Scope of Work

Team Members: Tucker Rose, Alex Throener, Munezero Twubahimana, Cam Becker
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The goal of this project is to automate the Nebraska Department of Transportation (NDOT) concrete mix design process by translating the calculations from the NDOT Excel Mix Design worksheet into a structured Python based program. The automated system will replicate the logic currently used in Excel and allow users to input mix design parameters step by step through a sequential prompt system.

The objectives of this project are to:

1. Translate all major calculations from the NDOT Mix Design Excel worksheet into clearly defined Python functions.
2. Implement structured sequential user input prompts that mirror the order of the Excel worksheet.
3. Automatically generate a formatted weight chart for one cubic yard of concrete.
4. Research and evaluate four realistic concrete mix design scenarios using the automated Python workflow.
5. Improve transparency, repeatability, and reliability of the mix design process by moving from Excel to a modular Python structure.

Tasks

To meet the project goals, the following tasks will be completed:

Task 1: Review and Interpret the NDOT Excel Model

The team will review the NDOT Mix Design Excel workbook to fully understand the calculation logic used in the Mix Design tab. Each formula will be identified and documented, including volume calculations, weight conversions, water to cement ratio relationships, and aggregate adjustments.

Dependencies between inputs and outputs will be mapped to ensure accurate translation into Python functions.

Task 2: Translate Excel Calculations into Python Functions

All major engineering calculations will be implemented as clearly defined Python functions. Each function will accept input parameters and return calculated outputs. Functions may include:

- Water to cement ratio calculations
- Cementitious material weight calculations
- Volume based aggregate calculations
- Specific gravity and unit weight conversions
- Final weight chart formatting

The program will maintain the basis of calculation of **one cubic yard of concrete**, consistent with the NDOT Excel model.

Task 3: Implement Sequential User Input Prompts

The program will prompt the user to enter required design parameters in a logical order that mirrors the Excel worksheet. These may include:

- Cement content

- Supplementary cementitious materials
- Water to ement ratio
- Air content
- Aggregate proportions
- Specific gravities and material properties

Input validation will be implemented to reduce calculation errors.

Task 4: Generate Automated Weight Chart Output

The final program will generate a clearly formatted mix design output chart for one cubic yard of concrete. The output will include labeled weights for:

- Cement
- Supplementary cementitious materials
- Water
- Fine aggregate
- Coarse aggregate
- Admixtures

The output will be presented in a professional, client readable format.

Task 5: Research and Evaluate Four Concrete Mix Scenarios

The team will research four realistic concrete mix design scenarios using NDOT specifications and related engineering references. Each scenario will:

- Be fully defined using the required model inputs
- Be run through the automated Python workflow
- Be documented for verification and validation

Comparisons will be made between the four mixes to identify differences in material quantities and intended applications.

Task 6: Project Management and Documentation

To ensure timely completion, the team will develop a Gantt chart showing task sequencing, dependencies, and deadlines. The chart will be created using a professional project management tool.

All required documentation will be prepared, including:

- GitHub repository with code and README
- Annotated Code Document (ACD) explaining the Excel to Python translation
- Technical report including introduction, methods, results, discussion, and references

Deliverables

The following deliverables will be submitted to NDOT and uploaded to the project GitHub repository:

- **Python Code (.ipynb):** Functional Jupyter Notebook automating the Mix Design tab logic.
- **Four Mix Design Scenarios:** Documented and evaluated within the Python model.
- **GitHub Repository:** Public repository containing the notebook, documentation, and README with user guide.
- **Scope of Work (SOW):** This document outlining project goals, tasks, and deliverables.
- **Gantt Chart:** Visual project schedule.
- **Annotated Code Document (ACD):** Line by line explanation of code and translation logic.
- **Final Technical Report:** Formal report including Introduction, Methods, Results & Discussion, and References.