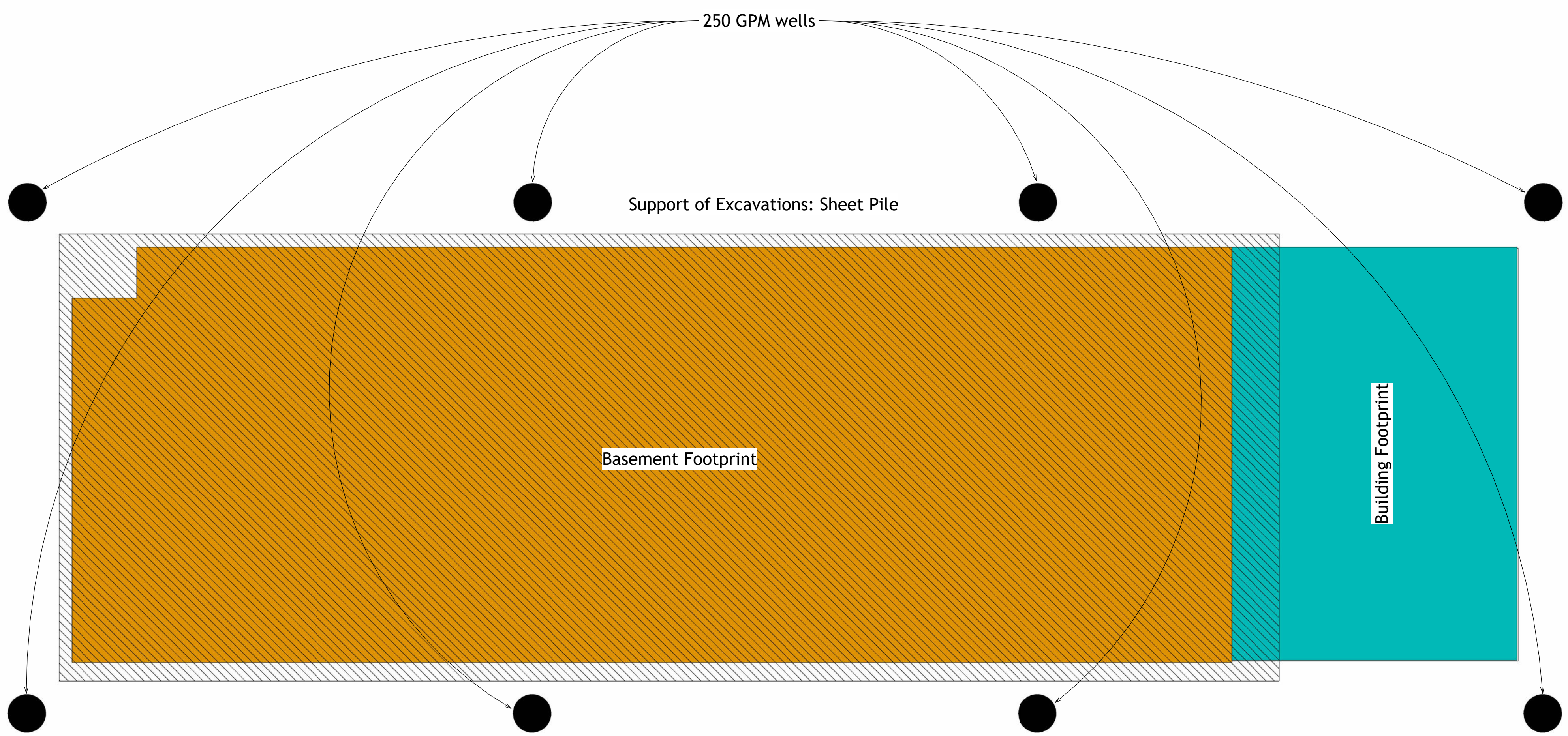
Faculty Advisor:
Diana Duran

Industry Advisor:
Ryan Knox



Project Number 20240930-00001
Date Sept. 30, 2024


3/31/2025 1:42:33 PM




1 SOE & Dewatering Plan
1/8" = 1'-0"

**Specifications**

1. Maximum 85' deep well point spacing (Typical 80' spacing)
2. Submersible well pumps should consist of 5-hp pumps intended for 6" well casings at a depth of 40 ft
3. Dewatering wells should be installed a minimum of 5' away from support of excavations

**Notes**

1. Drawdown calculations are estimates based on available data and not necessarily an accurate representation of actual conditions
2. Additional sump pumps should be available and accessible during excavation
3. Ensure appropriate discharge permitting prior to dewatering operations

UVA ENGINEERING

UVA 2024-2025 Undergraduate Civil Engineering Capstone

Capstone Team:
Katy Dominguez
Zubaidah Al Jumaili
Logan Holsapple
Michael Rogerson
Duy Tran
Faythe Way

Advisor:
Diana Duran

Industry Advisor:
Ryan Knox, Clark Construction

CLARK CONSTRUCTION

University of Maryland

UNIVERSITY OF MARYLAND 1856

E.A. Fernandez IDEA Factory Response to RFP

SOE & Dewatering Plan

| | |
|---|---|
| Project Number | 20240930-00001 |
| Date | Sept. 30, 2024 |
| Drawn By | Logan Holsapple |
| Checked By | Capstone Team |

C-101

| | |
|---|---|
| Scale | 1/8" = 1'-0" |

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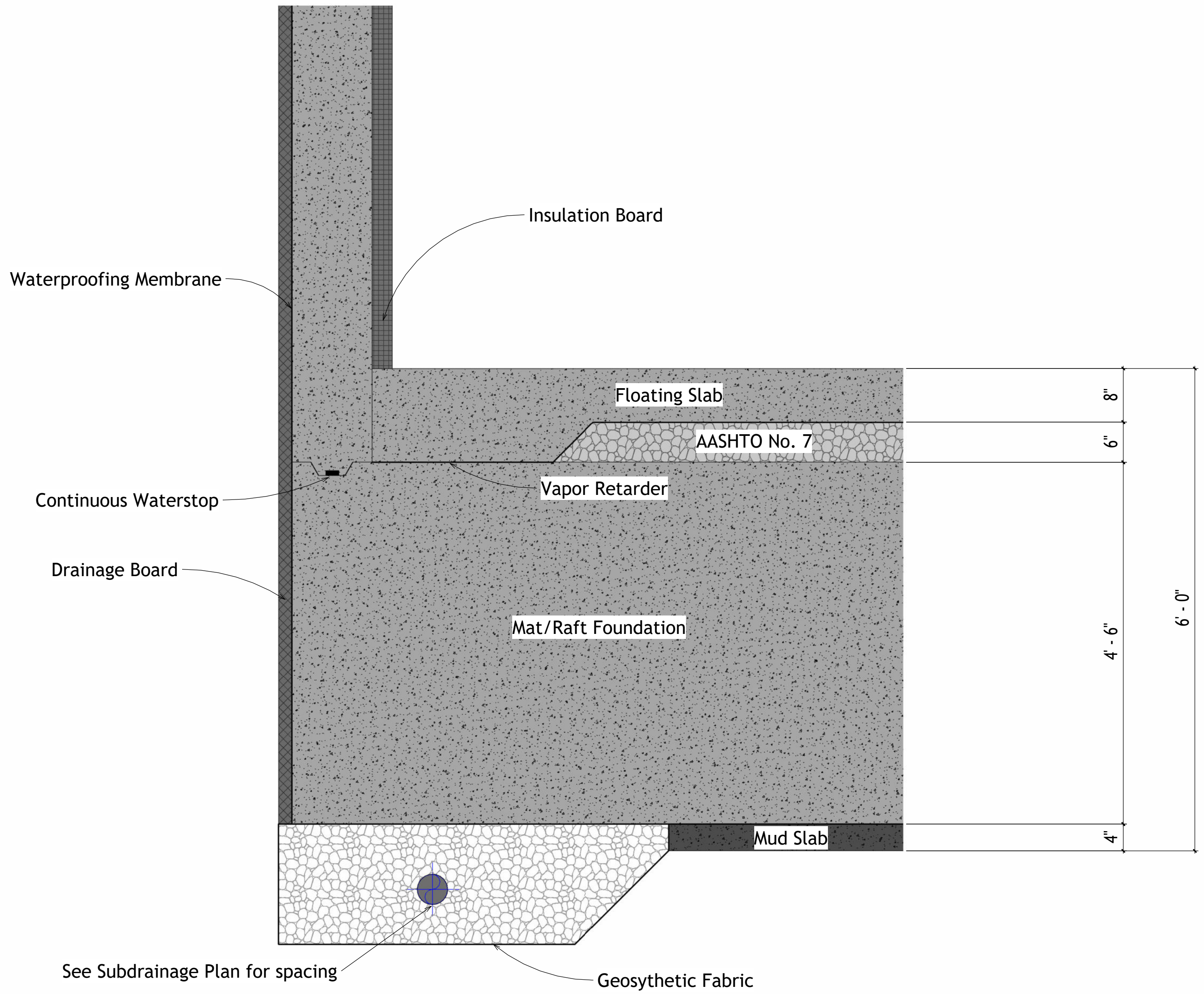
**Specifications**
1. Where applicable, backfill against drainage board using AASHTO No. 7 stone
2. Nonwoven geotextile filter fabric equivalent opening size less than the US Standard No. 70 sieve
3. Install SikaProof-808 waterproofing solution according to manufacturer specifications

**Notes**
1. See subdrainge plan (P-B01) for drainage spacing and sloping requirements




1 Typical Foundation Detail
1 1/2" = 1'-0"

UVA ENGINEERING

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Undergraduate Civil
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University of
Maryland

E.A. Fernandez
IDEA Factory
Response to RFP

Typical Foundation
Detail

| | |
|---|---|
| Project Number | 20240930-00001 |
| Date | Sept. 30, 2024 |
| Drawn By | Logan Holsapple |
| Checked By | Capstone Team |

A-D01

| | |
|---|---|
| Scale | 1 1/2" = 1'-0" |

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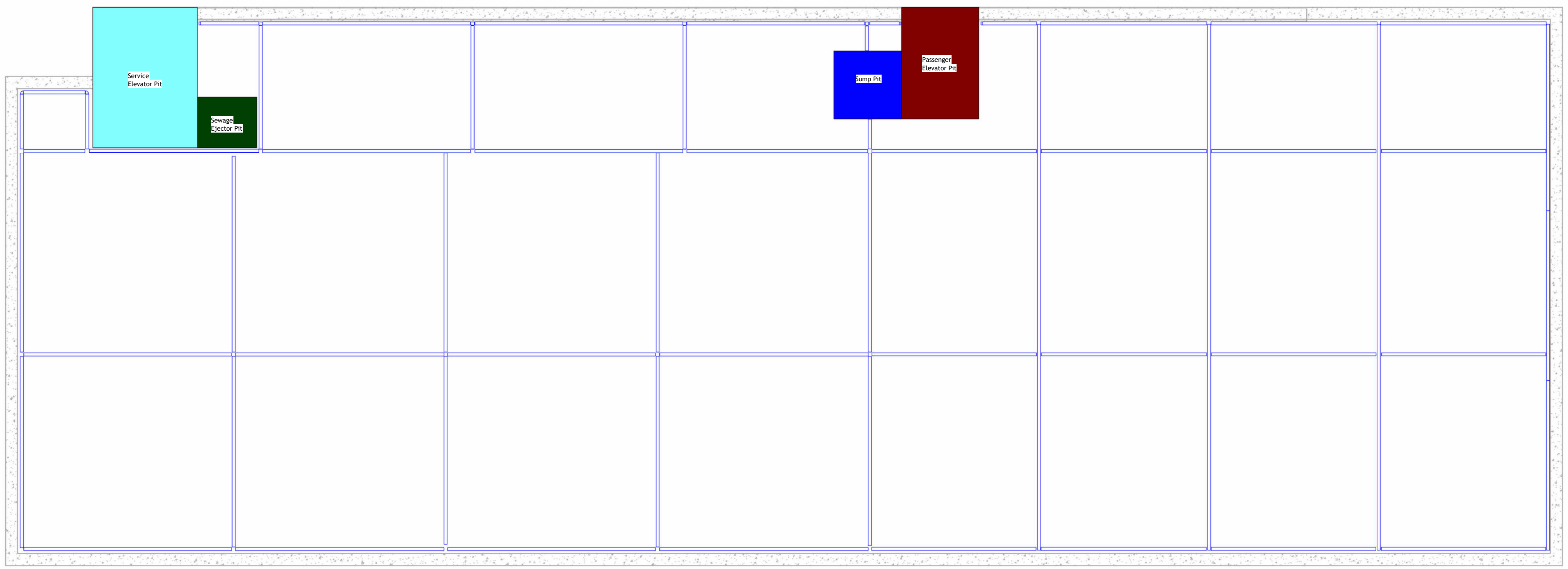
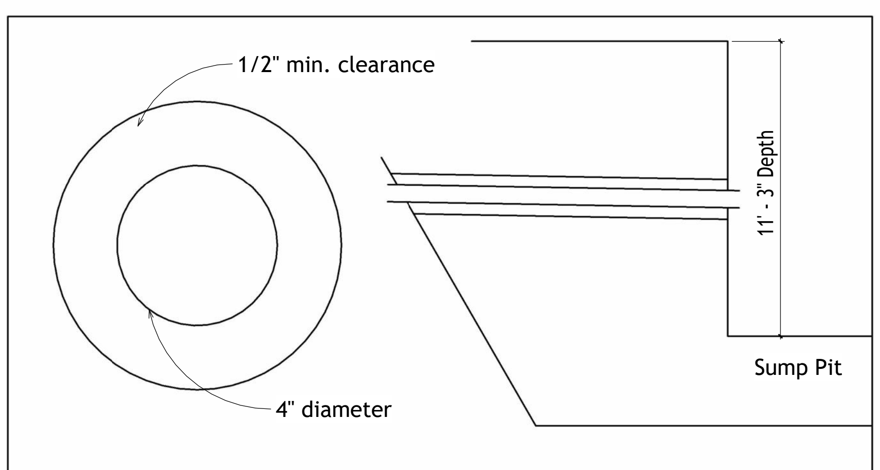



1 Subdrainage Plumbing Plan
5/32" = 1'-0"

N




Sleeving Detail

**Specifications**
1. Corrugated polyethylene 4" diameter
2. Maximum 1/8" slot width
3. Maximum 25' c-c spacing
4. HDPE injection molded fittings

**Sloping Specifications**
5. Minimum 2% slope (1/4" per foot towards subdrainage sump pit)

UVA 2024-2025 Undergraduate Civil Engineering Capstone

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Ryan Knox, Clark Construction

University of Maryland

E.A. Fernandez IDEA Factory Response to RFP

Subdrainage Plan

| | |
|---|---|
| Project Number | 20240930-00001 |
| Date | Sept. 30, 2024 |
| Drawn By | Logan Holsapple |
| Checked By | Capstone Team |

P-B01

| | |
|---|---|
| Scale | 5/32" = 1'-0" |

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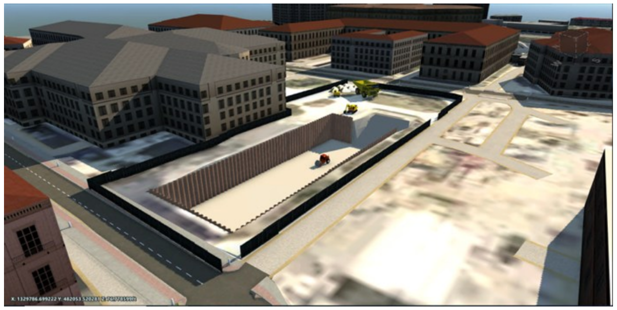
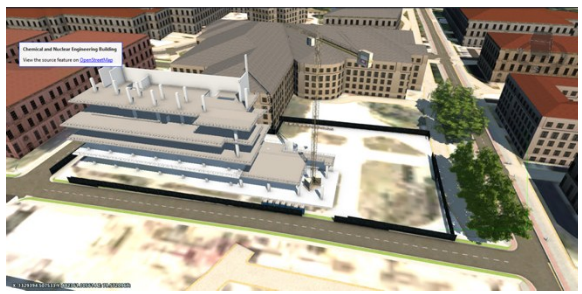
## Three phase, 3-D Site Logistics Design Evolution

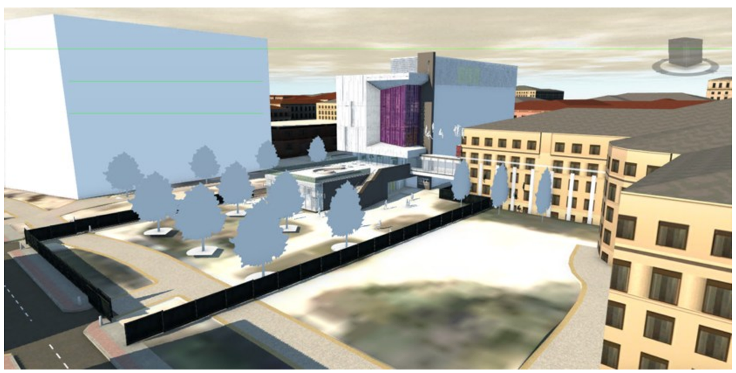
Excavation Model:

| First Iteration | Second Iteration | Final Model |
| --- | --- | --- |
|  |  |  |
|  |  |  |

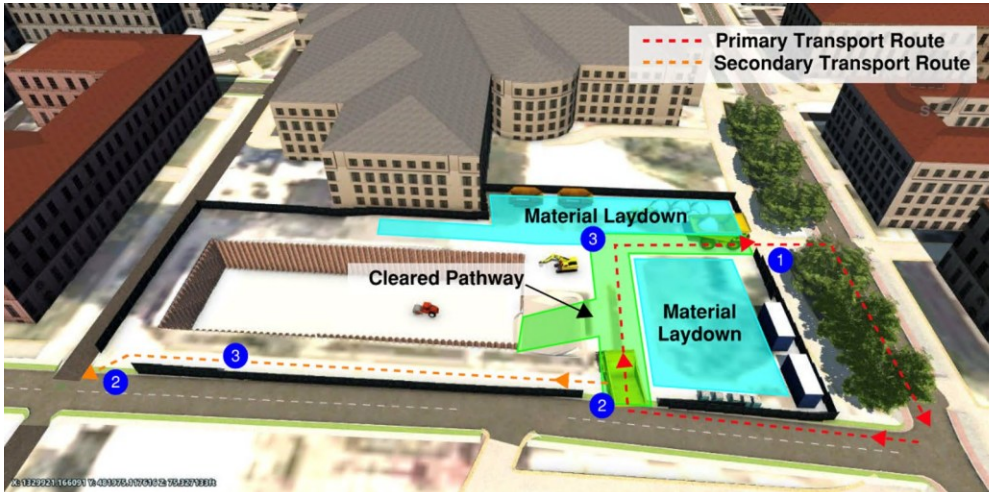
Structural Phase Model:

| First Iteration | Second Iteration | Final Design |
|---|---|---|
|  |  |  |
|  |  |  |

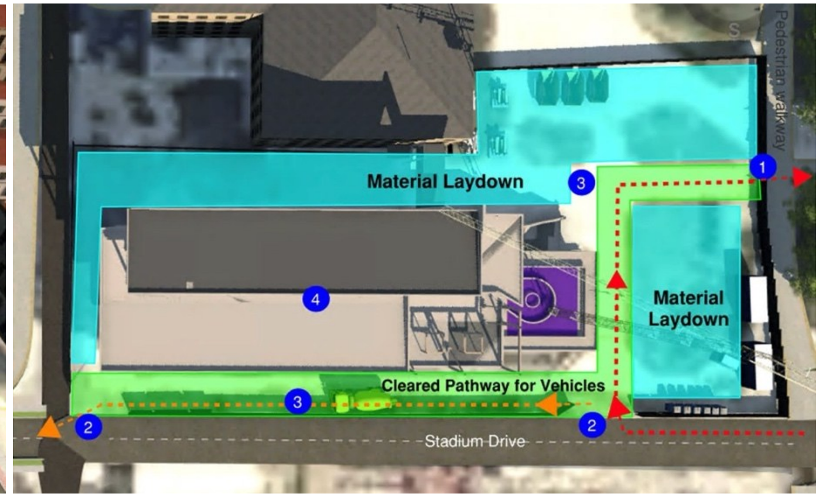
Building Envelope Model:

| First Iteration | Final Iteration |
|---|---|
|  |  |
|  |  |

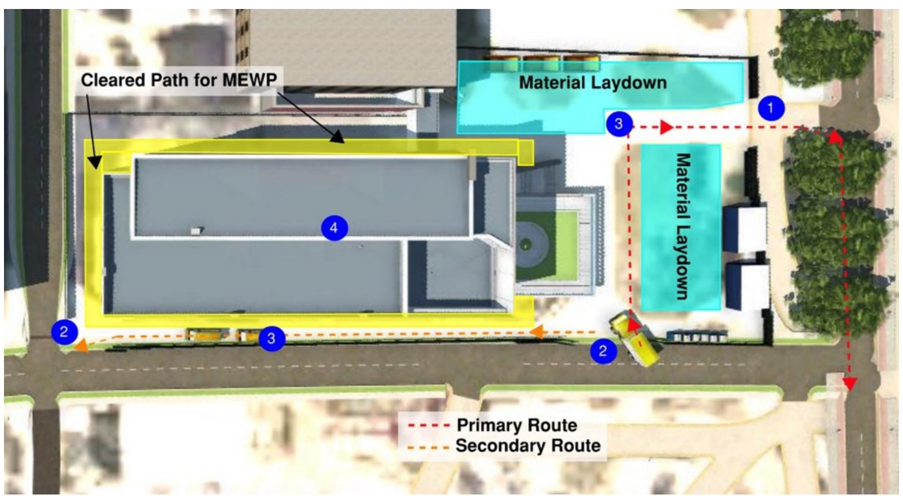
**Phase 1 Site Logistics Plan: Excavation**




**Phase 2 Site Logistics Plan: Structural**




**Phase 3 Site Logistics Plan: Envelope Install**




**Markers Legend**

1. Pedestrian Corridor
2. Possible flaggers required for large vehicle entry/exit
3. Loading and unloading locations
4. Additional material storage at each floor level after concrete setting

**Comments on Designs Evolution:** The initial designs of each model began as rudimentary models, starting off with the import of the 3D environment available through Autodesk software. The limited access to edit the Revit drawings provided by Clark Construction presented some initial challenges, but through collaboration of the capstone team and individual research, the models evolved to more refined representations of the project environment that more accurately depicted the physical surroundings. From that point, development of each model from the excavation phase to envelope installation took place by importing the Revit files provided by Clark into Infraworks and using various tools in Infraworks to depict a construction site with equipment and machinery placements. These models were critical to the development of the traffic plan and each detailed site logistics plan which allowed us to communicate our thought out plan for traffic flow through the site and through the UMD campus.

Traffic Management/Flow

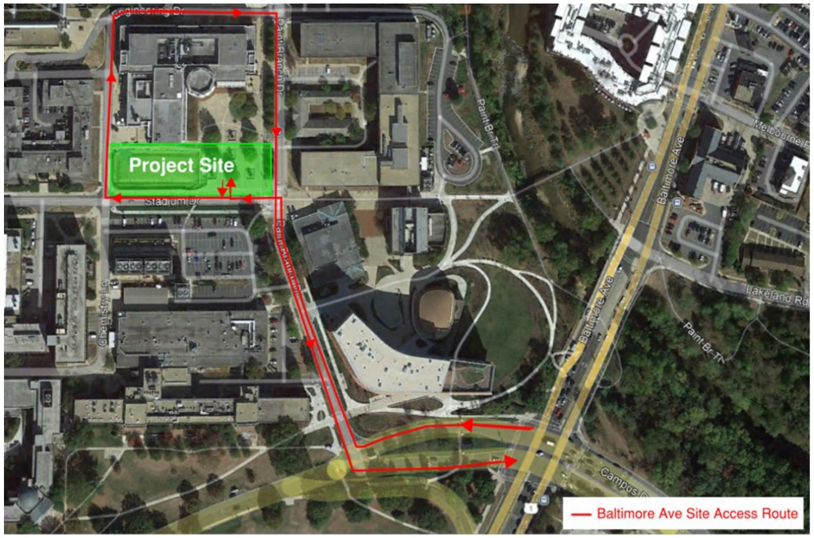
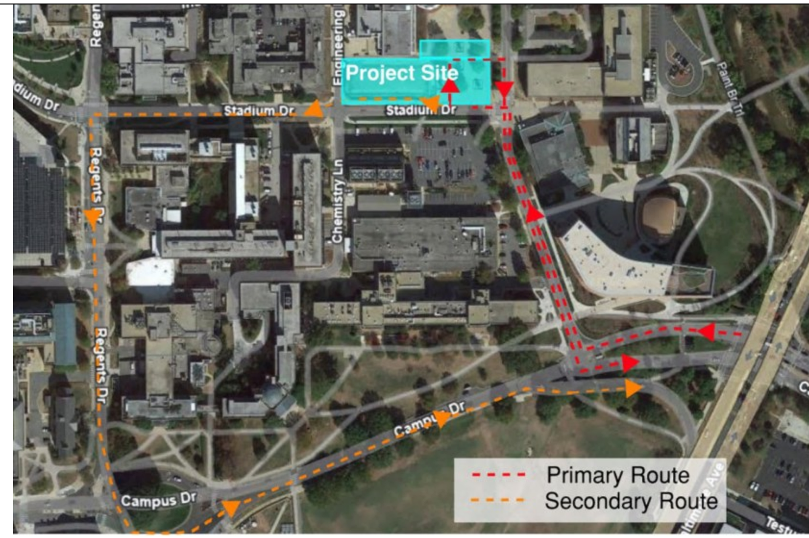
| First Iteration | Final Iteration |
|---|---|
|  |  |

**Table 1 - Total Project Cost Summary**

| | Unit | Quantity | Unit Price | Total Cost |
|---|---|---|---|---|
| Early Start Work | | | | $462,000 |
| Cranes (rental and labor) | | | | $500,000 |
| Sitework | | | | $ 2,753, 000 |
| Building Excavation | | | | $632,000 |
| Support of Excavation | SF | 12,500 | $52.30 | $653,750.00 |
| Foundation | | | | |
| Special Foundations ( Mat) | CY | 2,231 | $900.00 | $2,008,333.33 |
| Walls | SF | 17,908 | $11.92 | $213,463.36 |
| Structure Above Grade | | | | |
| Slab on Grade | SF | 12,200 | $75.00 | $915,000.00 |
| Structural Concrete ( columns, beams, elevated slabs and shear walls) | CY | 3,711 | $400.00 | $1,484,291.85 |
| Structural Steel | | | | $207,000 |
| Other | | | | $165,000 |
| Exterior Skin Envelop | | | | $5,202, 000 |
| Precast | SF | 14,386 | $80.00 | $1,150,880.00 |
| Curtainwall / Window | SF | 12,350 | $175.00 | $2,161,250.00 |
| Brick | SF | 5,047 | $50.00 | $252,350.00 |
| Misc. facade components (metal panels, etc.) | | | | $5,000,000.00 |
| Exterior Soffits | | | | $400,000 |
| Roofing | | | | $606,960 |
| Below Grade Waterproofing | | | | |
| Foundation Wall | SF | 17,908 | $20.00 | $358,160.00 |
| Finishes | | | | $4,055, 000 |
| Bridge to Kim Building | | | | $1,500,000.00 |
| Lab Construction/Costs | | | | $7,000,000.00 |
| Special Equipment | | | | $258,000 |
| Vertical Transportation | | | | $570,000 |
| Mechanical System | | | | $9,850, 000 |
| Electrical System | | | | $5,957,000 |
| General Conditions | | | | $2,596,435 |
| Overhead & Profit | | | | $1,460,495 |
| Preconstruction Services | | | | $250,000 |
| Design Fees | | | | $1,500,000 |
| Other | | | | $250,000 |

## Estimate Summary

| Cost Category | Cost ($) | | Cost (%) | Cost $/ SF | |
|---|---|---|---|---|---|
| **Design Costs/Fees** (includes Design Contingency) | $ | *1,500,000* | 3.80% | $ | *25* |
| **Preconstruction Costs** | $ | *250,000* | 0.63% | $ | *4* |
| **Construction Costs** | | | | | |
| Cost of Work | $ | *32,455,439* | 82.19% | $ | *532* |
| General Conditions/General Requirements | $ | *2,596,435* | 8.00% | $ | *43* |
| Profit (Fee) | $ | *1,460,495* | 4.50% | $ | *24* |
| Other | $ | *250,000* | 0.63% | $ | *4* |
| **Construction Contingency** | $ | *973,663* | 3% | $ | *16* |
| **Estimated Project Cost** | **$** | ***39,486,032*** | | **$** | ***647*** |
| **PROPOSED GMP** | **$** | ***39,486,032*** | | **$** | ***647*** |


Jefferson
Contracting
IDEA
Factory
APRIL 4, 2025

# Agenda

**1**

**Overview**

Meet the Team

**2**

**Team Ideology**

Our approach to the job

**3**

**Design Considerations**

Concrete vs. Steel and Foundation Systems

**4**

**Budget**

Predicted Monetary Allotment

**5**

**Construction Approach**

Site Logistics Plan, Schedule, QA/QC

**6**

**Community**

Community Impact and Commitment to Diversity & Inclusion

**7**

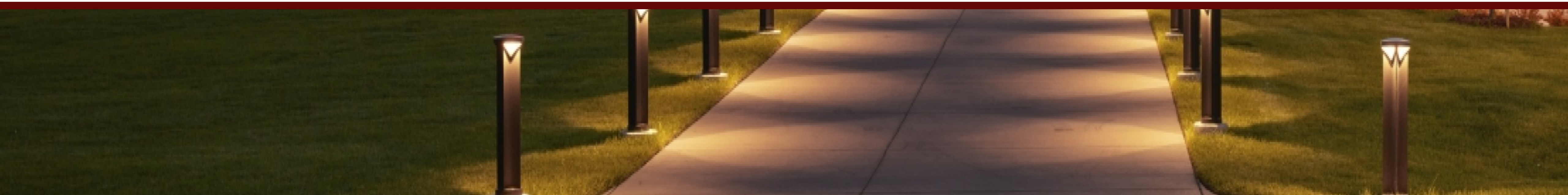
**Why Us?**

Closing Statement

**8**

**Q+A**

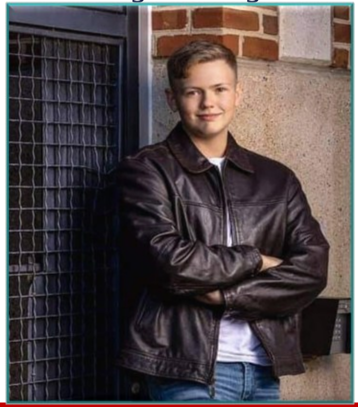
Ask us anything!



# Presentation Team

**Zubaidah Al Jumaili**
Scheduler

**Logan Holsapple**
Design Manager



**Tony Tran**
Project Engineer

**Katy Dominguez**
Superintendent

**Michael Rogerson**
Project Manager

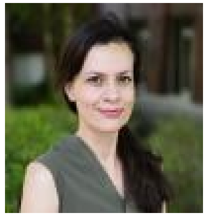
**Faythe Way**
Cost Estimator

# IDEA Factory Project Team

**University of Maryland**
Owner

**EYP Architecture & Engineering**
Architect

**Ryan Knox**
Project Executive



**Diana Duran**
Faculty Advisor

**Mike Rogerson**
Project Manager

**Logan Holsapple**
Design Manager

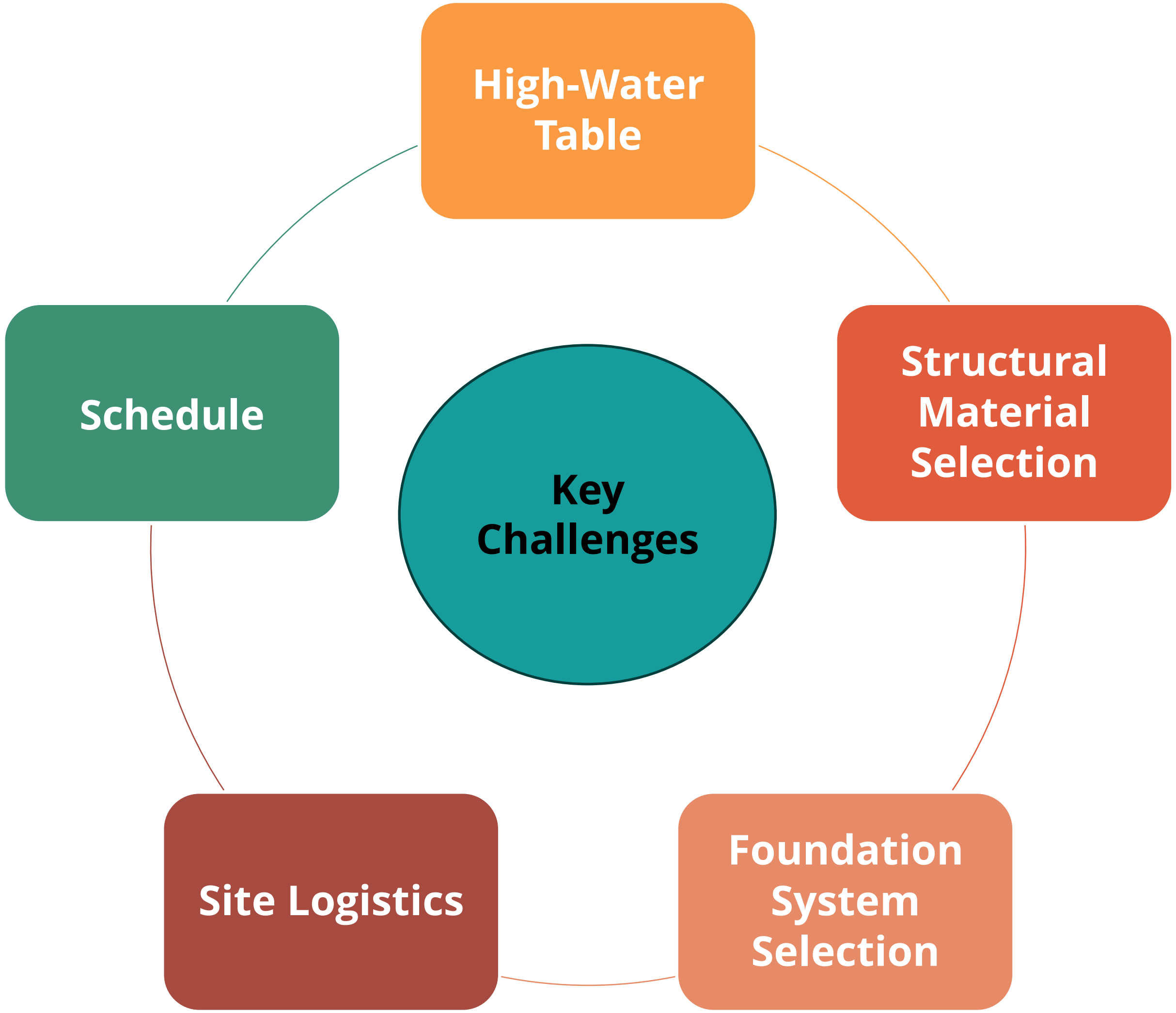
**Faythe Way**
Cost Estimator

**Katy Dominguez**
Superintendent

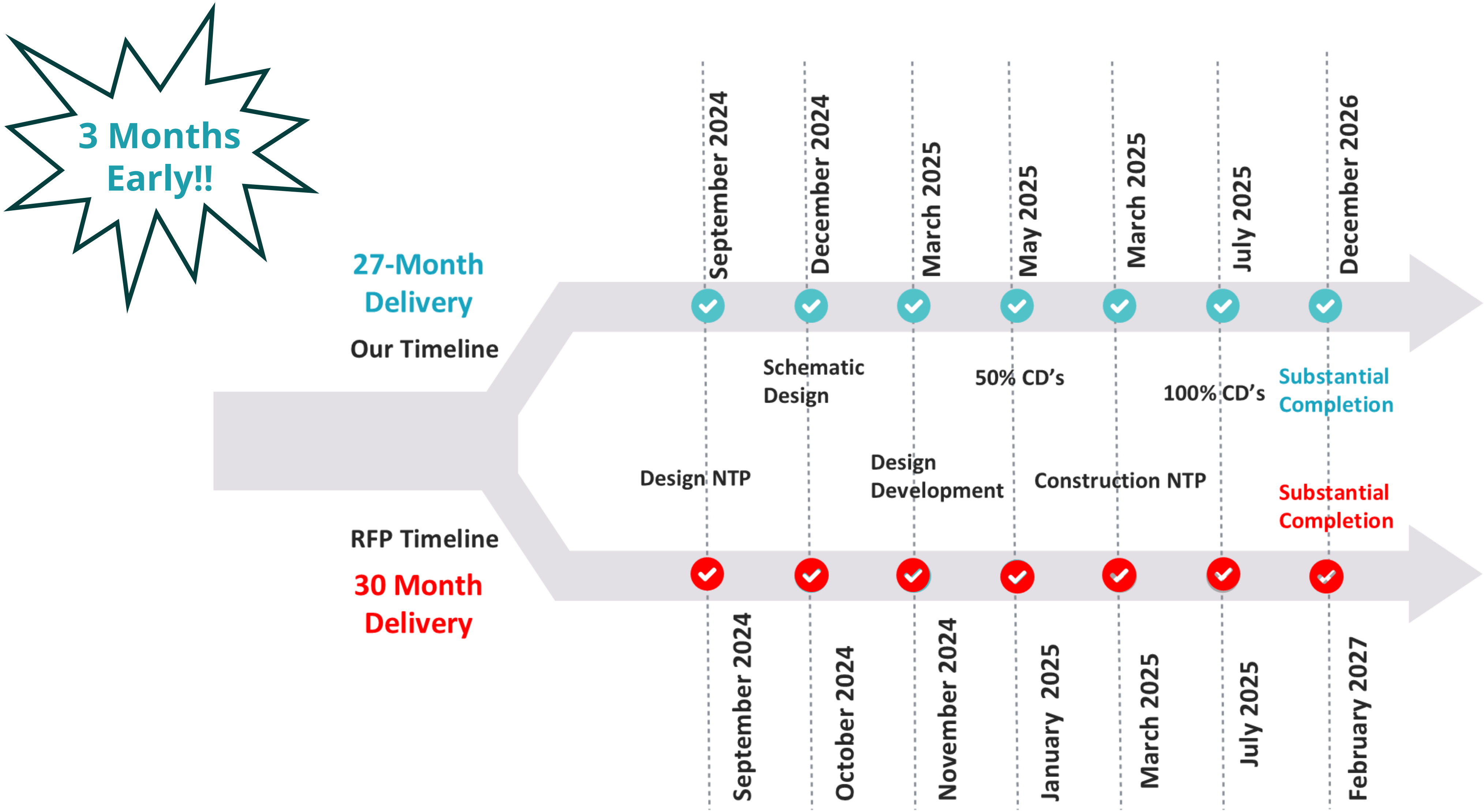
**Zubaidah Al Jumaili**
Scheduler

**Tony Tran**
Project Engineer

# Key Challenges for IDEA Factory Project



# Timeline Comparison



# Jefferson Contracting EATS

- **Elevate**: We ensure our clients' visions are executed to bolster their image and strengthen their platform
- **Align**: We facilitate smooth collaboration between all parties and ensure the right groups are chosen for our clients' projects
- **Thrive**: Both Jefferson Contracting and the client benefit from working together, ensuring project success
- **Succeed**: We are committed to overcoming challenges and doing everything in our power to make each project a success

# Design Considerations

Campus Impact
(25 points)

Schedule
(20 points)

Below Grade Condition
(20 points)

Cost
(10 points)

# DECISION MATRIX

Maintainability
(10 points)

Environmental Sustainability
(5 points)

Labor Efficiency
(5 points)

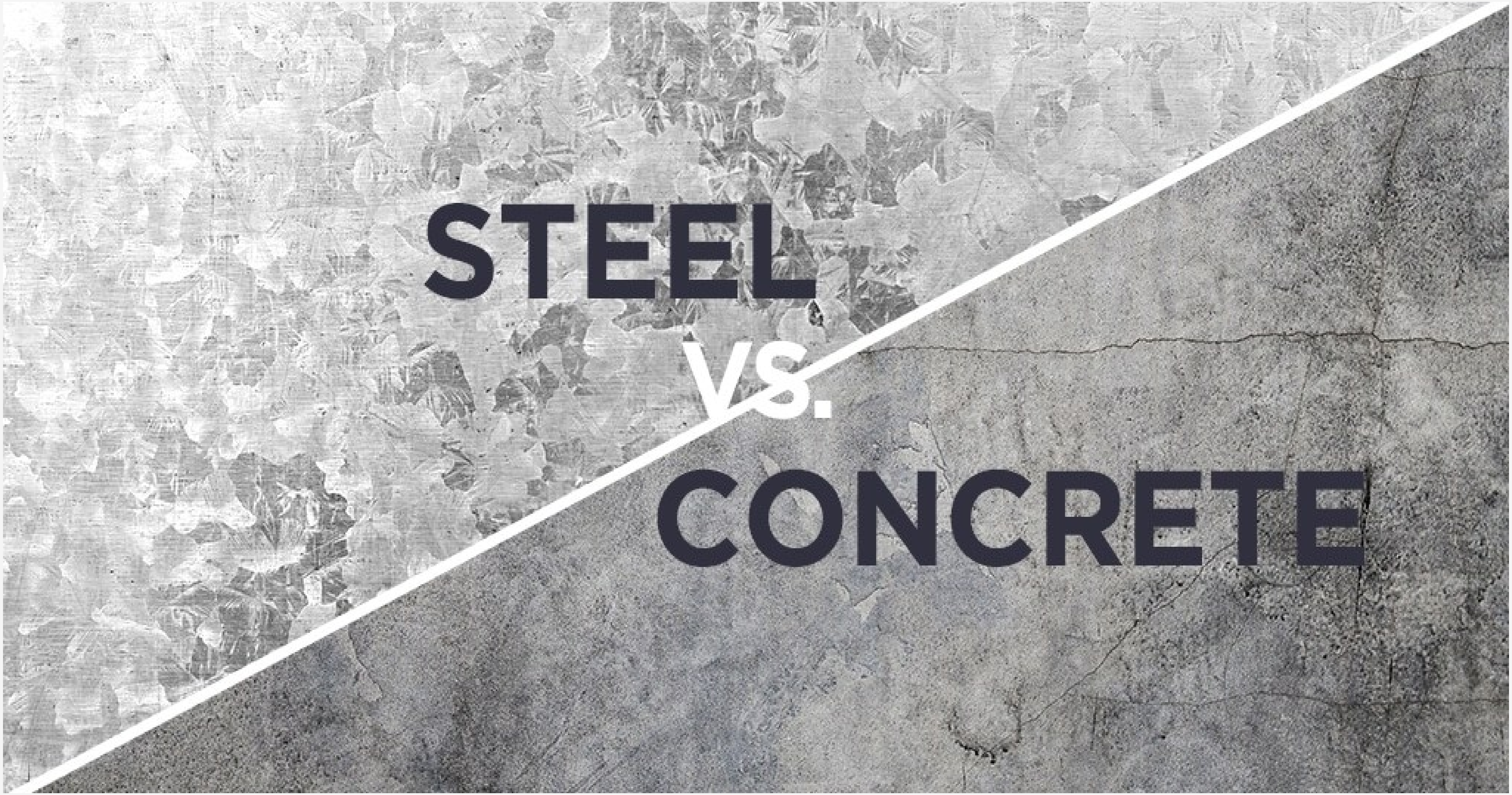
Material Availability
(5 points)

# Foundation Evaluation

| FOUNDATIONS DECISION MATRIX | | | | | | |
|---|---|---|---|---|---|---|
| **CRITERIA** | **Max Possible Score** | **Spread/Strip Footings** | **Mat Slab** | **Rammed Aggregate Piers** | **Driven Steel Piles** | **Drilled Shafts (Caissons)** |
| Campus Impact | *25* | | 23 | | | |
| Schedule | *20* | | 17 | | | |
| Below Grade Condition | *20* | | 20 | | | |
| Cost | *10* | | 10 | | | |
| Maintainability | *10* | | 10 | | | |
| Environmental Sustainability | *5* | | 2 | | | |
| Labor Efficiency | *5* | | 3 | | | |
| Material Availability | *5* | | 5 | | | |
| **Total Score** | 100 | 85 | 90 | 78 | 62 | 63 |

# Support of Excavation Evaluation

| SHORING AND BRACING DECISION MATRIX | | | | | | |
|---|---|---|---|---|---|---|
| **CRITERIA** | **Max Possible Score** | **Soldiers Piles/Lagging** | **Sheet Piles** | **Secant Piles** | **Struts** | **Rakers** |
| Campus Impact | *25* | | 21 | | | |
| Schedule | *20* | | 20 | | | |
| Below Grade Condition | *20* | | 20 | | | |
| Cost | *10* | | 8 | | | |
| Maintainability | *10* | | 8 | | | |
| Environmental Sustainability | *5* | | 4 | | | |
| Labor Efficiency | *5* | | 4 | | | |
| Material Availability | *5* | | 5 | | | |
| **TOTAL SCORE** | 100 | 74 | 90 | 58 | 76 | 67 |

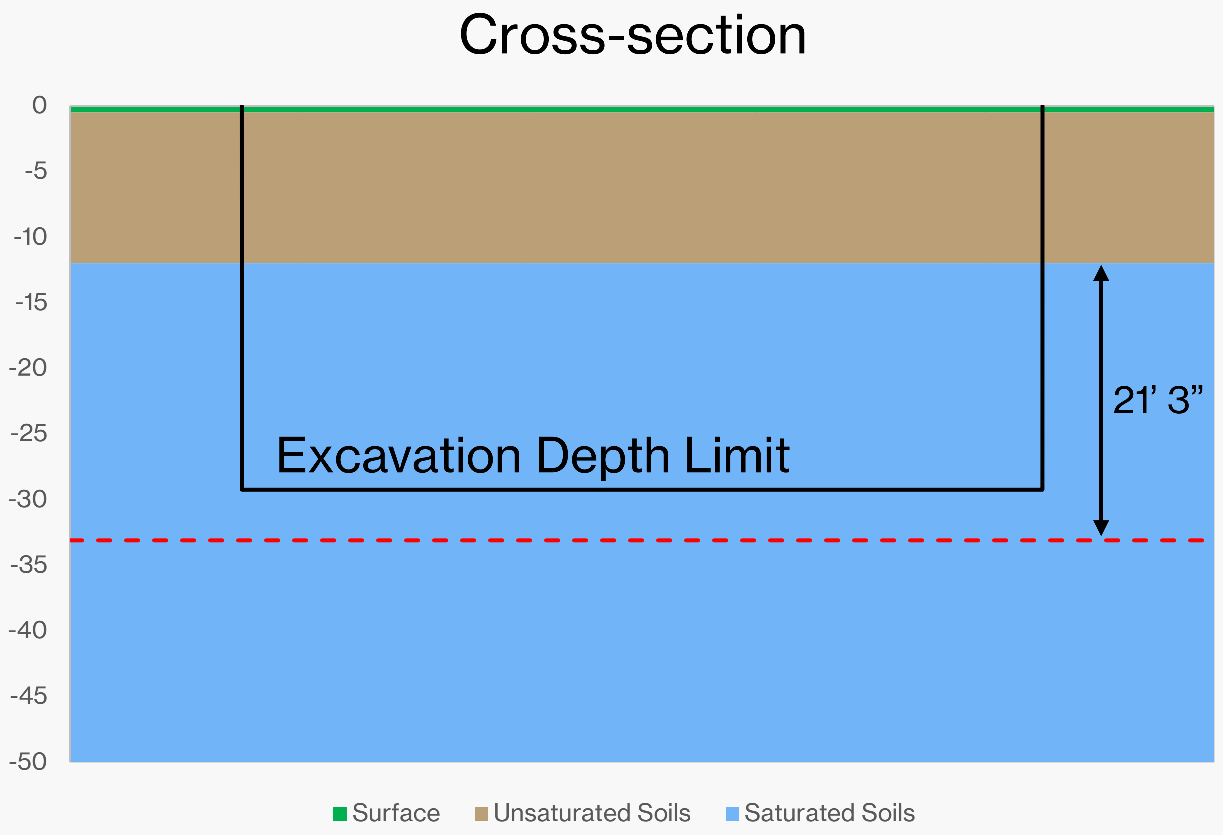

STEEL
VS.
CONCRETE

# STEEL VS CONCRETE

| CRITERIA | STEEL | CONCRETE |
|---|---|---|
| Material & Functionality | Lightweight, adaptable | Ideal for labs, heavyweight |
| Cost and Time | Higher cost, fast installation | Lower cost, Slower installation |
| Vibration Control | Increased vibration, needs damping | Excellent vibration control |
| Foundation Impact | May need tie-downs | Good stability in highwater areas |
| Sustainability | Recyclable, energy-intensive | Green mixes available |
| Longevity | Requires ongoing maintenance | Long lasting, minimal maintenance |

# Construction Dewatering Plan

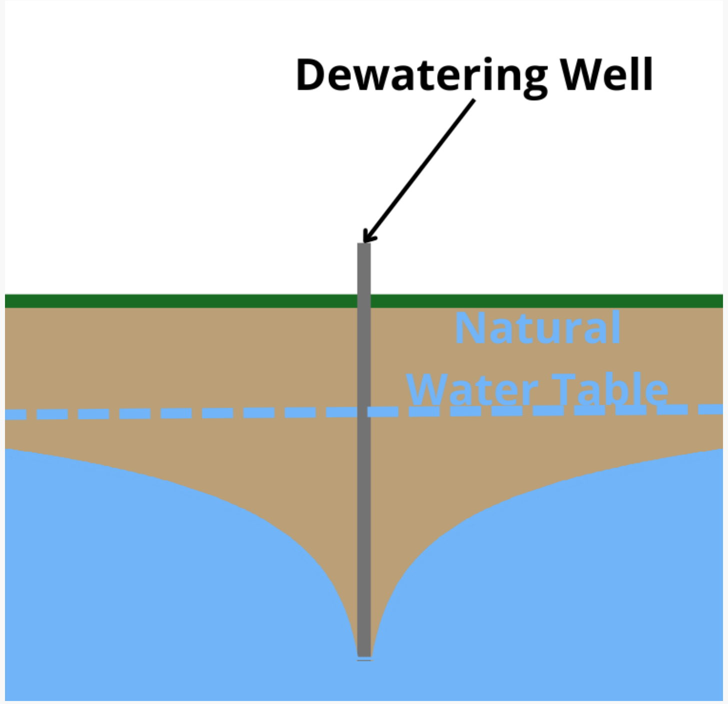
## Deep Well Point Dewatering




- Water Table is 12' below grade
- Max Excavation Depth of 30' 3"
- Need water table an additional 3' below deepest excavation
- Required drawdown of 21' 3"

# Construction Dewatering Plan

## Deep Well Point Dewatering




$$u = \frac{r^2 S}{4Tt}$$

$$W(u) \cong -0.5772 - \ln(u) + u - \frac{u^2}{2 * 2!} + \frac{u^3}{3 * 3!} + \cdots$$

$$s = \frac{Q}{4\pi T} W(u)$$

**Modeling Methodology**

- Theis Equation

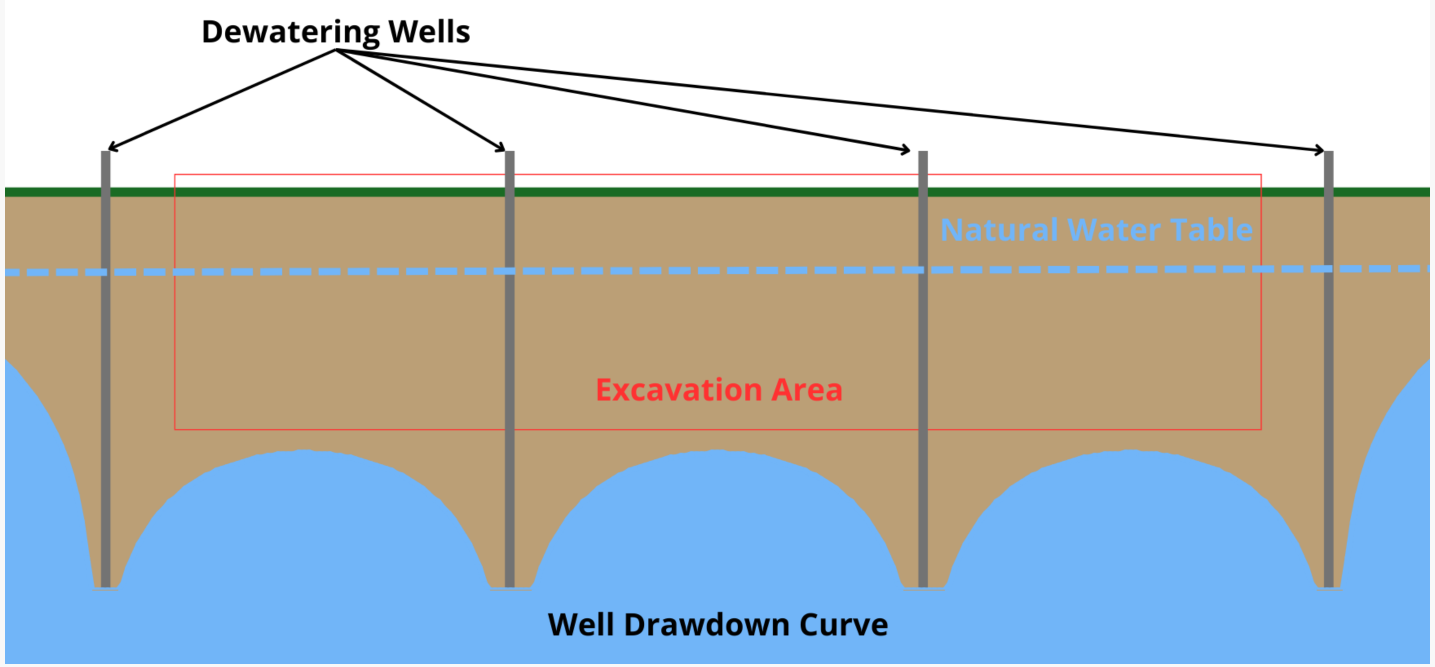
**Assumptions**

- Uniform Hydraulic Conductivity
- Soil conditions generally correspond to Geotechnical Report
- Groundwater flow below 40 ft is not a factor

# Construction Dewatering Plan

## Deep Well Point Dewatering

**Drawdown Effects at 80 ft spacing**



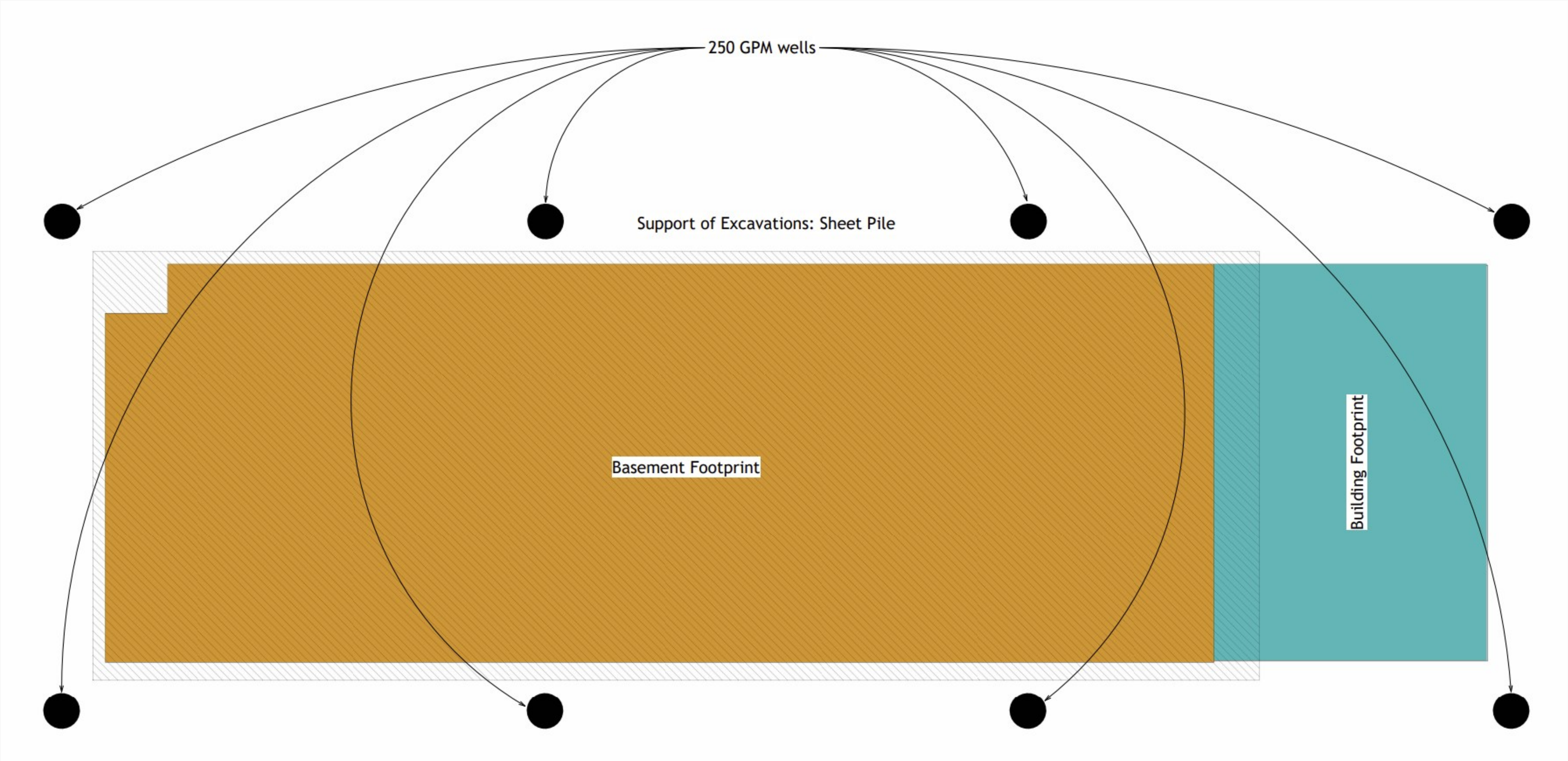

For 85 ft spacing

- Min. drawdown from 1 well = 11’ $^{1}/_{2}$”
- Considering drawdown effect from 2 nearest wells
- Drawdown at midpoint (with max 85’ spacing) = 22’ 1”’

22’ 1” > 21’ 3” ✓

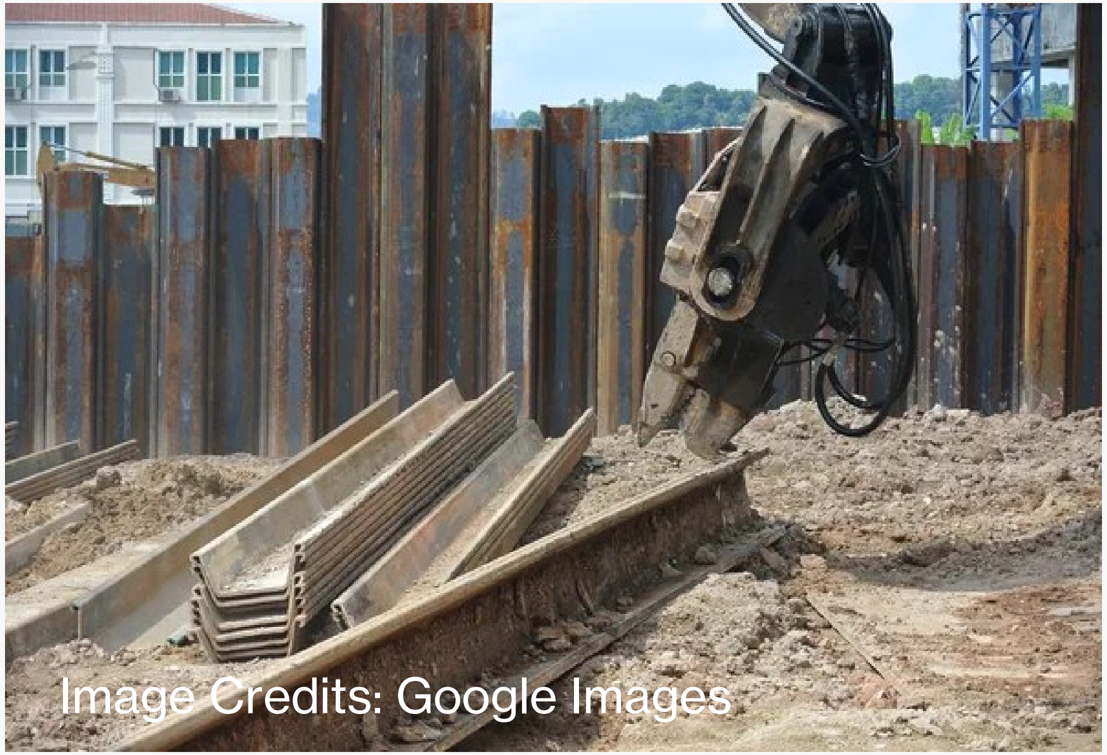
# Construction Dewatering Plan

## Deep Well Point Dewatering



# Construction Dewatering Plan

## Sheet Piles



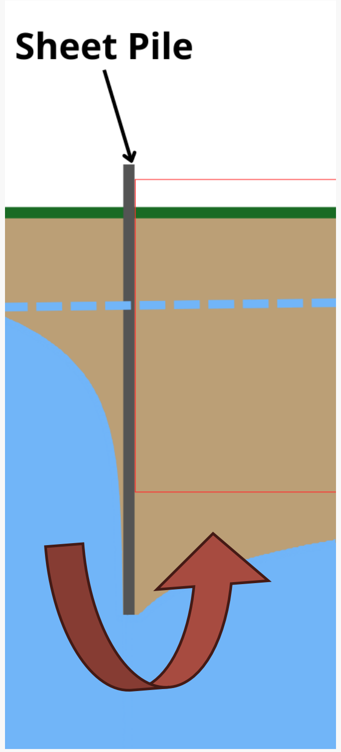

Interlocking Joints

↓

Sealed

↓

Impermeable



# Permanent Ground Water Management Plan

# Budget

# Assumptions and Exclusions

Bridge to KIM Building

Marketing

Miscellaneous Façade Materials

Demolition

Scope Changes/Unforeseen Conditions

Dirt Disposal &Transport

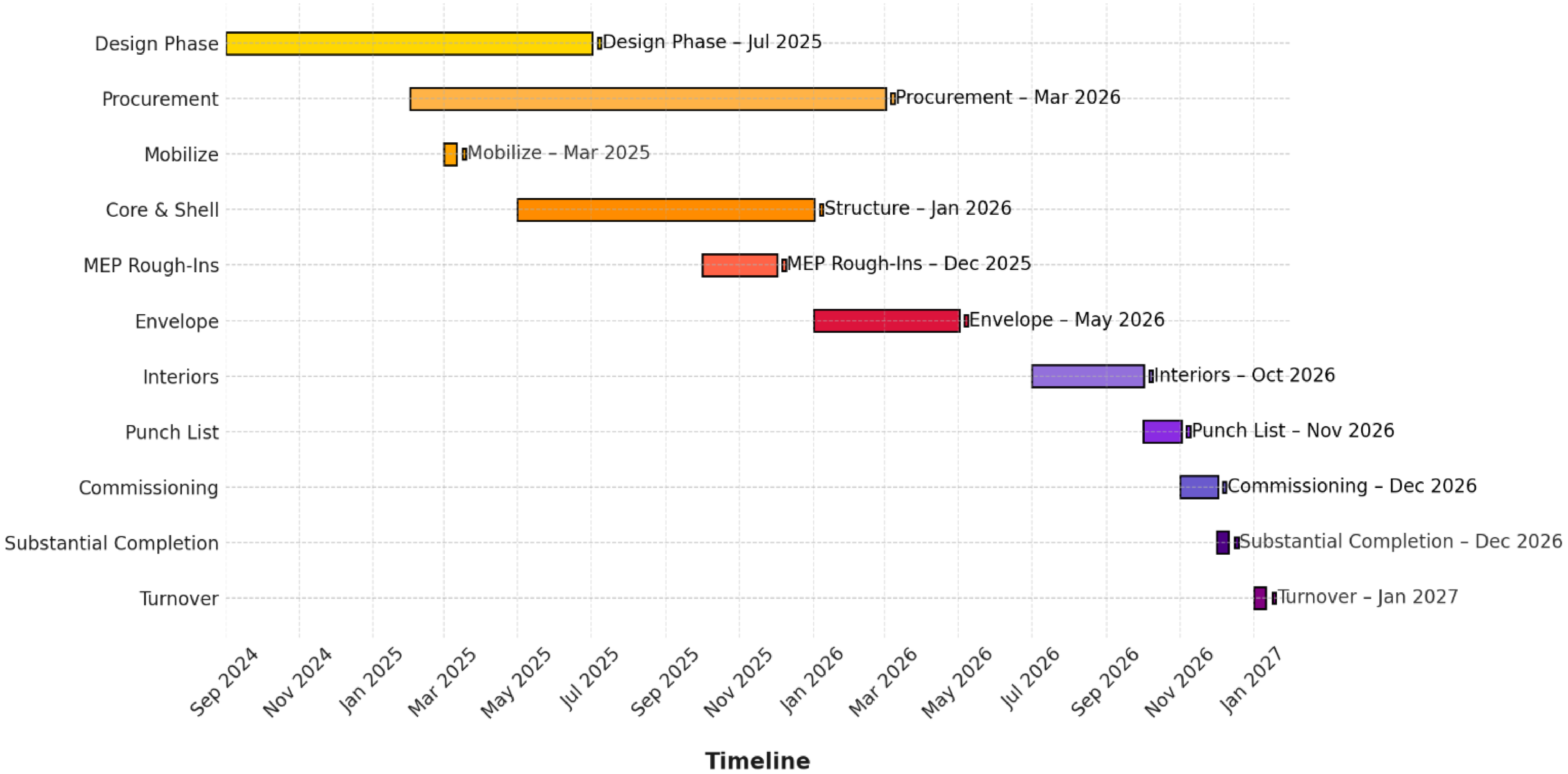
Presence of Hazardous Materials

# Summarized Cost Estimate

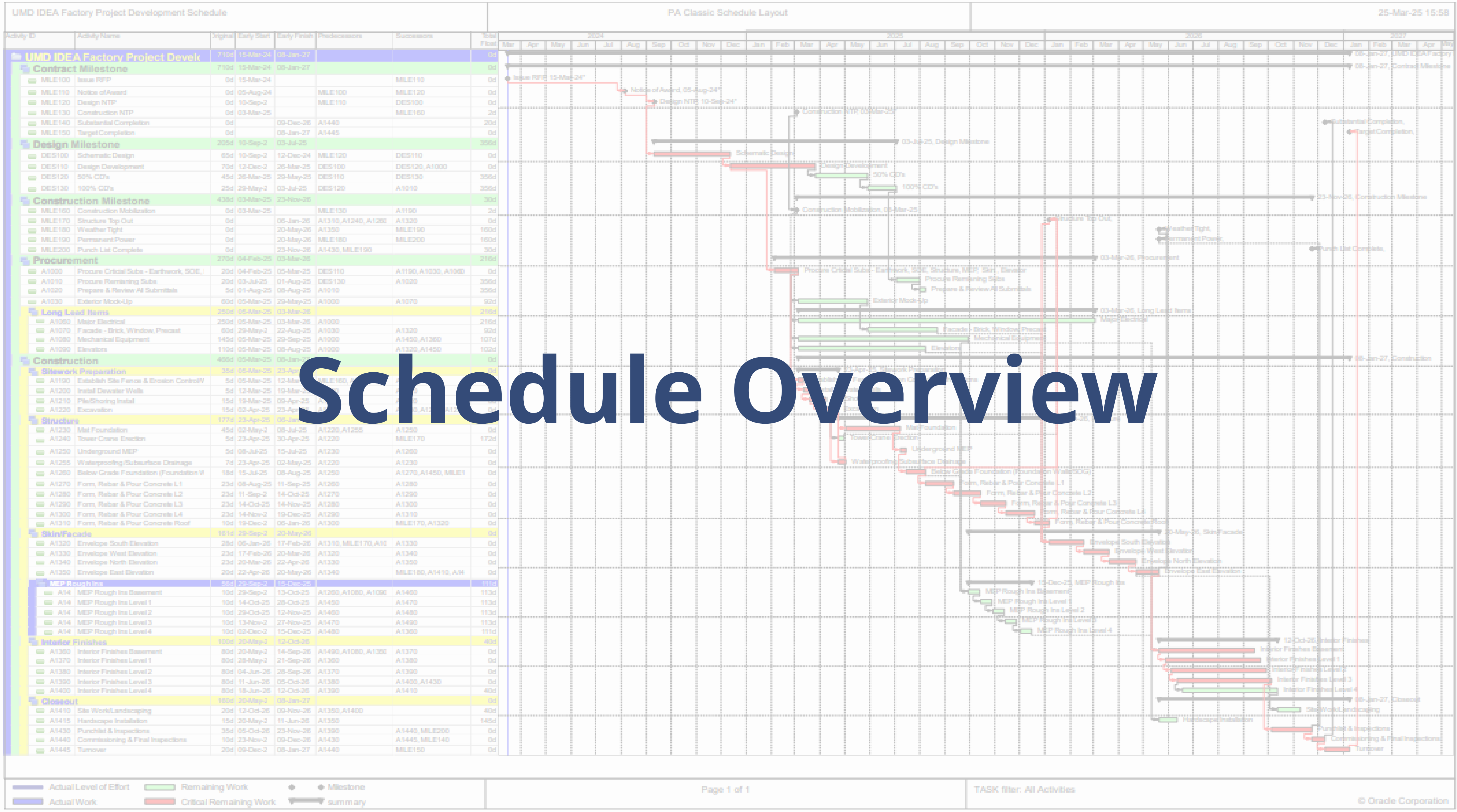
| Cost Category | Cost ($) | Cost (%) | Cost $/SF |
|---|---|---|---|
| **Design Costs/Fees** *(includes Design Contingency)* | $1,500,000 | 3.80% | $25 |
| **Preconstruction Costs** | $250,000 | 0.63% | $4 |
| **Construction Costs** | | | |
| Cost of Work | $32,455, 439 | 82.19% | $532 |
| General Conditions/General Requirements | $2,596,435 | 8.00% | $43 |
| Profit (Fee) | $1,460,495 | 4.50% | $24 |
| Other | $250,000 | 0.63% | $4 |
| **Construction Contingency** | $973,663 | 3.00% | $16 |
| | | | |
| **Estimated Project Cost** | **$39,486,032** | | **$647** |
| **Proposed GMP** | **$39,486,032** | | **$647** |

# Construction Approach

# IDEA Factory Key Project Phases

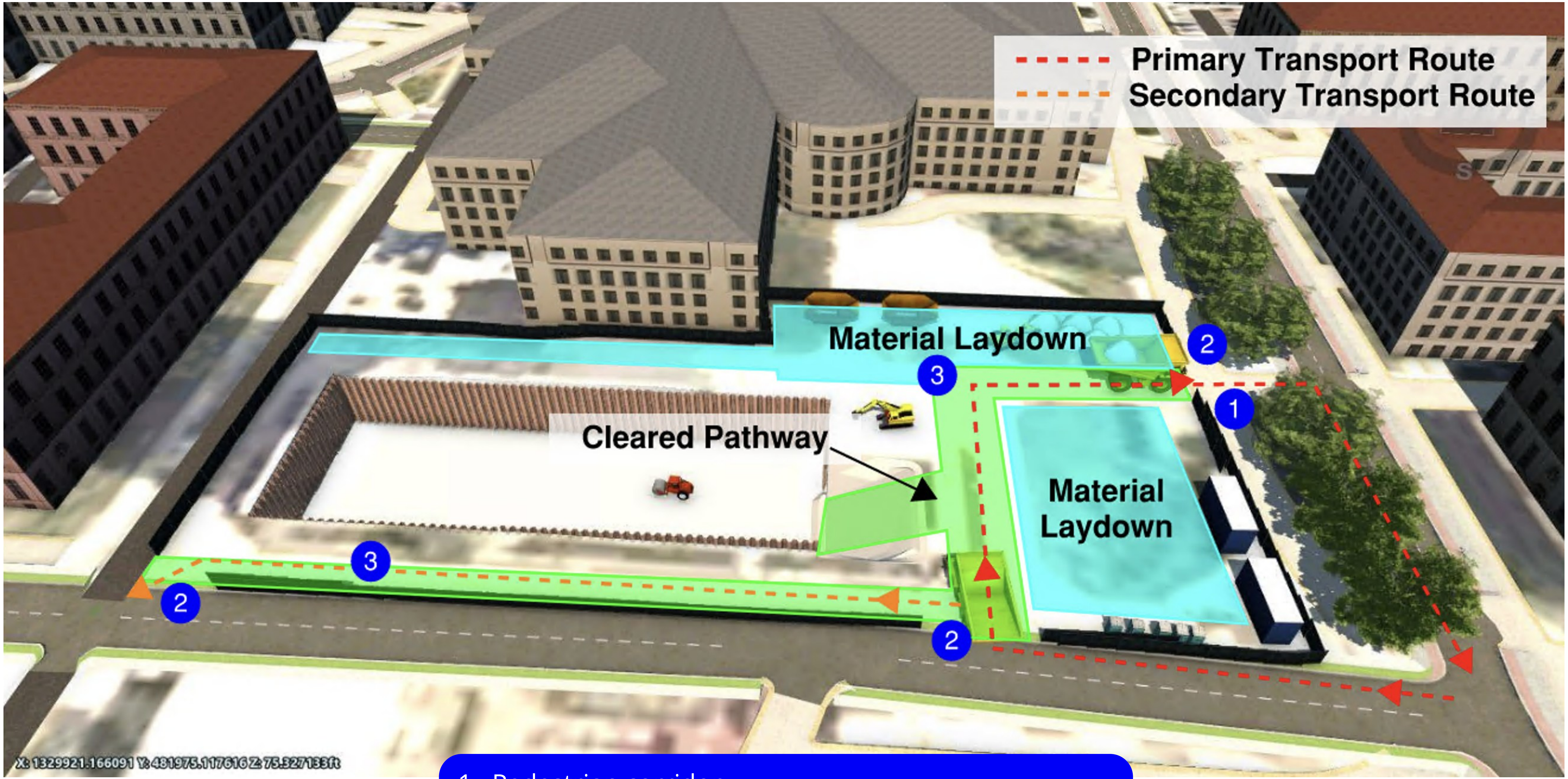


# Schedule Overview



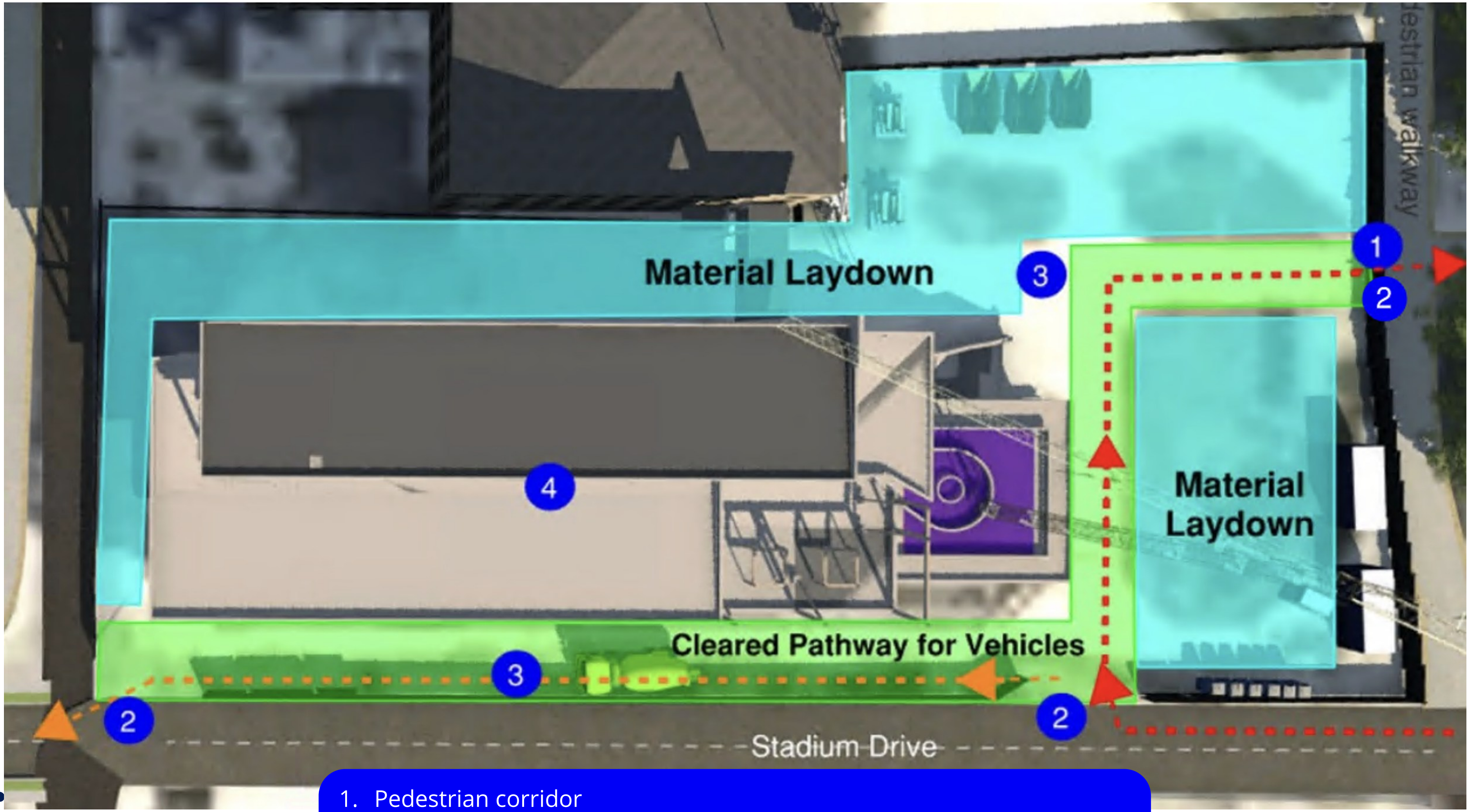
# Site Logistics

# Phase I – Excavation Site Plan



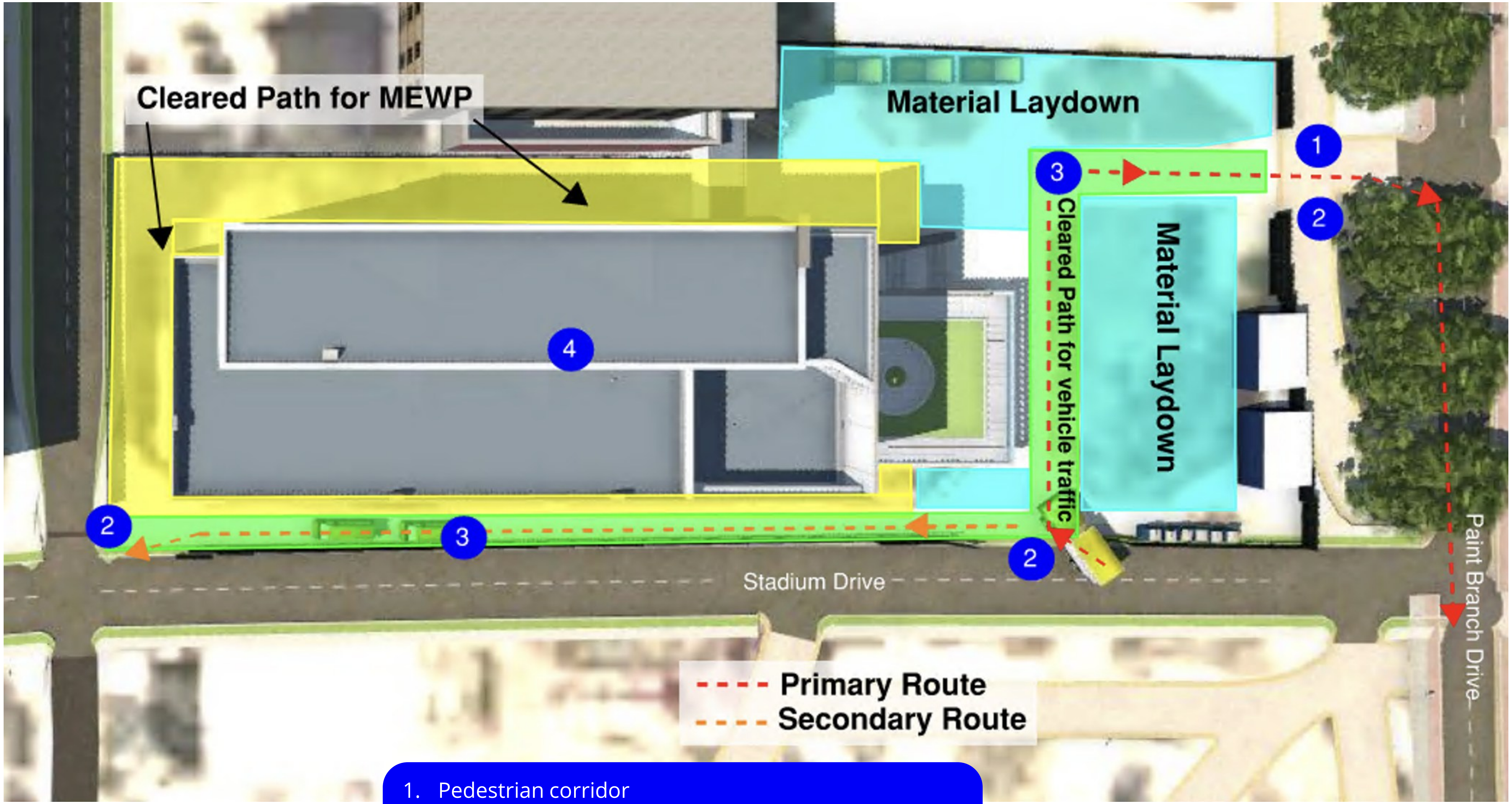

1. Pedestrian corridor
2. Possible flaggers required for large vehicle entry/exit
3. Loading and unloading locations

# Phase II - Structural




1. Pedestrian corridor
2. Possible flaggers required for large vehicle entry/exit
3. Loading and unloading locations
4. Additional material storage at each floor level after setting

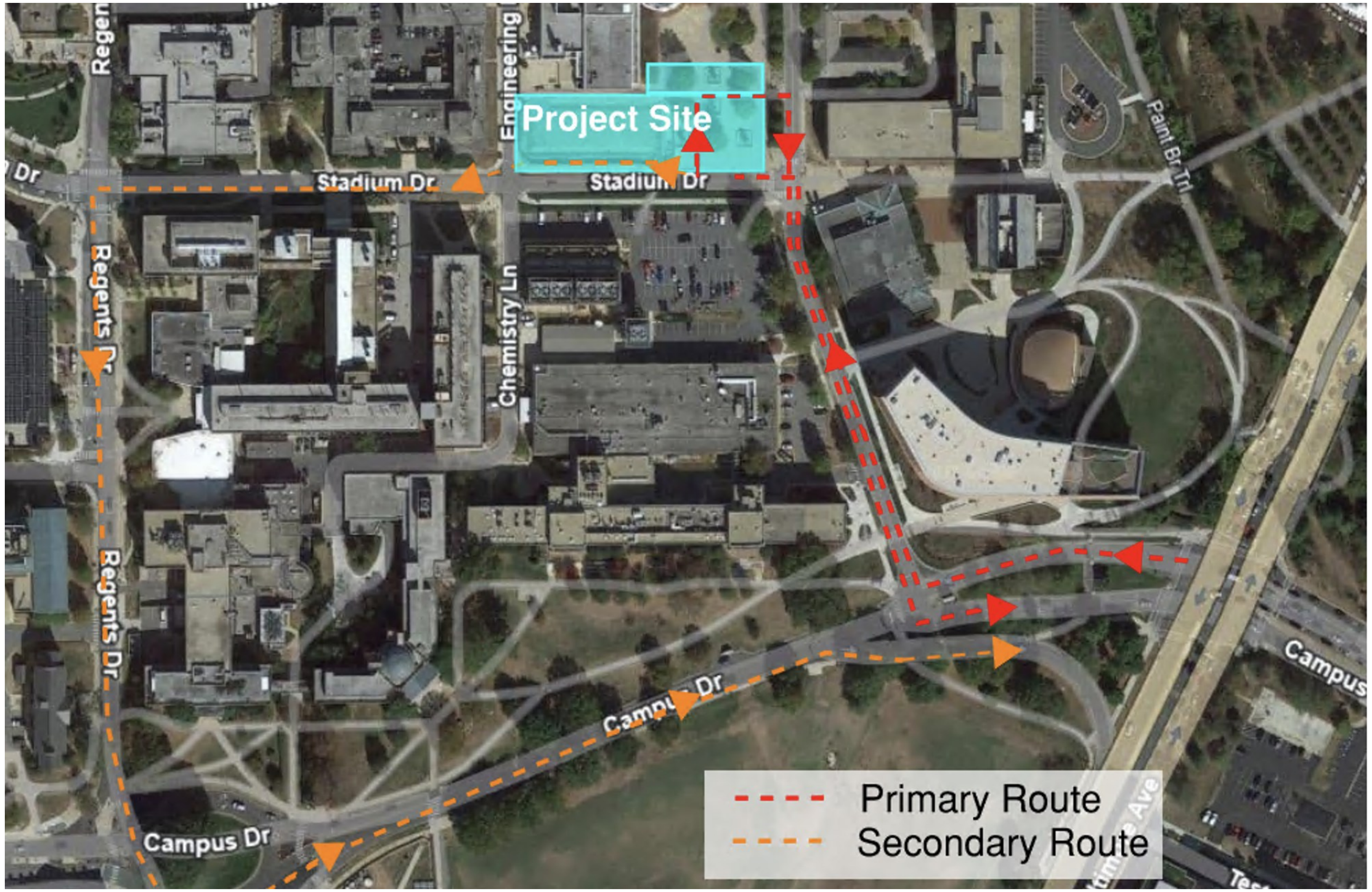
# Phase III – Envelope




1. Pedestrian corridor
2. Possible flaggers required for large vehicle entry/exit
3. Loading and unloading locations
4. Additional material storage at each floor level

# Delivery/Transport route in/around UMD

- Using Baltimore Avenue for access to and from project site
- One entry, two exit points
- Primary route (in red) to be used in periods of low pedestrian traffic
- Secondary route (orange) will be used more frequently
- This route to be communicated to trade partners



# Prioritizing Safety

Jefferson Contracting is committed to safety on the jobsite. A culture of safety for our teams means conducting regular safety training, ensuring people are equipped with proper PPE and other safety equipment, and that all personnel on site are empowered to enforce safety across the board.

| | | | |
|---|---|---|---|
| Envelope | Enforce proper fall arrest systems used in operation of EWP's | Ensure operators are qualified to operate EWP's | Ensure proper (safe) use of EWP's |
| Structure | Ensure handrail and toe board installation | Identify tie off points for roof work | Use of whistles for overhead loads |
| Excavation | Locate underground utilities | Acquire dig permits | Enforce proper shoring and bracing |

# Quality

### 1. Pre-Construction Expectations

- Design Development Reviews with Owner
- BIM/VDC Coordination
- Constructability Reviews
- Submittal Review
- Mock-Ups
- Quality Kickoff Meetings

### 2. First Work Inspection and DFoW

- Early Quality Assurance
- Preparatory Phase
- Initial Phase
- Follow-Up Phase for Continuous QA

### 3. Quality Control

- Internal Spot Check QCs
- Inspections
- Commissioning
- Warranties
- Internal Punchlists

### 4. Delivery of As-Builts, O&M Manuals

- Owner Trainings
- Attic Stock Delivery
- Guarantees
- Incorporation of 3D As-Built into UMD Infrastructure

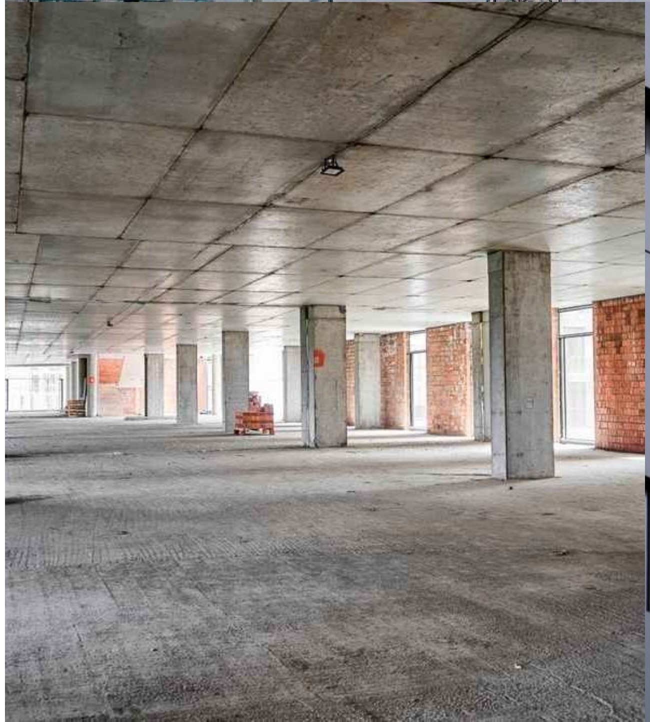
# Key First Work Inspections and DFoW

**Early Packages and Critical Items**

1. Concrete Slab and Elevated Deck Pours
2. Below Grade Blindside Waterproofing
3. Façade and Masonry Install
4. Exposed Concrete for Beams and Columns

**Field Items**

1. Roofing
2. MEP Sleeving and Hangers
3. Controls and Low Voltage
4. Cold-Formed Metal Framing
5. Interior Finishes



# Community

# Community Impact

**University Impact**:
Enhance UMD’s reputation as a leading research hub and public university.

**IDEA Factory Goals**:
Foster a collaborative, innovative, and research-driven learning space.

**Jefferson Contracting's Mission**:
Create a positive community impact at UMD.

# MBE & Inclusion

**30%** of contract value committed to MBE

**Commitment to Diversity**: Advocating for diverse project teams across all projects.

**Team Ideology – "T" in EATS**: Emphasizing that teams **thrive together** with varied perspectives.

**MBE Participation**: Enhancing innovation and teamwork through Minority Business Enterprise (MBE) subcontractors.

**Parallels to UMD**: Reflecting the university's diverse community to foster innovation and collaboration.

**Project Priority**: Actively including MBE-certified subcontractors to achieve the project's vision.

# Why Jefferson Contracting?

University of Virginia

Jefferson Contracting

# Thank You!

# Questions?

# Jefferson Contracting

**IDEA Factory at the University of Maryland**
**Response to Request for Proposal**
**April 4th, 2025**


***University of Virginia***
***Charlottesville, VA 22903***

# TABLE OF CONTENTS

I

INTRODUCTION

II

DESIGN SOLUTION

III

PROJECT EXECUTION

IV

PRICE PROPOSAL

V

APPENDIX

# Introduction

# Project Overview

The E.A. Fernandez Innovate, Design, and Engineer for America (IDEA) Factory

- 61,000-square-foot building at the University of Maryland, College Park
- Designed to foster innovation in engineering and science
- Provides future engineers with essential tools, resources, and collaboration opportunities

Features:

- 12,000 GSF 1-level basement below grade
- 5 stories with a 14,000 SF floor plate above grade
- Pedestrian bridge connecting to the Jeong H. Kim Engineering Building

Key facilities:

- Rotorcraft Laboratory
- ALEx Garage
- Quantum Technology
- Microscope Suite
- Startup Shell
- Robotics Realization Laboratory

# Key Objectives

| Design & Planning | Groundwater Management | Scheduling |
|---|---|---|
| Develop thoughtful designs, estimates, schedules, and plans for accuracy and quality. | Implement a cost-effective and efficient plan to manage the high groundwater environment. | Consider sequencing, durations, and client timelines in the proposed schedule. |

| Pricing | Structural Systems Comparison | Site Logistics Plan |
|---|---|---|
| Provide an accurate and inclusive cost-estimate, considering specialty materials/trades and large equipment rentals | Develop a matrix to convey thought processes and recommend solutions. | Create a three-phase  3D model showing project site relations at various construction stages. |

# Key Challenges for IDEA Factory Project

**Key Challenges**

**High-Water Table**

Requires temporary dewatering during excavation and permanent sub-drainage to prevent water intrusion

**Structural Material Selection**

Balancing cost, sustainability, and structural integrity between concrete and steel

**Foundation System Selection**

Evaluating mat slab, footings, piers, or driven piles for stability and efficiency

**Site Logistics**

Managing material storage, traffic flow, and pedestrian safety in a busy campus environment

**Schedule**

Coordinating phased construction activities to align with academic schedules and minimize disruptions

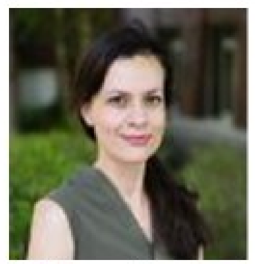
# IDEA Factory Project Team

**University of Maryland**
Owner

Page/

**EYP Architecture & Engineering**
Architect

**Ryan Knox**
Project Executive

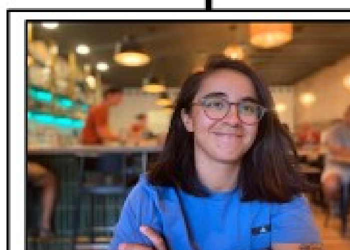


**Diana Duran**
Faculty Advisor

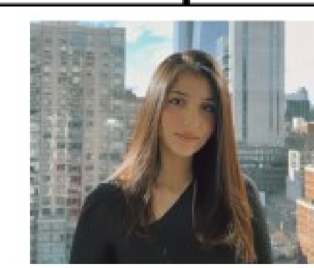
**Mike Rogerson**
Project Manager

**Logan Holsapple**
Design Manager

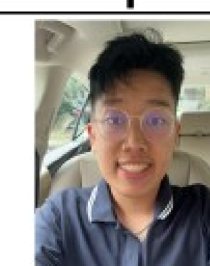
**Faythe Way**
Cost Estimator



**Katy Dominguez**
Superintendent



**Zubaidah Al Jumaili**
Scheduler



**Tony Tran**
Project Engineer

# Mike Rogerson

***Project Manager***

Owner and design team liaison

Conduct internal team meetings

Facilitates budget and change order approval

Coordinates with superintendent for constructability reviews and scheduling

Coordinates with cost estimator to develop budget for design and construction phases

Coordinates with scheduler for input on CPM and managing material lead times

**Work Experience**

- Teaching Assistant in the Department of Civil Engineering for Introduction to Construction, Project Business Planning, and Risk Analysis
- Incoming Project Engineer for Whiting-Turner
- Project Intern on Tenant Improvements at Medical Office Building and 22-Story Senior Independent Living Tower

# Katy Dominguez

***Superintendent***

**Work Experience**

- Army veteran – leadership and administrative experience
- Two years building envelope testing/inspection with Lerch Bates
- Project engineer intern on the Western Stock Show Headquarters, Legacy Building
- Incoming project engineer with Saunders Construction Inc. (Denver, CO)

Site logistics champion

Constructability champion

Coordination with the design manager for constructability review of dewatering, shoring, foundation, etc.

Coordination with project engineer on site-specific quality assurance

Safety manager

# Logan Holsapple

***Design Manager***

Material Selection Coordinator

Manage Design Team as Part of DBC

Determine Shoring and Bracing Systems

Material Lead Times

Coordinate with Scheduler for Phasing/Sequencing

## Work Experience

- Dam Safety Engineer - produced Emergency Action Plans (EAPs) for 4 high-hazard dams, coordinated with state regulatory agency, completed owner yearly inspections
- Geotechnical Engineer - QA/QC inspections of reinforcing steel, formwork, and concrete placement; geotechnical investigations including SPT drilling, electrical resistivity imaging (ERI), seismic refraction, and soil laboratory analyses
- Teaching assistant in the University of Virginia's Civil Engineering department

# Zubaidah Al Jumaili

***Scheduler***

Milestone Manager

Coordinate with Cost Estimator

Relay schedule to team with knowledge of critical paths, float times, etc.

Develop weekly look-ahead schedules for team coordination

Lead scheduler for IDEA Factory project

**Work Experience**

- 1 year as a Construction Scheduling Intern
- Experience with Primavera P6 and MS Project
- Incoming Project Engineer at DPR Construction

# Faythe Way

***Cost Estimator***

Complete materials and construction cost comparisons

Monitor progress and update the schedule regularly

Updating costs associated with scheduling changes/material availabilities

Cost estimator for IDEA factory project

Creative design manager for presentations/documents

**Work Experience**

- 1 year as an estimating engineer intern
- Incoming civil engineer analyst at Kimley-Horn in Dallas TX
- Licensed Real Estate Referral Agent

# Tony Tran

***Project Engineer***

Document Review Champion

Presentation Manager

Develop a Site-Specific Quality Control/Quality Assurance Plan

Coordinate with Project Manager

Coordinate with Cost Estimator for IDEA Factory Estimate

**Work Experience**

- 1 year as an Estimating Engineer Intern
- 1 year as a Project Engineer Intern


## Team Ideology: Jefferson Contracting EATS

Jefferson Contracting is a University of Virginia (UVA) - based general contracting firm. With this, the Jefferson Contracting EATS ideology encapsulates everything that our team strives to accomplish with all of our projects. We ***elevate*** our clients by ensuring that their vision for the project is executed in a way that bolster's their image and strengthens their platform. We ***align*** teams by making collaboration between all parties as smooth as possible and guaranteeing that the proper groups are chosen to be a part of our client's project. We ***thrive*** together in the way in which both parties, the client and Jefferson Contracting, are able to benefit from working with one another in the manner in which Jefferson Contracting makes sure that the project is successful. This connects with the last part of our acronym, ***succeed***. Jefferson Contracting always assures its clients that they will do everything in their power to see that the project at hand is a successful one no matter what challenges are present for the given project.


Design
Solution

# Decision Matrix Explained

Jefferson Contracting created the following decision matrix to inform UMD of the selection of Support of Excavation and Foundation Systems. The project team highlighted eight different categories to have a comprehensive view of each option and assigned relative weights-based importance to UMD. The following is an explanation of each criteria and a justification for the weighting.

### 1. Campus Impact (Max Score: 25 points)

The project's location is within an active university campus, making minimal disruption a top priority. An option that has a low level of noise, vibration, and disturbance would be given the highest weight. Ensuring smooth campus operations while maintaining construction efficiency is important.

### 2. Schedule (Max Score : 20 points)

Time efficiency is also crucial to meeting project deadlines. Some options require longer installation times due to labor-intensive processes or curing periods, impacting overall project timeline. Faster methods that allow for quicker construction would receive higher scores.

### 3. Below Grade Condition (Max Score: 20 points)

Due to the presence of a high groundwater table, there is a strong need to focus on water management. The selected options need to provide structural stability while preventing water infiltration. Options that effectively mitigate hydrostatic pressure and ensure durability would score higher.

### 4. Cost (Max Score: 10)

Cost-effectiveness is also a key consideration to maintain the project budget. Options that optimize materials, reduce labor-intensive processes, and minimize the need for special equipment were rated higher. Moreover, cost was weighted lower than schedule and performance criteria to ensure long-term value over short-term savings.

### 5. Maintainability (Max Score: 10)

Long-term maintenance requirements would impact project efficiency and lifecycle costs. Options that require minimal future repairs, allow for easy inspection, and require less frequent interventions would be scored higher in this category.

### 6. Environmental Sustainability (Max Score: 5)

Environmental considerations play an important role in material selection and construction procedure. Options with low environmental impact, minimal material waste, and potential for reuse would be given higher ratings.

### 7. Labor Efficiency (Max Score: 5)

The complexity of installation directly affects labor demands. Options requiring specialized skills, long work hours, or additional safety measures would be rated lower, while options allowing for simple labor processes received higher scores.

### 8. Material Availability (Max Score: 5)

Delays due to material availability can affect overall project timelines. Readily available materials that reduce lead times and supply chain risks would be rated higher, ensuring uninterrupted construction progress.

# Foundation Evaluation

| Foundations Decision Matrix | | | | | | |
|---|---|---|---|---|---|---|
| **Criteria** | **Max Possible Score** | **Spread/Strip Footings** | **Mat Slab** | **Rammed Aggregate Piers** | **Driven Steel Piles** | **Drilled Shafts (Caissons)** |
| Campus Impact | *25* | 25 | 23 | 20 | 20 | 18 |
| Schedule | *20* | 20 | 17 | 16 | 15 | 10 |
| Below Grade Condition | *20* | 10 | 20 | 18 | 10 | 20 |
| Cost | *10* | 9 | 10 | 8 | 4 | 3 |
| Maintainability | *10* | 8 | 10 | 4 | 3 | 6 |
| Environmental Sustainability | *5* | 3 | 2 | 4 | 2 | 2 |
| Labor Efficiency | *5* | 5 | 3 | 4 | 4 | 2 |
| Material Availability | *5* | 5 | 5 | 4 | 4 | 2 |
| **Total Score** | 100 | 85 | 90 | 78 | 62 | 63 |

Jefferson Contracting suggests using a mat slab for the foundation because it is stable, cost-effective, and well-suited for challenging conditions like high water tables. The large, continuous concrete slab evenly distributes the weight of the building, which is especially helpful in areas with weak or unstable soils. This also reduces the need for multiple smaller footings, making it a more affordable choice for larger buildings. While the installation process can be complex and requires skilled labor and careful planning, the long-term benefits of durability and low maintenance can outweigh these challenges. Additionally, although using large amounts of concrete raises environmental concerns, sustainable materials can help minimize the impact. Overall, mat slab provides strong, reliable support for large structures like the IDEA Factory when properly planned and executed.

Example of Mat Slab Installation

# Foundation Evaluation

**Campus Impact – 23**

Heavy machinery and large concrete pours are required for the mat slab, which can be noisy. However, the disruption can be mitigated by scheduling work to be done at times in which construction is less of a bother to the community.

**Schedule – 17**

With the mat slab, curing times must be considered, and due to the size and complexity of this system, installation will likely take a few weeks. Weather may also impact the timeline of the mat slab installation.

**Below Grade Condittion – 20**

It acts well with a highwater table as it provides stability at the base of the structure, especially due to the way in which it evenly distributes loads. This foundation in addition to a dewatering system will act very well in an area with a highwater table.

**Cost – 10**

For larger structures, they are very cost-efficient since you only need the one mat slab to cover the land where the foundation will be placed rather than multiple (i.e. multiple spread footings).

**Maintainability – 10**

Given the way in which mat slabs provide an even distribution of loads, they require very minimal maintenance unless settlement issues occur.

**Sustainability – 2**

To make a mat slab, a large amount of concrete is required, which results in a large carbon footprint. However, implementation of more sustainable concrete alternatives may mitigate the negative environmental impacts.

**Labor Efficiency – 3**

Formwork, reinforcement, and concrete placement are required for a mat slab. These tasks are more complex and require more skilled labor.

**Material Availability – 5**

The primary materials required are concrete and rebar, which are easy to acquire. Proper planning for acquiring materials will need to be done given the larger scale of this project, but as long as this is done, material acquirement should be simple.

# Support of Excavation Evaluation

| SHORING AND BRACING DECISION MATRIX | | | | | | |
|---|---|---|---|---|---|---|
| **Criteria** | **Max Possible Score** | **Soldiers Piles/Lagging** | **Sheet Piles** | **Secant Piles** | **Struts** | **Rakers** |
| Campus Impact | *25* | 23 | 21 | 12 | 23 | 19 |
| Schedule | *20* | 18 | 20 | 8 | 18 | 15 |
| Below Grade Condition | *20* | 8 | 20 | 20 | 8 | 8 |
| Cost | *10* | 8 | 8 | 3 | 8 | 7 |
| Maintainability | *10* | 5 | 8 | 8 | 6 | 7 |
| Environmental Sustainability | *5* | 3 | 4 | 2 | 4 | 4 |
| Labor Efficiency | *5* | 4 | 4 | 2 | 4 | 3 |
| Material Availability | *5* | 5 | 5 | 3 | 5 | 4 |
| **TOTAL SCORE** | 100 | 74 | 90 | 58 | 76 | 67 |

Jefferson Contracting recommends implementing sheet piles for the shoring and bracing design. Sheet piles emerged as the best option for this project, particularly due to their performance in critical criteria such as the below grade condition. The interlocking design of sheet piles offers a nearly watertight barrier making sheet piles particularly effective for managing high water tables. While sheet piles may have a moderate impact to campus due to heavy equipment use and noise levels, installation also requires skilled labor and specialized equipment. These aspects can be managed with careful scheduling and experienced labor, respectively. Additionally, their reusability enhances sustainability, which is beneficial for projects with a focus on environmental considerations. Although sheet piles may involve higher costs and moderate maintenance due to potential corrosion, their strong performance in water control and adaptability make them an optimal choice for this project's needs. Overall, sheet piles balance essential requirements, providing an adaptable and sustainable solution for the IDEA Factory.

Example of sheet piles in place

# Support of Excavation Evaluation

**Campus Impact - 21**

Driving sheet piles into the ground creates noise and vibration, which can disturb the campus environment. However, with appropriate scheduling and planning, the impact can be minimized

**Schedule - 20**

Quick installation, but installation speed may vary based on soil conditions, which can delay progress.

**Below Grade Condition - 20**

The interlocking design of sheet piles provides a nearly watertight barrier, making them ideal for excavations in high water table areas or where water control is critical

**Cost - 8**

Can be costly, particularly when using steel piles or in projects requiring specialized driving equipment.

**Maintainability - 8**

While durable, steel sheet piles can corrode, especially in wet environments, necessitating periodic maintenance.

**Sustainability - 4**

Can be reused, especially in temporary applications, enhancing sustainability over multiple projects

**Labor Efficiency - 4**

Sheet pile installation often requires skilled labor and specialized equipment, slightly reducing labor efficiency

**Material Availability - 5**

Standard sheet piles are generally available, though custom shapes or types may require special orders

# Steel v. Concrete

**1. Material Selection and Functionality**

The choice between concrete and steel for structural systems is mostly influenced by the building's intended function and environmental considerations.

- Concrete is well-suited for the laboratory basement due to its fire resistance and low vibration characteristics, which are critical for sensitive equipment. Its rigid structure minimizes deflection, ensuring stability in environments with height restrictions and requirements. Additionally, concrete's substantial weight provides advantages in areas with high water tables, countering buoyant forces and reducing the need for tie-downs.
- Steel, on the other hand, offers benefits in terms of faster construction and post-construction adaptability. Its lightweight structure reduces foundation requirements but may necessitate additional fireproofing. Steel structures are more prone to vibration and deflection, which can lead to damages to a laboratory environment housing precision equipment.

**2. Cost and Time Considerations**

A thorough cost and timeline analysis highlight key differences between the two materials:

- Concrete typically has lower material costs and benefits from the widespread availability of suppliers, reducing lead times. However, its installation process is slower due to formwork and curing. Despite this, concrete structures generally have lower maintenance costs over their lifespan, making them a more economical long-term choice.
- Steel has higher initial costs, with additional expenses for fireproofing and welding. The potential for higher vibration in steel structures may necessitate supplementary damping measures, further increasing costs—particularly in laboratory environments.

**3. Structural Depth and Vibration**

- Concrete offers minimal vibration and deflection, making it ideal for laboratory applications.
- Steel allows for easier modifications and coordination with mechanical, electrical, and plumbing (MEP) systems. However, its lightweight nature contributes to increased vibrations, which is less suitable for laboratory settings.

4. **Foundation Impact and Structural Weight**

Foundation requirements differ significantly between the two materials:

- Concrete is a heavier material, which improves stability in areas with high water tables by minimizing buoyant forces. However, this also necessitates larger foundations.
- Steel has a lightweight structure, reducing foundation costs. However, in locations with high water tables, steel buildings may require additional tie-downs to prevent buoyancy issues.

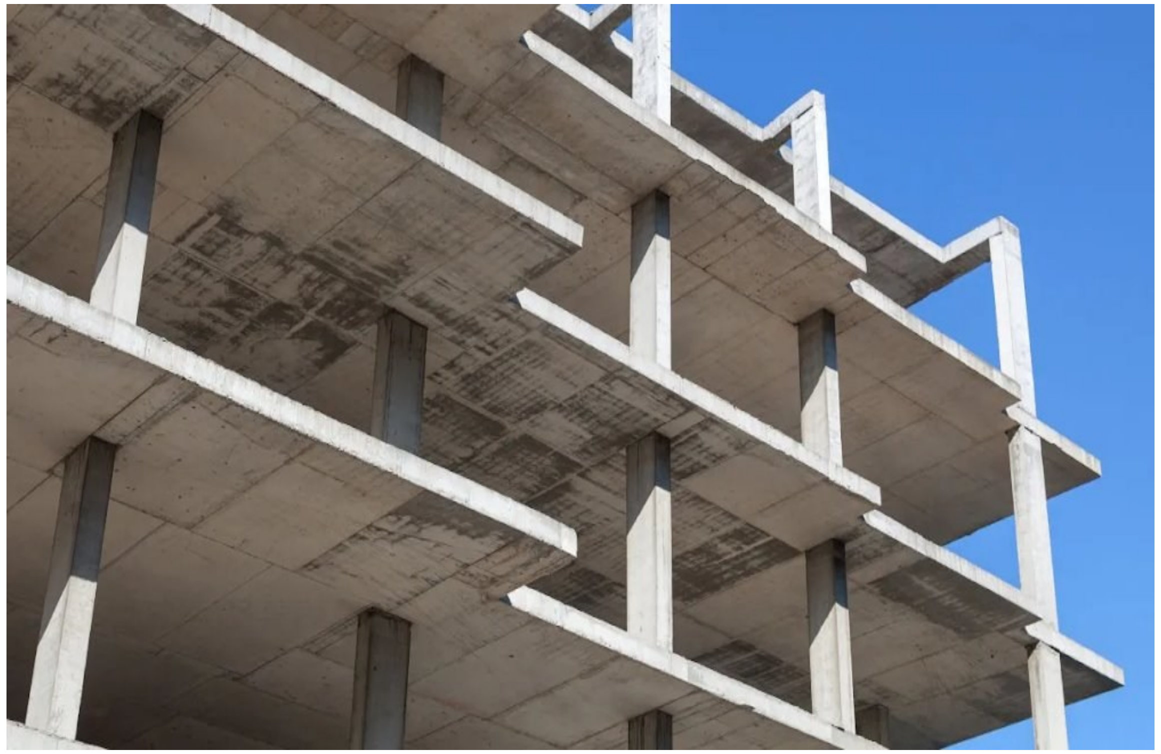
5. **Sustainability and Environmental Impact**

Both materials present their own advantages:

- There have been significant advancements in eco-friendly, green concrete formulations, including the use of fly ash and recycled aggregates. Moreover, its durability reduces the need for frequent renovations, contributing to long-term sustainability.
- Steel is highly recyclable and aligns with green building certifications. However, its production is energy-intensive, making modern sustainable concrete a more environmentally friendly alternative.

6. **Longevity and Maintenance**

- Concrete offers great fire resistance and corrosion resistance, requiring minimal maintenance over time. Although modifications post-construction can be challenging, its durability ensures a long lifespan.
- Steel provides flexibility for future modifications but demands ongoing fireproofing and corrosion prevention, leading to higher maintenance costs.



# Steel v. Concrete Summary Table

| Criteria | Steel | Concrete |
|---|---|---|
| Material Selection and Functionality | Light weight and adaptable, but prone to vibration and deflection | Ideal for lab basements due to fire resistance and low vibration; rigid structure minimize deflection |
| Cost and Time | Higher initial cost; faster installation; may require added damping and fireproofing | Low material cost; slower installation due to formwork and curing |
| Structural Depth and Vibration | Easier MEP coordination; increased vibration and deflection | Allows thinner slabs via post-tensioning; excellent vibration control for sensitive environments |
| Structural Weight and Foundation Impact | Light weight reduces foundation sizes; may need tie-downs to address buoyant forces | Heavy weight improves stability in high water table areas; requires larger foundations |
| Sustainability | Highly recyclable; energy-intensive production | Advancements in green mixes (fly ash); durable with fewer renovations needed |
| Longevity and Maintenance | Requires ongoing fireproofing and corrosion protection; easier to modify post-construction | Strong fire resistance and corrosion resistance; long-lasting with minimal maintenance |

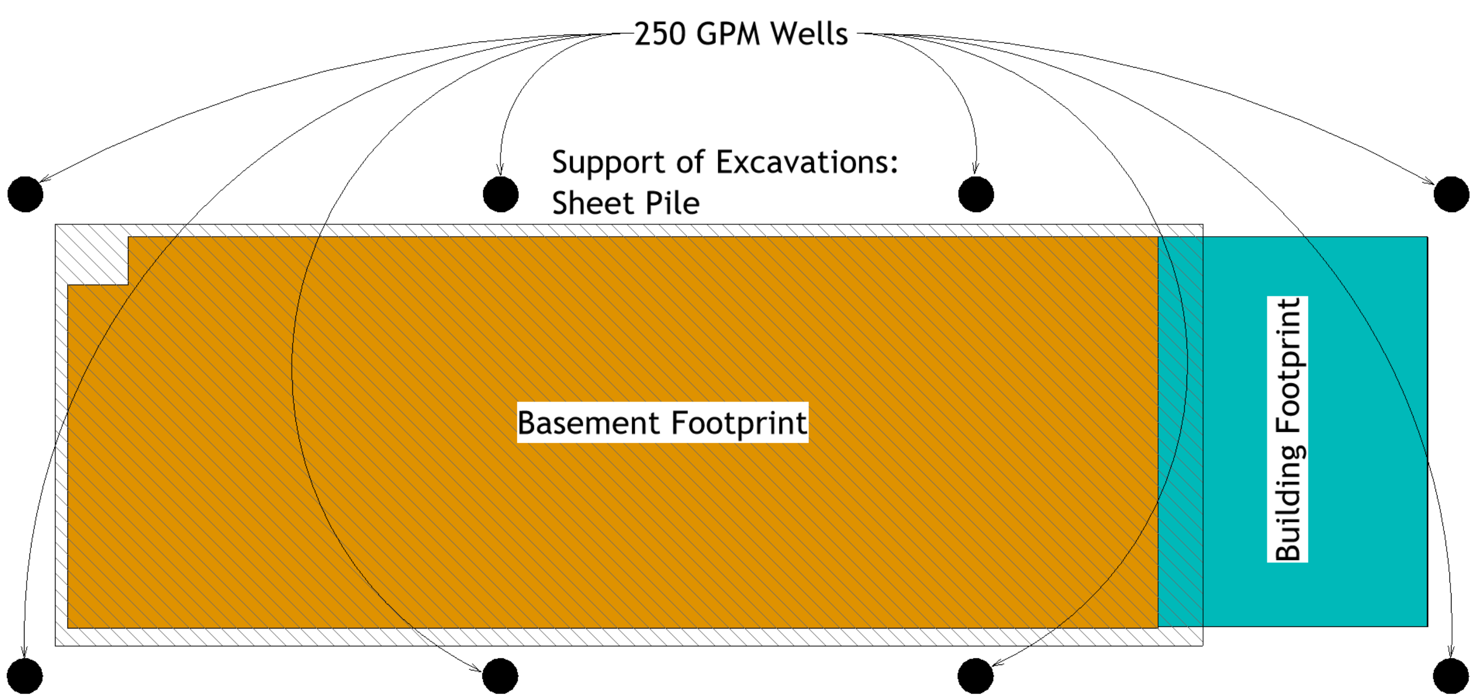
Concrete is the recommended structural material due to its better performance in key areas critical to the project. Its excellent vibration resistance ensures the stability required for laboratory environments which house sensitive equipment. While concrete is inherently fire resistance and stiff it also provide durability and versatility. From a cost perspective, concrete is more economical both initially and over the long term as it eliminates additional expenses associated with steel, such as fireproofing and welding. Sustainability is also a factor in selection of concrete, with modern advancements in concrete technology offering environmentally friendly alternatives that align with green building initiatives. Lastly, the higher weight of concrete enhances structural stability in areas with high water tables like this project, reducing the need for complex foundation tie-down systems. Considering these advantages, concrete is the better choice for this project.

# Construction Dewatering

To address the high groundwater environment during the excavation and construction activities, Jefferson Contracting recommends an array of deep well point dewatering wells to lower the water table at least 3 feet below the excavations in conjunction with driven steel sheet piles that will act as a vertical cutoff wall. The combined effect of these two systems will offer **redundancy** and limited groundwater monitoring capabilities that will ensure the **safety** and **success** of the project.

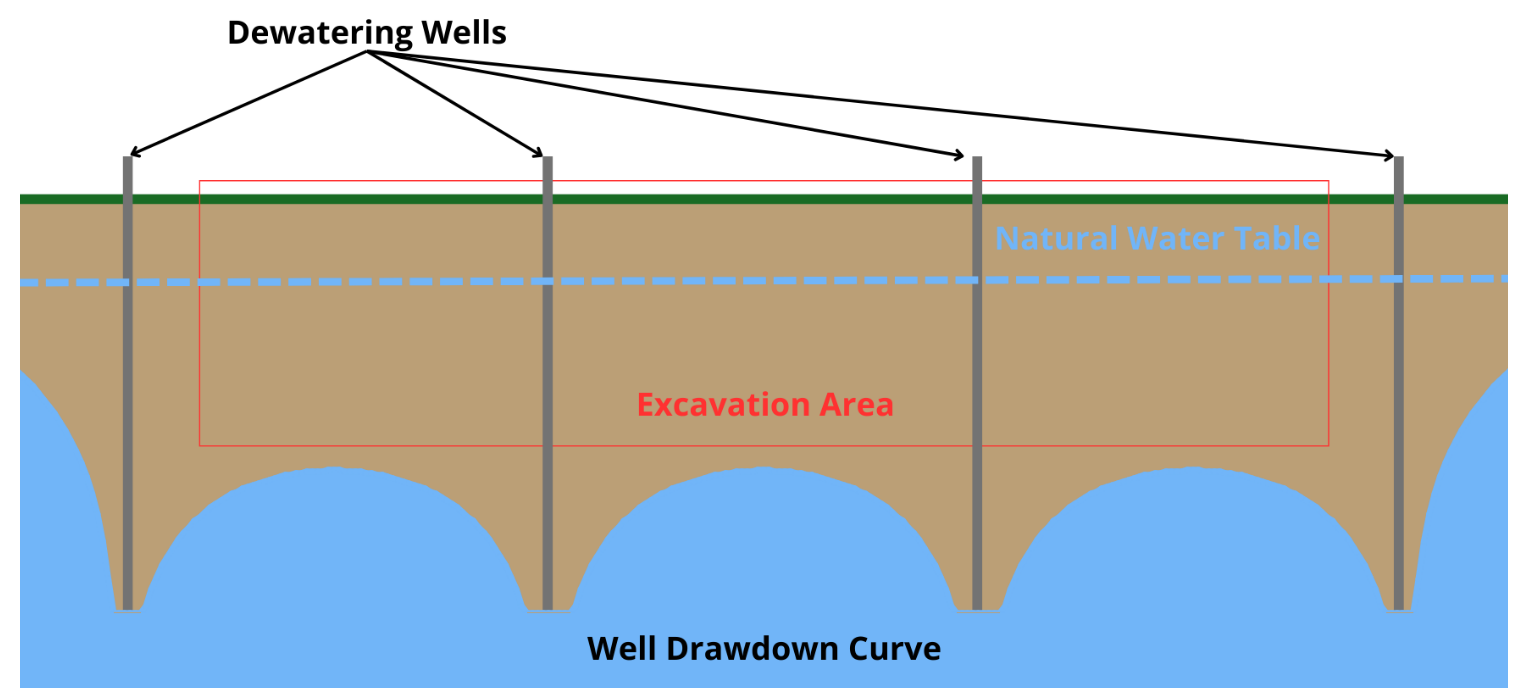
## Deep Well Point Dewatering

A total of **eight** 40-foot deep dewatering wells surrounding the perimeter of the excavations are required. Maximum well spacings were calculated using the superposition of in-line wells and the Theis Equation based on available soil information from the Geotechnical Report provided by GeoConcepts Engineering.




***Plan view of dewatering wells for the Innovate, Design, and Engineer for America Factory***

Based on high clay content at lower strata and a well depth of 40 ft, this model assumes a negligible flow rate below 40 ft, a general estimate of aquifer storativity equal to 0.3, and a uniform hydraulic conductivity of 28.3 ft/day. While these assumptions can provide a good estimate, variation throughout the depth of the excavations may lead to localized saturated soils, seeps, or springs that will be monitored and addressed as they present.




***Well drawdown illustration***

**For Construction Dewatering Pump Requirements**

Neglecting Frictional losses

$$h_p = \frac{v^2}{2g} + h$$

$$g = 32.2\ {}^{\mathrm{ft}}/_{\mathrm{s}^2} \qquad h = 40\ \mathrm{ft}$$

$$v = \frac{Q}{A} = \frac{Q}{\pi r^2} = \frac{0.557\ {}^{\mathrm{ft}^3}/_{\mathrm{s}}}{\pi\left({}^{1}/_{4}\ \mathrm{ft}\right)^2} = 2.94\ {}^{\mathrm{ft}}/_{\mathrm{s}}$$

$$h_p = \frac{\left(2.94\ {}^{\mathrm{ft}}/_{\mathrm{s}}\right)^2}{2\left(32.2\ {}^{\mathrm{ft}}/_{\mathrm{s}^2}\right)} + 40\ \mathrm{ft} = 40.2\ \mathrm{ft}$$

**Calculate Pump HP**

Assume $\eta = 0.8$

$$P = \frac{\rho g Q h}{\eta}$$

$$\frac{\left(1.94\ {}^{\mathrm{lb_f\,s^2}}/_{\mathrm{ft}^4}\right)\left(32.2\ {}^{\mathrm{ft}}/_{\mathrm{s}^2}\right)\left(0.557\ {}^{\mathrm{ft}^3}/_{\mathrm{s}}\right)(40.2\ \mathrm{ft})}{0.8}$$

$$= 1750\,\frac{\mathrm{lb_f\,ft}}{\mathrm{s}} \times \frac{1\,\frac{\mathrm{lb_f\,ft}}{\mathrm{s}}}{550\ \mathrm{hp}} = 3.18\ \mathrm{hp}$$

**Select 5 hp pump**

# Construction Dewatering

The **uncertainty** of the in-situ conditions poses considerable risks that must be managed effectively.

## Assumptions

- Uniform hydraulic conductivity
- No unforeseen localized deposits
- Aquifer storativity of 0.3
- Consistent groundwater depths
- Superposition of in-line pumps (conservatively only considering 2)
- No unforeseen conditions (unmarked utilities, aquicludes, etc.)
- Approval of discharge permitting

## The Art of Engineering

In the unknown, we recognize that many assumptions must be made to predict and prepare for project constraints. With the breadth of experience and technical knowledge from our project team, we are confident in the assumptions and conservative implementation of groundwater modeling. On-site, well drawdown tests can be performed to validate and refine the model, reducing safety risks and potential delays.

**For Construction Dewatering Spacing Requirements**

Drawdown for Max Excavation Depth @ Sump Pit,

$$(64\text{ ft} - 59\text{ ft}) + 11.25\text{ ft} + 2\text{ ft} + 3\text{ ft} = 21.3\text{ ft}$$

**Calculate Transmissivity**

$$T = \left(28.3\ {}^{\text{ft}}/_{\text{day}}\right)(40\text{ ft}) = 1130\ {}^{\text{ft}^2}/_{\text{day}}$$

**Apply Theis Equation**

From superposition of inline pumps at a critical distance (the midpoint between the two wells), drawdown can be calculated for various well spacings. Using a spacing of 85 ft between wells,

$$u = \frac{r^2 S}{4Tt} = \frac{(42.5\text{ ft})^2(0.3)}{4\left(1132\ {}^{\text{ft}^2}/_{\text{day}}\right)(7\text{ days})} = 0.0171$$

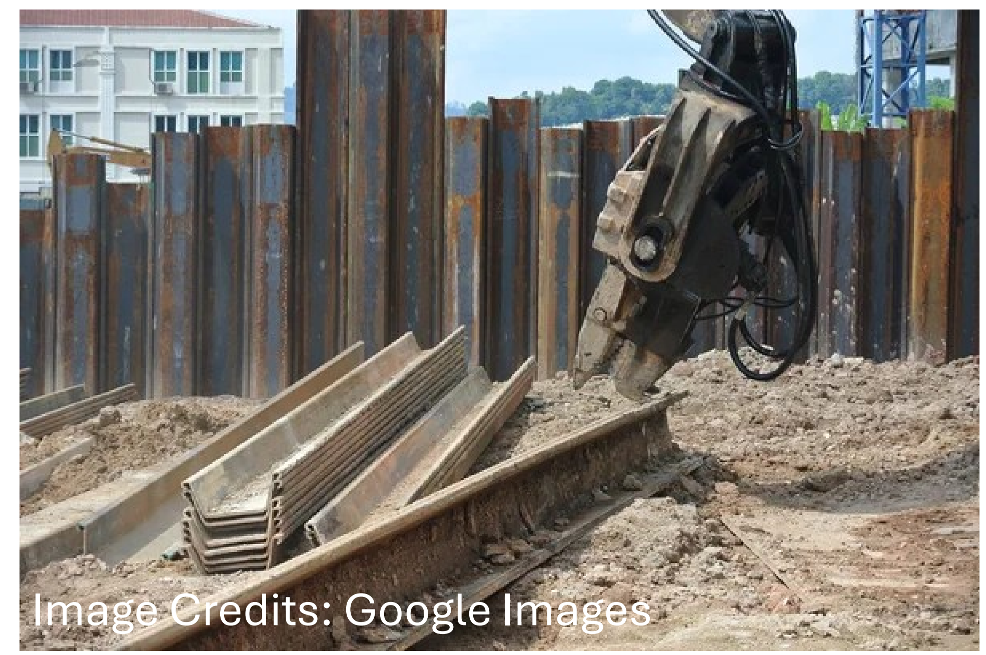
$$W(u) \cong -0.5772 - \ln(u) + u - \frac{u^2}{2*2!} + \frac{u^3}{3*3!} = 3.51$$

$$s = \frac{Q}{4\pi T}W(u) = \frac{\left(48100\ {}^{\text{ft}^3}/_{\text{day}}\right)(3.51)}{4\pi\left(1130\ {}^{\text{ft}^2}/_{\text{day}}\right)} = 11.9\text{ ft}$$

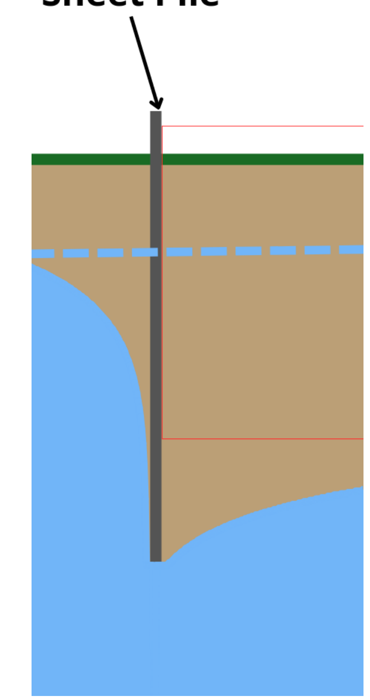
Drawdown @ 42.5' after 7 days from one well = 11.9 ft
Combined drawdown effect from 2 wells spaced 85' apart

**= 23.8 ft > 21.3 ft required ✓**

## Sheet Piles




*Sheet pile installation*




*Groundwater Interaction*

In addition to the deep-well point dewatering, the stay-in-place sheet piles used as the support-of-excavation (SOE) will also provide supplementary groundwater management capabilities with all joints sealed and sumps and pumps on standby. This approach prevents intrusion into the excavation area and further disturbance of the existing subgrades, facilitating a **safe and efficient** worksite. Recommendations for deep-well point dewatering and sheet piles offer **complementary advantages** and provide **critical redundancy** against the inherent variability of soil strata and behavior.

# Permanent Groundwater Management

- **'Belt and Suspenders Approach'**

Due to the high-water table present at the IDEA Factory's site, Jefferson Contracting recommends using a 'belt and suspenders' approach for groundwater mitigation. Our recommendation will incorporate advantages from two systems: a **(1) subgrade drainage system below the mat foundation** and the application of a **(2) pre-applied TPO sheet waterproofing membrane** along the foundation walls and mat foundation.

- **Extent of Excavations Design Philosophy**

Considering the space constraints provided from the existing roadways and the extent of excavations, we recommend a pre-applied blindside application against support of excavations. The decision to add a subgrade groundwater drainage system mitigates the upward hydrostatic pressure against the foundation system. These two design systems will offer complementary advantages ensuring the quality and integrity of the building's groundwater mitigation system, as a blindside waterproofing system is vulnerable to construction errors.

- **Risk Acknowledgement**

Risk in the groundwater management system is significant, especially for the laboratory spaces occupying the basement level. Jefferson Contracting recommends the following design considerations and has proposed a design with redundancy to mitigate risks for the IDEA Factory.

- **Jefferson Contracting Design Proposal**

Additionally, a typical foundation detail and subdrainage plan included in Appendix were developed to fit the unique needs of this project. To prevent water intrusion into the basement, exterior blindside waterproofing and drainage board along the foundation walls were selected. Aggregate fill will be placed around these excavations, with perforated drainage below the mat foundation to collect excess groundwater and prevent intrusion into the building. To mitigate intrusion, waterproofing will extend below the mat foundation and a slotted 4" corrugated polyethylene drainage grid will be implemented, sloping towards a sump pit, to prevent uplift pressures from hydrostatic forces. Finally, a floating slab floor system atop a layer of compacted stone and the mat foundation will provide additional resistance to vibrations that impact the performance of the sensitive equipment required in the buildings laboratory spaces.

- **Challenge of Using Sheet Piles**

Our plan, based on the evaluation of the support of excavation during early stages, is to use sheet piles. Blindside waterproofing will require an even substrate to be applied. Jefferson Contracting recommends adding a layer of **drainage board** to provide an even application surface.

**Required Construction Sequencing**

SoE Installed → Excavations → Subsurface Drainage → Piping Connections Under Mat Slab → Blindside Waterproofing → Concrete Foundation Walls and Floating Slab Work Starts



- **Groundwater System Details:**
  - **Sump Pumps:** Sumps and pumps will be installed below the slab to manage any water that accumulates in the subgrade drainage system.
  - **Perforated Piping:** 4 inch corrugated polyethylene piping will be used for the below grade groundwater drainage system to effectively convey water away from the foundation and into a sump pit.
  - **Drainage Board:** A drainage board will be installed to create an even application surface for the blindside waterproofing and to facilitate water movement towards the drainage system.
  - **French Drains:** Low profile French drains will be installed between the mat foundation and the basement slab, to manage groundwater and prevent hydrostatic pressure buildup.
- **Construction Risk and Product Selection**
  - Jefferson Contracting recognizes the **associated risk of a pre-applied product**, especially for the occupied basement. Risks include punctures during construction activities or non-compliant bonding/sealing, with the product's sensitivity to temperature and UV exposure. To address this risk, Jefferson Contracting has evaluated different products and recommended the **SikaProof-808** blindside waterproofing to be used. The Sika Product line enables the building envelope to have a single-source manufacturer for air and vapor barriers, ensuring that the building's waterproofing is covered under one warranty. This product offers superior puncture resistance and is a proven product for blindside applications. The Sika product line has a fully bonded layer between the concrete and the waterproofing layer. Alternatives, including the Henry Systems of MiraWELD and Blueskin, were also evaluated by the team. Jefferson Contracting also recommends the addition of the **SikaFuko-VT1 reinjectable hose system**. The injection hoses offer flexibility throughout the building lifecycle, where the owner has the opportunity to re-seal the waterproofing system from the interior in case of any future ground movement at the diaphragm walls.

# III Project Execution

# Plan & Schedule

## Project Timeline and Phased Execution

The construction schedule for the E.A. Fernandez Innovate, Design, and Engineer for America (IDEA) Factory follows a structured, milestone-driven approach to ensure efficient execution and timely completion. The project timeline includes early site preparation, phased construction, and strategic procurement to mitigate risks and streamline workflow.

## Opportunities for Acceleration

| Initiative | Benefits | Considerations |
|---|---|---|
| **Early trade buyout for structural & MEP systems** | Secures materials & mitigates delays | Requires upfront coordination with vendors |
| **Parallel execution of envelope & MEP rough-in** | Reduces trade interference | Demands phased logistics planning |
| **Prefabrication of critical building components** | Speeds up installation | Limited to modular design feasibility |

## Strategic Procurement & Risk Mitigation

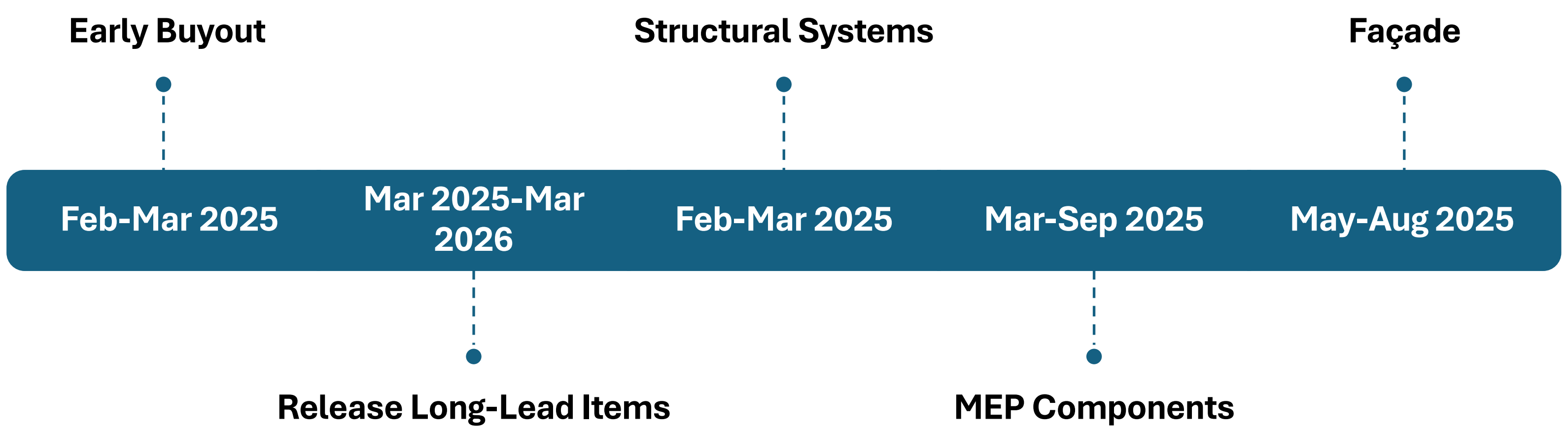
To maintain schedule integrity, the procurement phase begins February 2025, prioritizing long-lead items and early trade buyout for:

•Earthwork & Foundation: Ensures site readiness and mitigates unforeseen conditions

•Structural Systems: Efficient structural sequencing allows framing to start right after deck pours, maintaining steady progress

•MEP Components & Façade: Early procurement mitigates supply chain disruptions

A progressive design-build delivery model enables early contractor involvement, ensuring constructability reviews, cost control, and seamless trade coordination.



**Preconstruction & Design (March 2024 – July 2025)**

Issuance of Request for Proposals (RFP)

Award and contract finalization

Design phase from schematic to full construction documentation

**Construction Execution (March 2025 – December 2026)**

Site Preparation & Foundation

*-Mobilization, fencing, erosion control, dewatering*

*-Mat foundation completion*

Structural Framing & Envelope

- Superstructure top-out
- Phased envelope installation

**MEP & Interior Buildout**

Mechanical, Electrical, and Plumbing (MEP) rough-in and coordination

Interior finishes and commissioning

Activation of permanent power

Achieving substantial completion

**Project Turnover**

Final inspections and closeout activities

Official handover to stakeholders

# Delivery/Transport route to and from site (via Baltimore Ave)

## Considerations in Route Development

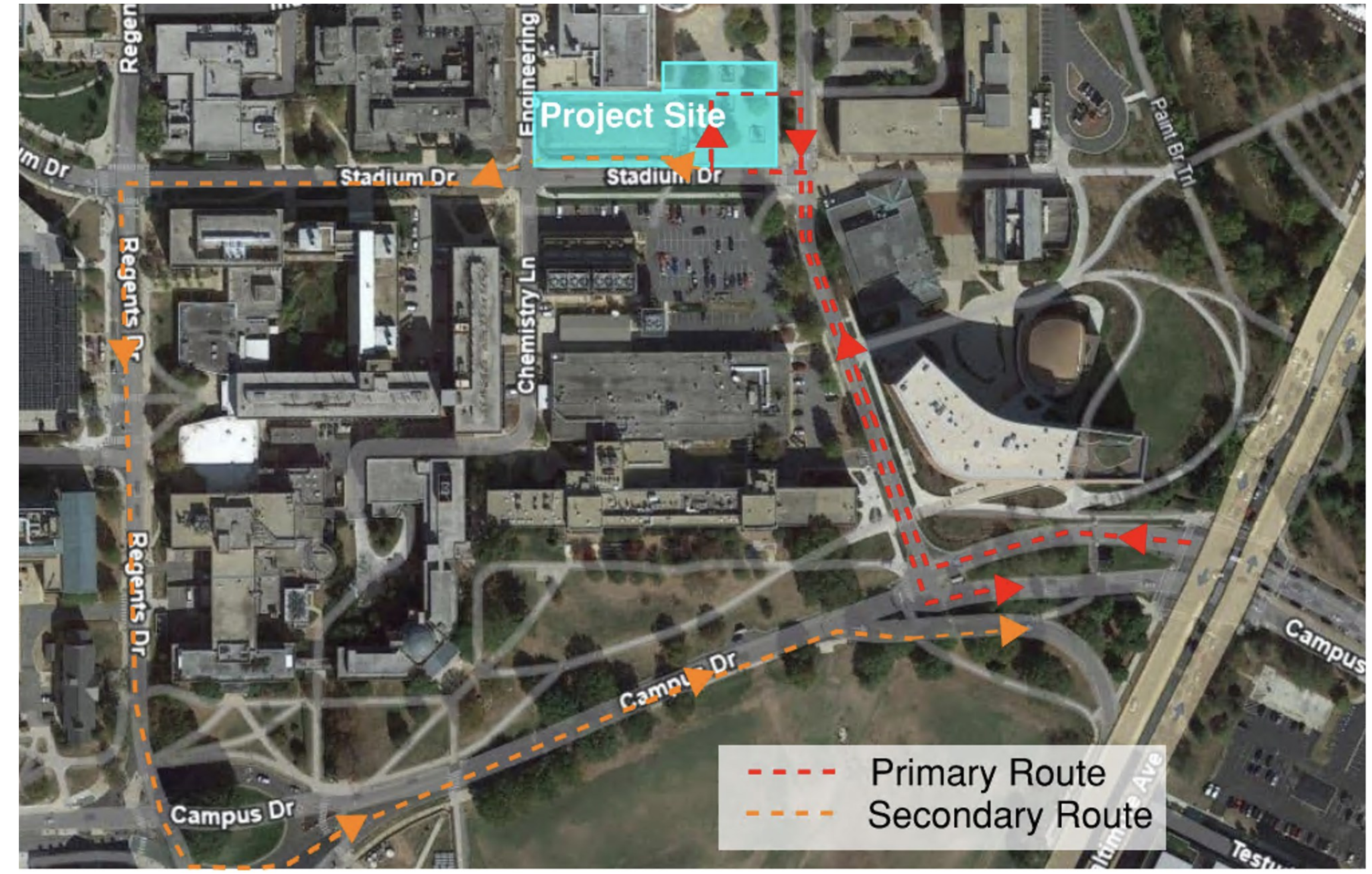
**Minimize traffic disruption on campus**
- Respectful of pedestrian and vehicular traffic
- Minimal interference with greater UMD campus
- Employing signage at Campus Dr. and Paint Branch Dr.

**Managing traffic through project site**
- Facilitating multiple vehicles moving through site
- Employing signage at site entrance to clarify routes

**Efficient use of site space**
- Two routes through site to allow for access and efficient exit
- Identifying loading/unloading location in phase specific site plans

**Primary Route**
- Low pedestrian traffic
- Short turn-radius vehicles

**Secondary Route**
- High pedestrian traffic
- Larger turn-radius vehicles




To reduce traffic disruption in and around the UMD campus and while construction is ongoing Jefferson contracting identified the flow of traffic plan pictured here. This route will be communicated to all trade-partners and delivery personnel prior to work-start so that any questions or logistical concerns can be addressed ahead of time.

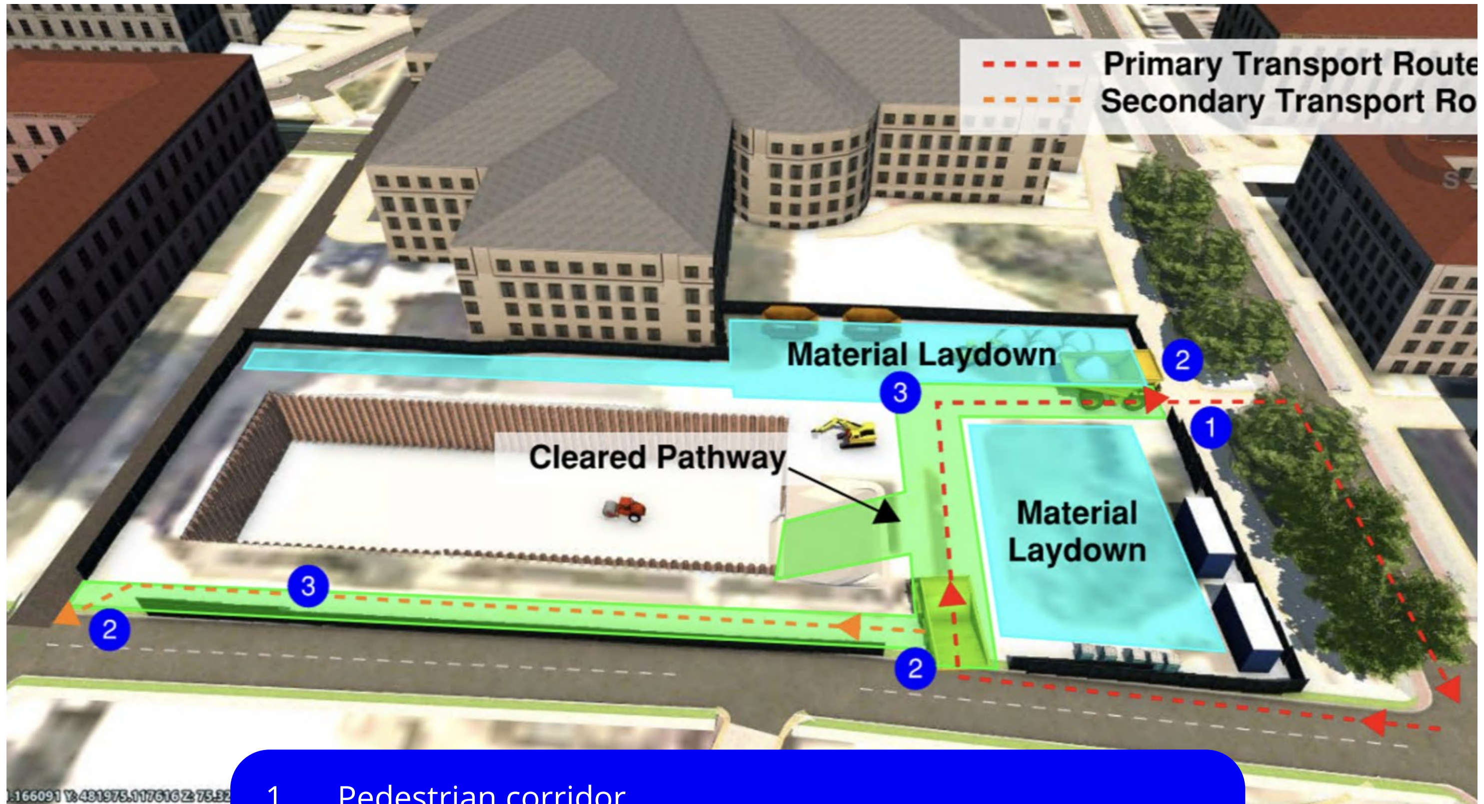
Baltimore Avenue is the closest entry and exit point to the project site, that does not disrupt other areas of UMD campus. Construction traffic will be encouraged to used this access point for entry and exit to the IDEA project site.

For exiting via Baltimore Ave southbound a secondary exit route is depicted in orange and can be followed by turning right at the Stadium Drive-Paint Brush Drive intersection, outside of  the southeast perimeter of the site.

Otherwise (for northbound traffic) the same entry path (along Paint Brush Drive) will be followed to exit UMD campus.

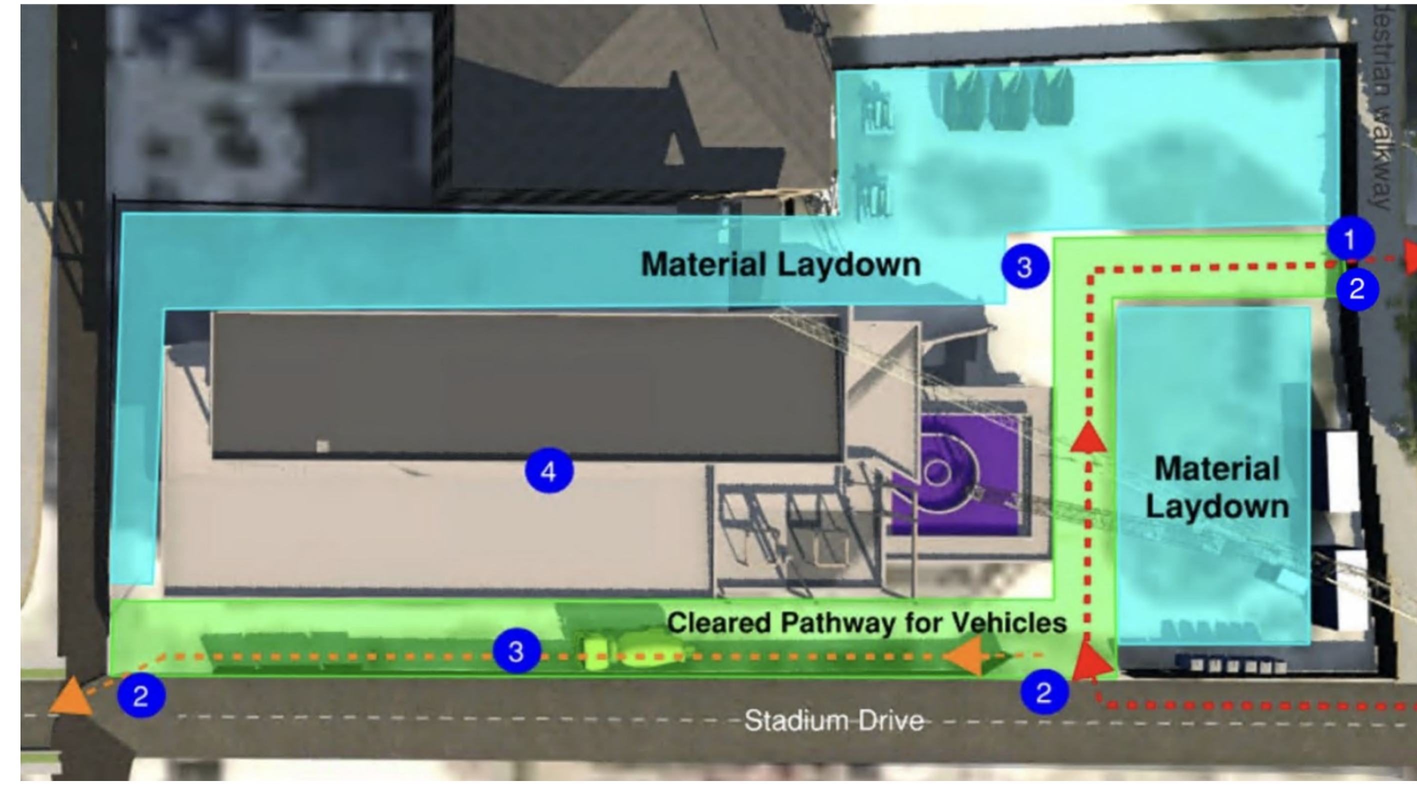
- One entry point (southeast gate)
- Two exits (southwest & east gates)
- Secondary route only during highest pedestrian traffic use
- Southbound travel after jobsite exit, follow secondary route
- Northbound travel after jobsite exit, follow secondary route
- Secondary route only during highest pedestrian traffic use

## Phase I – Excavation Site Plan

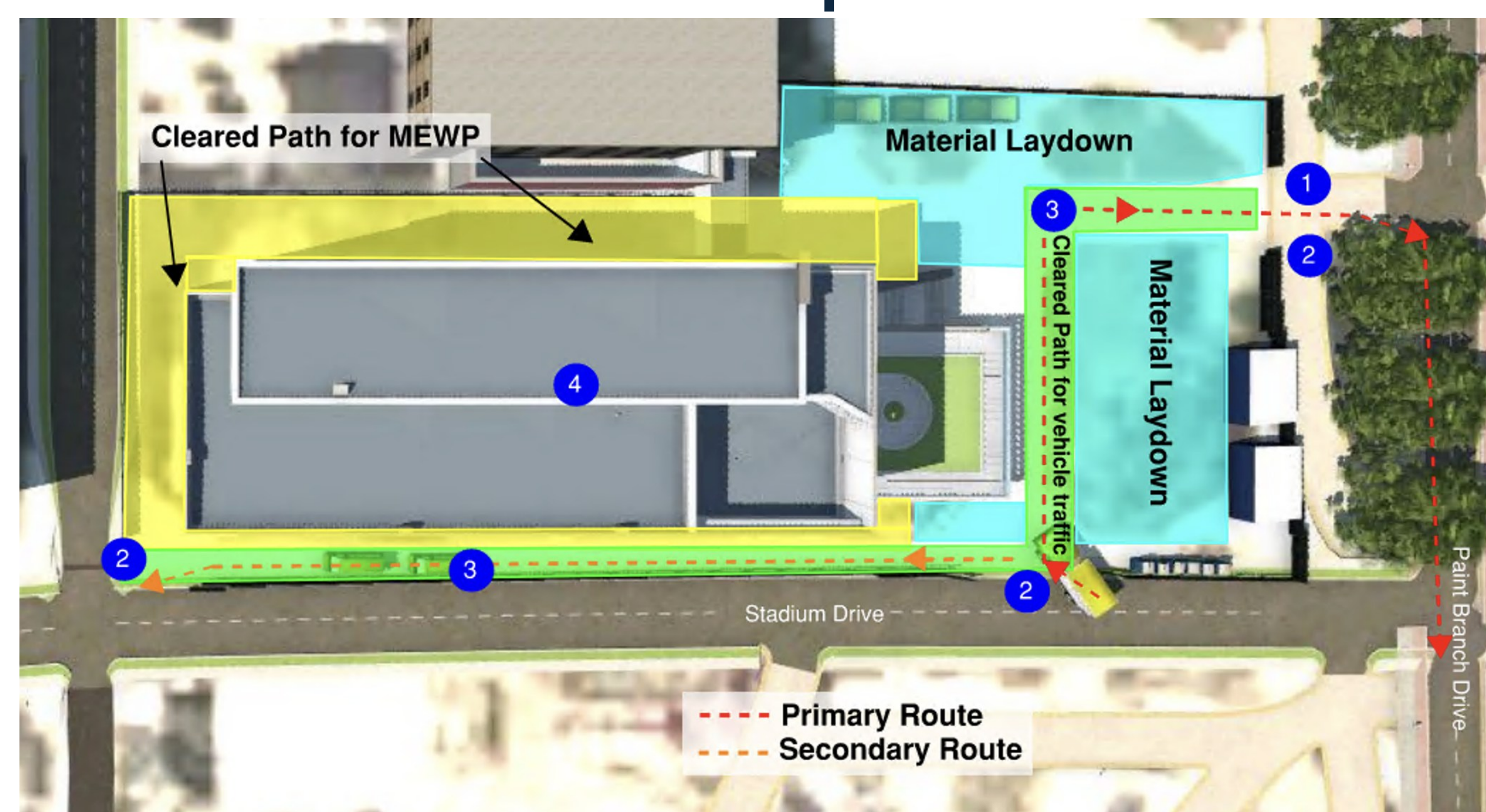



1. Pedestrian corridor
2. Possible flaggers required for large vehicle entry/exit
3. Loading and unloading locations
4. Additional material storage at each floor level after setting

## Phase II – Structural Site Plan




## Phase III – Envelope Install Phase




# Project Site Logistics

To facilitate efficiency and safety at each stage of the project, Jefferson contracting developed the site plans displayed here. Each plan uses the southeast gate for access onto the site and the southwest and northeast gates as exit locations.

To minimize disruption to pedestrian traffic the southwest gate will be used as an alternate exit point, especially at times of high pedestrian activity.

Based on the information available to us and our experience with similar projects Jefferson Contracting recommends these plans for efficient flow of traffic through the site, management of space, and ensuring safety to the surrounding environment including the safety of students and faculty of UMD.


# Record of Safety

**Track Record:** Our EMR rating of 0.6 is a reflection of our commitment to safety. Jefferson Contracting employs teams who focus solely on improving and enforcing safety at all project sites.

Although Jefferson Contracting is proud of our rating, we are committed to improvement especially as it applies to jobsite safety. Our safety teams are constantly looking for areas to improve safety and lower our rating further.

**Commitment to Safety:** Jefferson Contracting is committed to safety driven partnerships. This takes shape by ensuring that the trade partners brought onto our worksites share our vision for a safe work site and safe practices.

Jefferson contracting is also committed to implementing site specific training for each project site. This helps us identify high risk activities and mitigating those risks ahead of time.

**Empowering Safe Teams:** Jefferson Contracting believes in fostering an environment of trust. This means ensuring that our teams feel comfortable bringing safety concerns up with the team to be addressed and handled respectfully and professionally.

No single person can address all safety concerns. By empowering all team members to value safety at all times on the jobsite allows for safer and productive job sites.

# Site Specific Safety Requirements

**Envelope**
- Enforce proper fall arrest systems used
- Ensure operators are qualified to operate EWP's
- Ensure proper (safe) use of EWP's

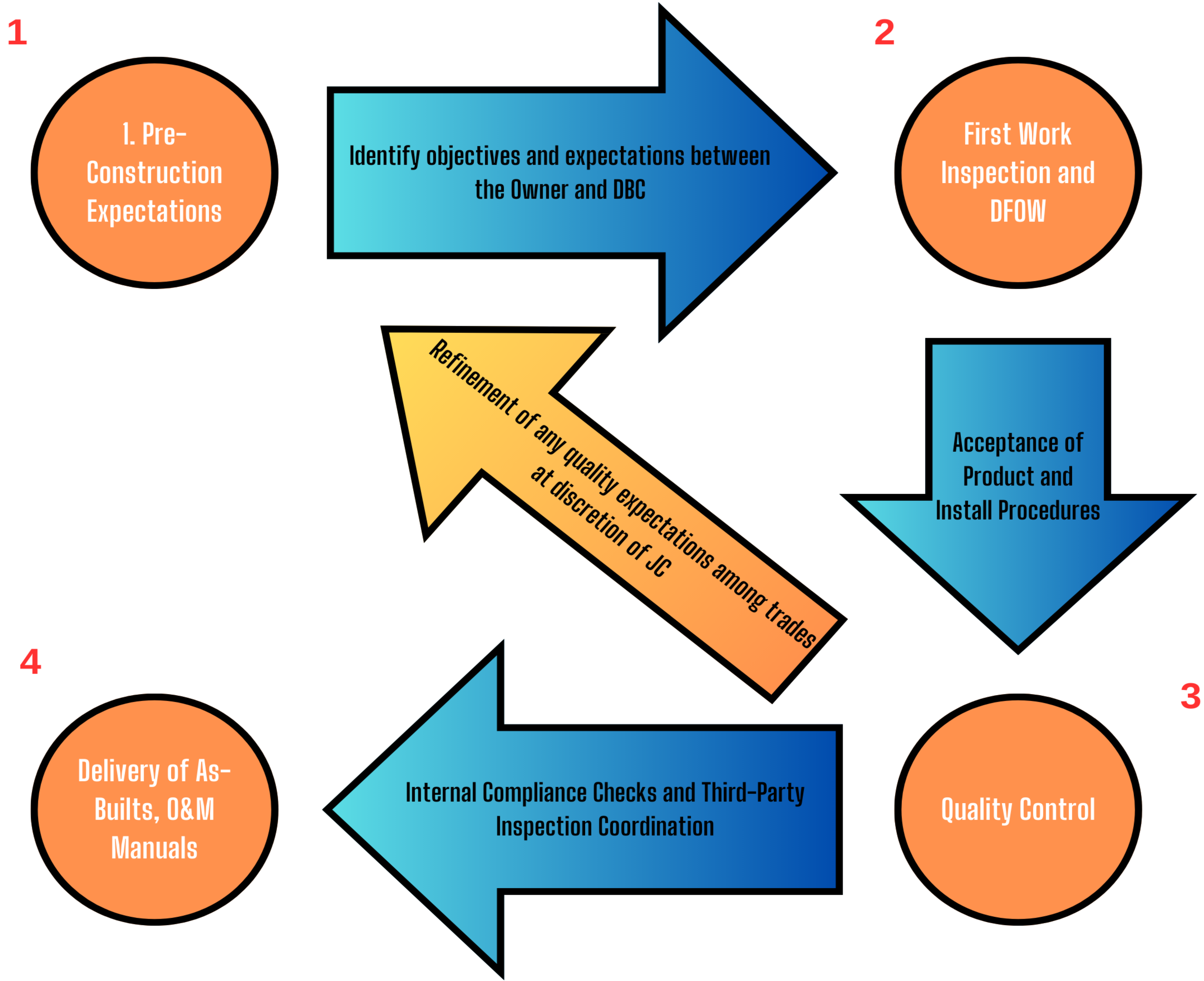
**Structure**
- Ensure handrail and toe board installation
- Identify tie off points for roof work
- Use of whistles for overhead loads

**Excavation**
- Locate underground utilities
- Acquire dig permits
- Enforce proper shoring and bracing

## Project Specific Safety Item of Concern

**Precast panel installation** on the building exterior. The nature of the precast panels being hoisted into the air present significant risk if materials fall. These risks include loss of life, significant injury, damage to installed materials, damage to equipment, and other risks not listed here. To minimize risk posed by the placement of precast panels Jefferson Contracting plans to develop a specific installation/placement plan in collaboration with trade partners and equipment operators to ensure the problem is comprehensively addressed and professionally and safely managed. Lastly, due to the timing of building envelope installation later in the project we expect the tower crane to be deconstructed. With this in mind the team expects to use a mobile crane for the placement of panels which introduces the additional risk of blind picks. As the project approaches the start work for panel placement Jefferson Contracting will address the specific safety concerns and risk mitigation through a sitewide safety stand-down.

# Quality




- **"Quality Early Means Quality Delivered"**

1. **Pre-Construction Expectations:** Define and set expectations for quality with UMD and the Design-Build Team.

   Jefferson Contracting will implement a comprehensive Quality Control and Quality Assurance program. Quality **will first begin with the Design-Build Team**. Internal reviews, including the Owner, will be used throughout the design development schedule to ensure the designed plans meet the owner's requirements. Throughout design development, **constructability reviews** will be conducted, and the BIM/VDC coordinator will conduct reviews with the engineers, architects, and Jefferson Contracting to **ensure alignment among all systems**, including structural, mechanical, electrical, and plumbing. **Quality begins with design development**.

   Jefferson Contracting will have a **dedicated Quality Manager** on-site. The Quality Manager will ensure that throughout the development process, all aspects are considered and will **prioritize early trades involvement** to deliver a comprehensive set of drawings. The Quality Manager will also handle all quality-related events highlighted below throughout the project duration. The Quality Manager has the authority to stop work when quality falls below Jefferson Contracting's standards.

Once a suitable design is achieved, and Contract Documents are approved and delivered:

- **Quality Assurance:** Submittal Review and Approval, Mockups, Pre-Construction Quality Kickoff Meetings - Prior to a subcontractor mobilizing on site, a meeting will be conducted with the Owner, Architect, Jefferson Contracting, and any associated Third Party Inspectors. This will set the stage for the quality expected once the subcontractor begins work. Simulations and Software - BIM/VDC will help streamline the process and limit the amount of field coordination of any alterations of the system, ensuring compliance with the Contract Documents.

**2. First Work Inspection and Definable Feature of Work (DFoW)**

- Jefferson Contracting will have two early quality control/quality assurance modes for any work going in place for the IDEA Factory. The First Work Inspection kicks off the Definable Feature of Work (DFoW). The Site Superintendent and Quality Manager will coordinate with the trade placing the work to make sure the early measures of each phase of work is off to the right start. The **Contractor will invite the Owner, Architect, and inspectors** involved to see the placement of the beginning of the work, to verify the product and field conditions are met. The DFoW will be comprehensive throughout the project, with the Superintendent and other associated Field Staff reviewing and certifying the quality for any piece of work that goes into the IDEA Factory. Jefferson Contracting recommends the following to be included for the IDEA Factory and has included them in the proposal.

**3. Quality Control:** Jefferson Contracting Internal Spotcheck QCs, Inspections, Commissioning, Warranties, and Internal Punchlists

- Jefferson Contracting will work internally and closely with all Inspectors and Third Parties to ensure the quality delivery of the IDEA Factory.

After the project is completed:

**4. As-Builts, Operation and Maintenance Manual Delivery**

- Including a 3D as-built plan to be incorporated into the **existing UMD infrastructure**. Will onboard subcontractors on the usage and make sure the owner has all necessary information

**Key Activities Jefferson Contracting regarding Quality Control for the IDEA Factory:**

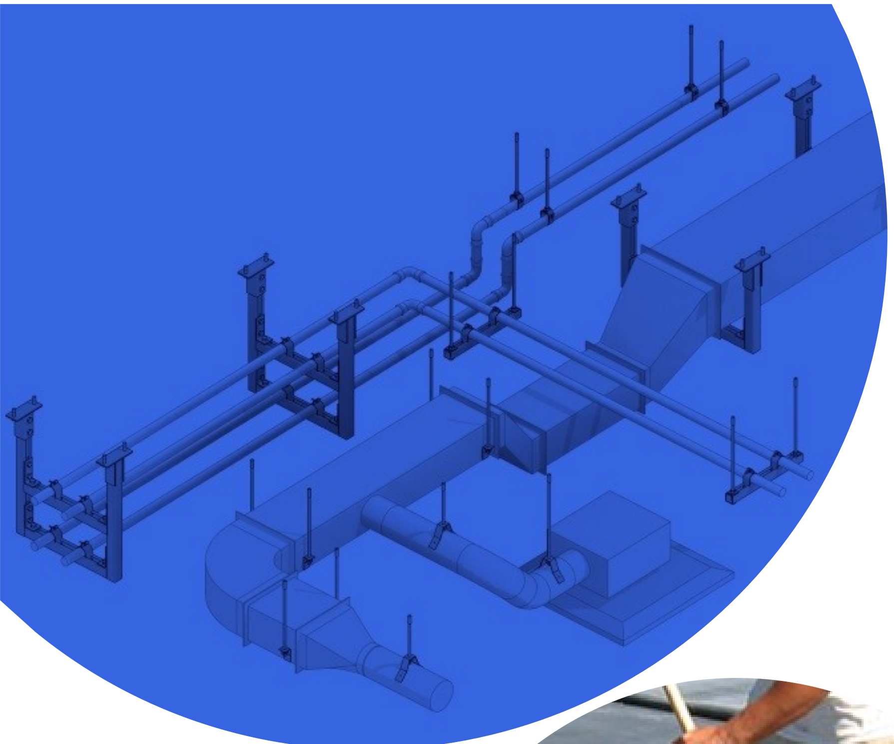
A. **Below Grade Blindside Waterproofing:** The first step is selecting a viable Pre-Applied Manufacturer. Jefferson Contracting and the Waterproofing Subcontractor will be in close contact with the Manufacturer, which we propose using Sika Products. Before installation of the pre-applied product, there will be a pull test to ensure adequate bonding strength between the concrete foundation and the waterproofing. After acceptance by the manufacturer and third-party inspectors, work will be performed. DFoW will be completed prior to foundation wall pours to ensure a quality product is installed.

B. **Concrete Slab and Elevated Deck Pours:** Prior to the first slab pour, Jefferson Contracting will have the Concrete Subcontractor pour a small in-place product to set finish standards of the work. Any alterations to the finish process will be addressed prior to larger deck pours. For elevated decks, the Quality Manager will onboard all trades involved in setting quality standards and verify that all required work will be completed.

C. **Facade and Masonry Install:** Jefferson Contracting recommends an exterior mockup to set the standard of the products selected, see the quality of the installation, project but see the waterproofing standards. Any issues arising from this mockup will be addressed by the team and followed up with an in-place mockup at DFoW.

D. **Exposed Concrete for Beams and Columns throughout the IDEA Factory:** Jefferson Contracting recognizes the quality required for exposed concrete. After the first Beam and Column pour for the elevated decks, there will be an in-place mockup with all parties on site to determine the required amount of finish work for the remainder of the building.

The four above areas are where Jefferson Contracting sees the highest level of risk and have put in these quality control mitigation measures. These will apply to all aspects of the project but want to continually develop the mitigation and contingency plans. **Quality will be revolving.**



## Non-Critical Path Activities Jefferson Contracting regarding Quality Control for the IDEA Factory:

A. **Roofing**: Jefferson Contracting recognizes the risks associated with roofing. This process begins with selecting materials to ensure the manufacturer is covered by UMD's insurance provider. The subcontractor will be onboarded by the Quality Manager to set expectations. After the roof slab is poured, the manufacturer, subcontractor, and third-party inspectors will verify that conditions are acceptable for the roofing installation to begin. Once a section of roofing is installed, a DFoW will take place to ensure all areas are adhered and all penetrations are sealed.

B. **MEP Sleeving and Hangars:** As concrete work begins, Jefferson Contracting will monitor the installation of MEP sleeves and hangers required for the IDEA Factory. The Quality Manager will hold a coordination meeting with MEP contractors, along with the concrete contractor, before both the slab-on-grade pour and the first elevated deck pour. While this is not critical, as Jefferson Contracting recommends a reinforced concrete structure that allows for flexibility after concrete, it will help streamline the labor process. The responsibility and standards for these items will be established early.

C. **Controls and Low Voltage:** Jefferson Contracting recommends maintaining a register for all low-voltage wiring and any necessary conduit for the low voltage contractor. This register will include details for the doors and hardware contractor, security, controls, and other relevant trades. Before commencing any low voltage work, all involved trades will attend a Quality Kickoff meeting to ensure they have all necessary coordination information. This process aims to minimize the amount of field changes required close to turnover.

D. **Cold-Formed Metal Framing (CFMF):** For the exteriors, it is critical to have the CFMF studs at the correct elevation and spacing as required by the façade. It is important to ensure all dimensions for any openings in the exterior are accounted for and correct. The First Work Inspection will occur in conjunction with the exterior mock-up, allowing any quality issues to be resolved before work is placed in the IDEA Factory. Once an elevation is installed on the building, the Quality Manager and field staff will verify the dimensions of all walls and openings, ensuring the necessary tolerances are met for the exterior elements. After the DFoW, the quality of the exterior will be continually monitored in the field.

E. **Interior Finishes:** Jefferson Contracting and the design team will coordinate with the owner for a mock-up registry for interior finishes. This mock-up will be staged in a weather tight, finished room to include casework, flooring, finished partitions, doors and hardware, tile, light fixtures. Any adjustments necessary will be addressed by quality manager and team.

# Community Impact

**University Impact**: Enhance UMD's reputation as a leading research hub and public university.

**IDEA Factory Goals**: Foster a collaborative, innovative, and research-driven learning space.

**Jefferson Contracting's Mission**: Create a positive community impact at UMD.

# Why MBE?

Jefferson Contracting is a strong advocate for diversity within the project team on all of its projects. We believe that the team works better with varying perspectives. This goes along with the "T" in our team ideology, Jefferson Contracting EATS. We truly believe that the addition of MBE participation facilitates the team's ability to "thrive together" as each member's unique talents prove valuable to the project in a multitude of ways. This is similar to a college campus, like the University of Maryland, where diversity abundantly flows throughout the faculty and student body. This level of diversity has proven useful in furthering innovation and creating a sense of community. With this, our team will make it a priority to have subcontractors with MBE business certifications as a part of this project in order to accomplish the project's vision.

**<u>30%</u>** of contract value committed to MBE

# IV Price Proposal

# Pricing

## Estimate Summary

This estimate summary provides a summarized breakdown of the costs associated with the project. The total cost of our project is predicted to be $39,486,032 with the cost per square foot being $647. This is also our proposed GMP. While we are aware that our predicted project cost is lower than the expected GMP of about $50,000,000, we are confident in the accuracy of our numbers and strongly believe that we can achieve the vision for the IDEA Factory with less money than anticipated. The detailed estimate is located in the Appendix.

## Exclusions and Assumptions

For the cost of the bridge to the Kim Building, contingency is included due to it being an indoor bridge. With this type of bridge comes uncertainty with things like demolition since it is inside of the building. We also are putting money towards the promotion of the building including hiring a social media team; this is accounted for in the “other” category. While the building is primarily concrete, we will also use miscellaneous materials and paneling on the facade like various types of metal panels. We are excluding demolition because the site is being delivered to us. Owner initiated scope changes and unforeseen site conditions are also excluded. Any hazardous materials that may be present are also excluded from this budget. We are also not taking into account the cost of dirt disposal and the associated cost for operation of the dirt truck; we are assuming this will be a cost taken on by the owner. However, we are also willing to cover the cost for an increased GMP.

| Cost Category | Cost ($) | Cost (%) | Cost $/SF |
|---|---|---|---|
| **Design Costs/Fees** *(includes Design Contingency)* | $1,500,000 | 3.80% | $25 |
| **Preconstruction Costs** | $250,000 | 0.63% | $4 |
| **Construction Costs** | | | |
| Cost of Work | $32,455, 439 | 82.19% | $532 |
| General Conditions/General Requirements | $2,596,435 | 8.00% | $43 |
| Profit (Fee) | $1,460,495 | 4.50% | $24 |
| Other | $250,000 | 0.63% | $4 |
| **Construction Contingency** | $973,663 | 3.00% | $16 |
| | | | |
| **Estimated Project Cost** | **$39,486,032** | | **$647** |
| **Proposed GMP** | **$39,486,032** | | **$647** |

# Appendix

# Pricing

## Detailed Estimate

The Detailed Estimate below provides a specific breakdown for the costs associated with the project. This estimate includes unit rates, as well as quantities for each item.

| | Unit | Quantity | Unit Price | Total Cost |
|---|---|---|---|---|
| Early Start Work | | | | $462,000 |
| Cranes (rental and labor) | | | | $500,000 |
| Sitework | | | | $ 2,753, 000 |
| Building Excavation | | | | $632,000 |
| Support of Excavation | SF | 12,500 | $52.30 | $653,750.00 |
| Foundation | | | | |
| Special Foundations ( Mat) | CY | 2,231 | $900.00 | $2,008,333.33 |
| Walls | SF | 17,908 | $11.92 | $213,463.36 |
| Structure Above Grade | | | | |
| Slab on Grade | SF | 12,200 | $75.00 | $915,000.00 |
| Structural Concrete ( columns, beams, elevated slabs and shear walls) | CY | 3,711 | $400.00 | $1,484,291.85 |
| Structural Steel | | | | $207,000 |
| Other | | | | $165,000 |
| Exterior Skin Envelop | | | | $5,202, 000 |
| Precast | SF | 14,386 | $80.00 | $1,150,880.00 |
| Curtainwall / Window | SF | 12,350 | $175.00 | $2,161,250.00 |
| Brick | SF | 5,047 | $50.00 | $252,350.00 |

| | | | | |
|---|---|---|---|---|
| Misc. facade components (metal panels, etc.) | | | | $5,000,000.00 |
| Exterior Soffits | | | | $400,000 |
| Roofing | | | | $606,960 |
| Below Grade Waterproofing | | | | |
| Foundation Wall | SF | 17,908 | $20.00 | $358,160.00 |
| Finishes | | | | $4,055, 000 |
| Bridge to Kim Building | | | | $1,500,000.00 |
| Lab Construction/Costs | | | | $7,000,000.00 |
| Special Equipment | | | | $258,000 |
| Vertical Transportation | | | | $570,000 |
| Mechanical System | | | | $9,850, 000 |
| Electrical System | | | | $5,957,000 |
| General Conditions | | | | $2,596,435 |
| Overhead & Profit | | | | $1,460,495 |
| Preconstruction Services | | | | $250,000 |
| Design Fees | | | | $1,500,000 |
| Other | | | | $250,000 |

**Appendix D – Supporting Materials**

Files used during this project can be found in the following folder: IDEA Factory Files

https://myuva-my.sharepoint.com/:f:/g/personal/yzm7yd_virginia_edu/EnNbxLEjqdpOjmQCh2J7pf8BrS9j9GWPHWzF9ZFKSQTOwA?e=2oV3mN