

## Forms of Rio Tinto - Progress Report

### Email

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### Project Manager Name

Cynthia Navarro

### Requested Metrics

Project Manager (student / Cynthia Navarro):

Approximately 80-100 cumulative hours coordinating all aspects of the project since its start. Responsibilities include outreach and recruitment coordination with the College of Engineering and the Honors College, conducting interviews, organizing the research team structure, coordinating procurement processes, maintaining communication with faculty advisors and collaborators, and supervising fabrication and experimental planning. During March specifically, project management focused on coordinating prototype fabrication, overseeing materials purchasing, and organizing research tasks related to mix design development.

Faculty Advisor (Dr. Kim):

Approximately 8–10 cumulative hours of technical guidance supporting the development of the research direction, including feedback on sustainable concrete strategies, microbial mineralization approaches, and general project planning.

Doctoral Student Assistant (Federico):

Approximately 5 hours assisting with technical consultation and laboratory coordination related to the research process.

Undergraduate Research Assistants:

3 undergraduate researchers actively involved in fabrication, literature review, and experimental preparation.

abrication and Research Metrics (cumulative):

10 concrete planters fabricated as initial prototypes.

1 modular lounge chair system designed (digital design completed).

1 large structural mold currently under construction for chair fabrication.

All primary materials purchased for mold construction and prototype casting.

Multiple sustainable concrete formulations researched for microbial and slag-enhanced concrete systems.

## **Project Accomplishments**

### Project Advancements and Accomplishments

During March, the Forms of Rio Tinto project transitioned from early preparation into an active phase of fabrication and experimental exploration. The team successfully produced the first round of physical prototypes by fabricating approximately ten concrete planters. These planters serve as small-scale demonstration pieces that allow the research team to observe material behavior, curing performance, and fabrication methods using sustainable concrete mixtures. Producing these prototypes was an important milestone because it marked the first opportunity to test the constructability of the material system in real fabricated objects rather than only in theoretical design.

The fabrication of these planters also allowed the team to gain practical insight into mixing procedures, curing time, and mold preparation techniques. These early observations will inform future iterations of the mix design and improve the casting process for larger structural elements such as the modular seating system.

In parallel with fabrication, the research team conducted a focused investigation into potential sustainable concrete formulations for the project. The group reviewed literature on microbial-induced calcite precipitation, bacterial mineralization processes, and sustainable binder replacement strategies involving industrial byproducts. Particular attention was given to identifying formulations that could incorporate mining-related materials while maintaining acceptable mechanical performance and durability. This research phase has helped guide the development of possible mix designs that will be tested experimentally in upcoming phases of the project.

Another major accomplishment during March involved significant progress toward the fabrication of the modular concrete lounge chairs, which represent one of the central design elements of the project. All major materials required for constructing the chair molds were purchased during this period. Logan, who leads the fabrication subgroup, completed the digital design of the chair geometry and structural configuration. The design process involved evaluating stability, mold assembly requirements, and casting feasibility.

Following the completion of the digital model, Logan began constructing the full-scale mold required for casting the chairs. The mold construction process is currently in its final stages, and the mold is expected to be completed during the coming week. Once completed, the mold will allow the team to begin the first casting trials for the modular seating prototypes.

Overall, March represented an important step forward for the project, as it moved from planning and procurement into active experimentation and fabrication. The production of the first planters, the advancement of the chair design and mold construction, and the continued investigation into sustainable concrete formulations have collectively strengthened the technical foundation of the project and prepared the team for larger-scale experimental work in the coming weeks.

## **Next Steps**

The next phase of the Forms of Rio Tinto project will focus on completing the fabrication and experimental components of the research before the end of the semester. The immediate priority is finishing the construction of the mold for the modular lounge chairs. Logan is currently completing the final stages of the mold assembly, and once the mold is finished the team will begin casting the first concrete chair prototypes. These prototypes will allow the team to evaluate structural stability, casting quality, and the feasibility of producing the seating elements at the intended scale.

At the same time, the project team will finalize the procurement process for the microbial component of the research. The project is currently completing the purchase of *Sporosarcina pasteurii* cultures, which will be used to explore microbial mineralization processes within the concrete system. Once the bacterial cultures are acquired, the team will begin preparing small experimental batches to observe how the microbial component interacts with the selected concrete formulations.

Another priority during the coming weeks will be completing the fabrication of the modular lounge chairs. After the mold construction is finalized, the team will proceed with casting the chairs and documenting the fabrication process. These pieces represent the primary structural elements of the project and will serve as the main demonstration of the research concept combining sustainable materials and experimental fabrication techniques.

In addition to completing the chairs, the team will continue producing and documenting planter prototypes when necessary to refine the material mixtures and casting techniques. The remaining weeks of the project will focus on final fabrication, documentation of results, and preparation for the final installation and project report.

The project timeline anticipates that all major fabrication activities, including the lounge chairs and material experiments, will be completed before May 14. During the final stage, the team will compile documentation, photographs, and experimental observations to finalize the project deliverables and submit the final report.

## **Challenges Faced**

One of the main challenges during this phase of the project involved navigating the university's procurement procedures. Because many of the materials required for the project needed to be purchased through institutional systems, additional time was required to understand the purchasing process, documentation requirements, and approval procedures. As the project manager, I spent time learning how to coordinate purchases within the university system, including identifying appropriate vendors, organizing orders, and ensuring that all materials required for fabrication were obtained through the correct channels. Although this process initially slowed some aspects of the project timeline, it ultimately helped establish a clearer workflow for future purchases and project logistics.

Another challenge involved understanding the biochemical component of the research. The project explores microbial processes related to mineralization within concrete systems, which requires familiarity with concepts from microbiology and bio-based materials that extend beyond traditional

civil engineering coursework. Developing a clear understanding of how microbial activity interacts with cementitious materials required additional literature review and discussions with collaborators. This learning process has been important in helping the team better understand the scientific mechanisms behind microbial-induced calcite precipitation and how it may influence the development of sustainable concrete mixtures.

Despite these challenges, both issues have contributed positively to the progress of the project. Learning the procurement system has improved the team's ability to efficiently acquire materials, while the deeper exploration of the biochemical aspects of the research has strengthened the technical foundation of the project. These experiences have helped the team better prepare for the upcoming experimental phase and continue advancing toward the completion of the project.

## Media/Links

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