



PATHWAYS INTERN REPORT

Spring 2016

ABSTRACT

Headquarters Building Phase I Construction, Indian River Bridge Studies, and other Civil Engineering projects at Kennedy Space Center, NASA.

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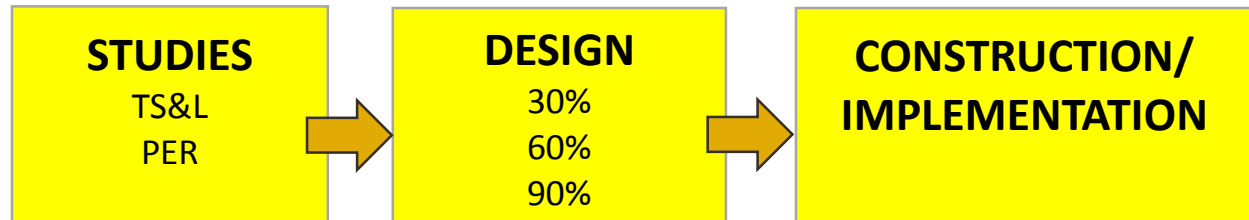
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Mixes of soil and clay have been used since the beginning of human settlements as the basic material with which civilizations were built. These mixes have evolved to masonry and to modern day concrete. At NASA's Kennedy Space Center (KSC) the work of replacing aging infrastructure from NASA's origination era in the early 1960s is just beginning. The Design and Construction Management Branch at KSC is tasked with the renovations of the center in preparation for NASA's missions of Space Exploration like the Space Launch System (SLS) Rocket that will travel to Mars, and the Multi-User Spaceport that KSC is evolving into.

Management of the renovation projects consists of certain phases and procedures that are the driving core of all projects. Three main phases a project can follow are Study, Design, and Construction/Implementation. The study phase, which can consist of several studies, allows for the creation of a baseline of circumstances. A renovation project currently in its study phase, the Indian River Bridge, is undergoing a Preliminary Engineering Study (PER), a Type, Size, and Location (TS&L), and a Statnamic Load Test. These studies result in reports that inform project investors (owners, engineers...) of the state of the current Bridge including economic analysis of the options of continued maintenance or complete replacement. The TS&L study adds detail to the possible replacement bridge; rough dimensions, possible alignments and structure types. Finally the Statnamic load test is conducted by geotechnical engineers on the river bed in the area of the current bridge. The test results in an understanding of the possible loads the soil can hold and is essential to the design of the bridge as it helps determine maximum weights, number of columns needed and type of substructure.



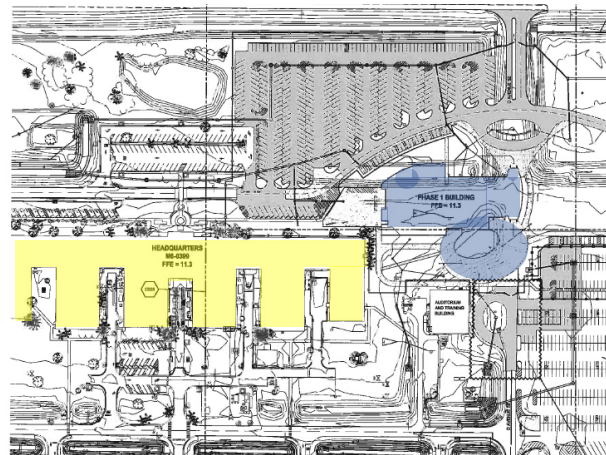
Study, Design, and Construction Phase Summary Graphic

The design phase of a project is usually broken up into milestones (also used for the deliverables of a study phase) delineated in the Statement of work for the project. The statement of work is like the legal heart of the project, it becomes part of the contract between the contractor and the owner (in this case the government). All elements of the project that the contractor is accountable for must be in the statement of work or in the overall contract in some form. This I think is one of the most tedious and difficult steps in a project process. The engineers and professionals in charge of writing the statement of work and contract must think of every which way in which the project details can be misinterpreted or misconstrued, and mitigate them as best as possible before hand. Accounting for countless possible scenarios like *what if there's a hurricane during construction? What tests do we need the contractor to perform to be sure our new water lines aren't being laid down cracked...?* And all this must be done without explicitly enforcing *means and methods* on the contractor, or specific manufactured parts, as it is the government's duty to uphold free and open competition.

If the government states means and methods of performing a certain job, then the responsibility of the project success in terms of structural safety for example switches to the government. This of course is always avoided, it remains the responsibility of the expert contractor to provide safe, high quality work that follows the Statement of work. The typical milestones for design are 30%, 60% and 90% completion. At each percent completion there is a large formal review where different parties look through the design documents and then gather to state inputs and new found errors; the idea is that along the process there are a variety of eyes to mitigate errors and come up with needs that remain to be addressed whenever possible.



Construction is the most exciting phase of a project in my mind. The Lead Design Engineer (LDE), Construction Manager (CM), and Project Manager (PM) are the three wise men and woman that must use organizational savvy, political wit, technical expertise, contract knowledge and a ton of experience to ensure the success of a project. One of the oldest structures at KSC is the Headquarters building located in the industrial area. Built in the 1960's, the building is due to be replaced by a smaller more efficient building to serve as the central campus of KSC. The new Central Campus Headquarters Building will be built in two phases that serve as two halves of the building. The first phase already in its construction stage, and the second phase of the building in its 30% design milestone. The structural aspect, or as I like to say when talking to non-engineers, the *muscle* of the building is mostly made of cast-in-place concrete. Meaning the concrete is brought to the construction site and is poured onto the molds on site. The architectural, or facade of the building exterior is mostly made up of precast-concrete and glass. Pre-cast as opposed to cast-in-place is a method that allows for the forms to be off-site, the rebar is pre-stressed and the concrete is poured.



Graphic: Yellow-current Headquarters,
Blue- new Headquarters Phase I

After the strength of the concrete is achieved, usually 28 days but depending on the concrete mix design, the individual pieces, like columns or walls, are brought to the construction site like LEGOs and fitted together like a LEGO building. Part of the work during the construction phase is inspecting the work for quality and accuracy. One Central Campus Phase I column can have over 30 reinforcement bars. The concrete strength, form, location, height, finish... have to be inspected, alongside the rebar type, placement, welding, ties... These inspections are usually done by a separate contractor under a separate contract, the CM keeps track of the inspections and their outcomes.

To maintain full understanding of the progress of the construction project the use of Requests for Information (RFIs) and Submittals are detailed in the Statement of Work. When a contractor has questions regarding for example a detail on the design intent from the design drawings provided by the owner, the contractor submits an RFI form with the question through a program such as NewForma or Sharepoint. In the mechanics of the Central Campus project the LDE, CM, and PM work together, along with the contractor that designed the building in the design phase, to come up with the answer to the question. There is always the question of whether an RFI will lead to changes that amount to money to be paid to either party. If it is within the scope per the Statement of Work it usually does not; however, when it is determined that it is a change or addition to scope it involves an additional process. Part of that additional process is the contractor submitting a Request for Equitable Adjustment (REA), the government in this case evaluates the REA in a technical evaluation, looking for an accurate depiction of the additional costs incurred by the contractor. The submittals are deliverables as stated in the Statement of Work. They may be things like a dewatering plan the contractor had to provide before starting dewatering operations for Central Campus. Welding details, rebar column shop drawings, and concrete strength test results are other examples. The RFIs and Submittals help the government do their own quality control and insure the project is going as intended, both technically accurate and per contract requirements.



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Mentorship is important throughout one's career as there is always something you don't know that the person next to you does. During the Indian River Bridge project studies and the Central Campus construction I have had many mentors that have been vital in my contributions to the projects. Courses offered are also to be taken advantage of; I took a project management class, Microsoft Project class, and a course on Creativity and Innovation, during this rotation. They have taught me about project management and how to increase value in a project, in yourself, and in an organization. Sometimes the thing that never gets taught is to think. These classes help to remind us that there is always another way, a better way perhaps, we just have to find it.



Central Campus Headquarters Phase I Construction