PRIME Engineering

Final Proposal:
Mental Health Counseling Mobile Office Space

Bret Burkes
Kristen Henderson
Edwin Perez
Danielle Yamson

December 12, 2018

CENE - 476C
Department of Civil and Environmental Engineering
College of Engineering, Informatics, and Applied Sciences

Table of Contents

1.0 Project Understanding 4
1.1 Project Purpose 4
1.2 Project Background 4
1.3 Technical Considerations 4
1.3.1 Architectural 4
1.3.2 Structural 4
1.3.3 Plumbing 4
1.3.4 Electrical 5
1.4 Potential Challenges 5
1.5 Stakeholders 5
2.0 Project Tasks 6
2.1 Preliminary Layout 6
2.1.1 Design Constraints & Criteria 6
2.1.2 Conceptual Architectural Floor Plan 6
2.1.3 Conceptual Structural Plan 6
2.2 Design Plans 6
2.2.1 Architectural Plan 6
2.2.2 Structural Plan 6
2.2.3 Plumbing Plan 7
2.2.4 Electrical Plan 7
2.2.5 Mechanical Plan 7
2.3 Cost Estimate 7
2.3.1 Materials Cost 7
2.3.2 Construction Cost 7
2.4 Project Management 8
2.4.1 Scheduling 8
2.4.1.1 Preliminary Design 8
2.4.1.2 Design Plans 8
2.4.1.3 Cost Estimate 8
2.4.1.4 Final Proposal/Final Presentation 8
2.4.2 Deliverables 8

2.4.3 Meetings 8
3.0 Project Schedule 9
3.1 Duration, Tasks, and Deliverables 9
3.2 Gantt Chart 9
4.0 Staffing and Cost of Engineering Services 10
4.1 Staffing 10
4.2 Cost of Engineering Services 11
5.0 References 13

1.0 Project Understanding

1.1 Project Purpose

The project proposed to the team is one in which the client needs a mobile office. The need for this office is due to the client's work as a licensed mental health professional. The client plans on using this mobile office for counselling her patients. This project requires that the team designs a mobile office that is best suitable for the client and their patients, and that the mobile office is designed to optimal standards and codes.

1.2 Project Background

Due to the project being a mobile office, there is no set site location. The client has expressed the desire to be able to take the office across the United States. Regarding the most common locations, the client has stated that the mobile office will stay within Yavapai County and Coconino County [1].

1.3 Technical Considerations

The five key technical aspects for the design of the mobile office space are architectural, structural, plumbing, electrical, and mechanical. Each one of these technical aspects must undergo a similar process in developing a conceptual design, analyzing potential desired solutions, and developing the final design drawings. Throughout the process for each technical aspects; software for drafting and analysis need to be used as well as hand performed portions of conceptual designs and calculations.

1.3.1 Architectural

Software such as Revit 3D will need to be utilized in both the beginning stages during the conceptual design of the mobile office space and when final renderings need to be developed for the client. SketchUp can potentially be used to aid Revit in the final rendering phase for the design. The analysis portion of the architectural process will entail the review of recreational vehicle design codes to make sure design and safety requirements are met across the United States.

1.3.2 Structural

Software such as Revit will be used in the conceptual design and final design layouts of the steel frame structure. The steel frame design will be cross referenced with the codes provided by the American Institute of Steel Construction (AISC) [2] to confirm all design requirements are being met. RSTAB is a software that has the potential to be utilized for the design and analysis of the steel frame structure. Hand calculations will also be conducted as a part of the analysis of the frame design. The final design will require structural detail drawings that will be developed in AutoCAD.

1.3.3 Plumbing

The conceptual design and final design of the pipe layout will be constructed in AutoCAD. The plumbing layout will design for black and grey water tanks, as well as fresh water tanks. The plumbing details that are determined will also be constructed in AutoCAD. RV codes will be

referenced to confirm the plumbing design is meeting requirements. The analysis that is done for the plumbing system will be conducted in the WaterGEMS software and also by hand calculations.

1.3.4 Electrical

AutoCAD will be used to layout the electrical conduit for the trailer. This drawing will also show the locations of the breaker box, the power output being provided by each conduit, and the locations of the outlets inside the trailer. The power supply will have to be evaluated to ensure that the power being supplied is sufficient. The mobile office will follow the codes developed for tiny homes across the United States from the National Fire Protection Association (NFPA). [3]

1.4 Potential Challenges

There are a few potential challenges that may come up in the process of designing the tiny mobile office. A major constraint is trying to keep the design within the budget the client has provided. This project is being completely customized for the client. Aspects of the project such as the steel frame, solar panels, and soundproofing will take up most of the budget.

Another potential challenge will be trying to come up with the design of the mobile office space that pleases the client. The client has confirmed that a fifth wheel trailer will best suit the needs for the mobile office space. As such, a main constraint is the weight of the trailer and how the axial of the trailer will be designed to carry such loads.

The client plans on mainly using the mobile office space within Yavapai and Coconino County, [4] but also plans on taking the vehicle out-of-state. This requires the team to come up with a design that complies with not only local county codes, but with national codes as well. This constraint will require the team members to constantly compare and comply with the codes during the design process.

1.5 Stakeholders

The major stakeholder in this project is the client who would like a sufficient design of a mobile office space to utilize. If the proposed design does not meet her needs or does not meet code requirements, then resources will have been wasted and design safety may be in question. Another major stakeholder in this project is the patients that the client will be serving in this proposed mobile office space. If the mobile office space is not adequately designed, then the safety of the patients will be in question.

2.0 Project Tasks

2.1 Preliminary Layout

2.1.1 Design Constraints & Criteria

The architectural aspects of the mobile office will be designed to meet the codes for Coconino County, national standards, and the client's requests. The mobile office will abide by the Yavapai and Coconino Counties. The American National Standards Institute (ANSI) for recreational vehicles will also be met [5]. The main criteria and constraints for the mobile office will be the soundproofing for the counseling office room, the overall aesthetic quality of the mobile office, and a removable divider that merges the counseling office and waiting room. This project will be a balance between the desires of the client and complying with design standards stated by the American Institute of Steel Construction (AISC) and by the Research Council on Structural Connections (RCSC). During the preliminary structural layout, the design team presents the client with possible design solutions that comply with the design standards stated, as well as attempting to meet the needs that the client has for the mobile office space. The goal by the end of this process is that an initial plan is designed, and it meets all of the design constraints and criteria.

2.1.2 Conceptual Architectural Floor Plan

The conceptual floor plan will be designed within the standardized codes and would also be designed to meet the major criterion of the architectural layout. The counseling room, soundproofing, and aesthetic quality will serve as the main focus for the architectural layout of the mobile office. The conceptual floor plan will be designed to standardized codes and the client's needs. Once the architectural layout is complete, it will influence the design of the structural layout, electrical layout, plumbing layout, and mechanical layout.

2.1.3 Conceptual Structural Plan

The conceptual structural plans are the multiple design visual representation solutions that are presented to the client with the goal to narrow down a solid design plan that will comply with design code standards, the architectural layout, and the needs of the client.

2.2 Design Plans

2.2.1 Architectural Plan

The architectural design plans will consist of the final floor plan layout, the final plumbing layout including tanks and pump locations, and the electrical wiring layout including potential permanent light fixtures. The criterion for the architectural aspects will be incorporated into the plans as well as potential Health Insurance Portability and Accountability Act (HIPAA) regulations. [6] The HIPAA regulations consist of requirements that health institutions must meet and for this structure the most important aspect is to make sure that each patient has enough privacy by incorporating sound proofing into the design.

2.2.2 Structural Plan

The structural plans will be designed in conjunction with the architectural plans. These plans will be designed in accordance with approved structural steel design codes and the design requirements

identified by the client for the mobile office space. The custom trailer will also be designed according to recognized tiny home design codes and the required load requirements presented by the general mobile office space design.

2.2.3 Plumbing Plan

The plumbing plan will be designed to standards and designed to accommodate the needs for the mobile office space demands. Draft layout plans will be designed and then the final plumbing layout design will be based off revisions received from the drafting plans.

2.2.4 Electrical Plan

The electrical plans will be designed after the structural and architectural plans. The plans for this portion will consist of a layout for the wiring and potential permanent light fixtures that will be incorporated into the mobile office space.

2.2.5 Mechanical Plan

The mechanical plan will consist of the HVAC (heating, ventilation, and air conditioning). The HVAC system will be installed to provide comfort inside the mobile office. The mechanical layout will be designed for after the architectural, structural, and electrical layout plans have started.

2.3 Cost Estimate

2.3.1 Materials Cost

The cost of the materials will be calculated throughout the design process. With the balance of the office needing to be aesthetically pleasing and be near budget, the material list will possibly change. The design will start by meeting all aesthetic requirements. Once that design is complete, the material cost will be calculated and inserted into the final budget to determine if that budget is acceptable.

2.3.2 Construction Cost

Due to the construction of the trailer being outsourced to a general contractor, multiple bids will need to be seen and evaluated. The cost of constructing the frame will stay relatively consistent due to that needing to be completed by a company with that specific expertise. The change in construction cost will come from the contractor fees, including the fees that the subcontractors have, or the contractor's cost if they will self-perform the work.

2.4 Project Management

2.4.1 Scheduling

2.4.1.1 Preliminary Design

The preliminary designs will encompass conceptual floor and structural plans to begin running through design ideas with the client to narrow down what exactly the client needs and agrees with. These preliminary designs are the first steps in this design process to see in what direction the overall design will be headed towards.

2.4.1.2 Design Plans

Once the architectural and structural designs of the mobile office space have been narrowed down, final floor and structural plans will be created. The plumbing, electrical, and mechanical plans are then based off the final floor plans with some influence by the structural plans. These design plans are the next step in putting together the final design for the mobile office space.

2.4.1.3 Cost Estimate

A cost analysis will be done to present to the client a clear budget for the mobile office space. The cost analysis will consist of material costs, and depending on the design that was created, more expensive material might be required. The cost analysis will also include staffing cost and how many hours are billed to create such a design.

2.4.1.4 Final Proposal/Final Presentation

The final proposal and presentation are essential to the project because this is where all of the designs, exclusions, and cost analysis are presented to the client. The client then gets to decide if they like the end result that was presented and would like to go forward with the construction of the mobile office space.

2.4.2 Deliverables

The final proposal will consist of a final design of the mobile office space. The proposal will consist of all design plans for the structural, architectural, plumbing, electrical, and mechanical aspects of the project. The proposal will also be designed in accordance to the client's budget. The final proposal and design will be given to the client. The final presentation will describe the team's process of design for the mobile office and how the challenges affected the overall design, and how the criterion was met to the client's satisfaction.

2.4.3 Meetings

The team holds multiple meetings over the course of the project to ensure all work is being completed and that the stakeholders fully understand the current standing of the project. The team as a group meets together on a weekly basis to go over the schedule and deliverables. The team will have a monthly meeting with client to ensure that everybody is aware of the progression of the project. [1] The team also meets with the technical advisor approximately every three weeks depending on the need of the project.

3.0 Project Schedule

3.1 Duration, Tasks, and Deliverables

Figure one below is the Gantt Chart that is utilized to keep the project on schedule through the design process. The total duration of the project is eighty-nine days. The major tasks are the creation of the architectural and structural floor plan, the structural design plan, and the 30%, 60%, and final report.

3.2 Gantt Chart

The critical path is the section that controls the main processes of the schedule. The critical path for this design schedule is made up of the design constraints and criteria, the conceptual architectural floor plan, the conceptual structural floor plan, the structural design plan, the mechanical design plan, and the 30%, 60%, and final report. The critical path is significant because it keeps the tasks on the entire schedule in order. The Gantt Chart shows the proper staggering of the designs associated with the critical path.

4.0 Staffing and Cost of Engineering Services

4.1 Staffing

Table one below indicates the tasks listed within the team's scope and the staffing that will be provided for the project as well as presenting how many eight-hour days each employee will invest. The classification of staffing includes the senior engineer, engineer, intern, and project manager. Most of the Senior Engineer's time will be invested into the design plans and project management portion of the project. The Senior Engineer's purpose during this project is to act more of as a revisor for the work that is being conducted by giving their input and revising the preliminary designs and cost analysis portions that are being developed. The Senior Engineer will invest more time into the development of the design plans to ensure that no errors are missed and that the design is technically and professionally completed. Since the Senior Engineer acts as more of a supervisor, a big portion of the time that is invested is identified as project management. The Engineer invests most of their time into the preliminary and final design plans section of the project because they are developing these portions and editing them as needed by the input from the client and Senior Engineer. The Intern invests time into all the tasks of the project as they are needed. Most of the Intern's time is invested into the design plans by helping the Engineer put together the schematics for the architectural, structural, plumbing, electrical, and mechanical plans. The Project Manager invests most of their time into the cost analysis and project management section of the project because a big portion of their duty is to put together the cost of the project and ensure that every portion of the project is running smoothly. Table 1 gives a total of 828hours that are devoted to design the mobile office space. Table 1 just breaks down how the 828 hours will be divided up among the staff, in order to complete the project.

Table 1: Project Tasks

Project Tasks	Staff (hrs) ENG	SENG	INT	PM	Task Total
1.0 Preliminary Layout	**129**	**13**	**39**	**41**	**222**
1.1 Design Constraints & Criteria	17	2	6	8	
1.2 Architectural Layout	20	2	8	7	
1.3 Electrical Layout	29	4	7	7	
1.4 Plumbing Layout	16	1	5	7	
1.5 Structural Layout	19	1	7	6	
1.6 Mechanical Layout	28	3	6	6	
2.0 Design Plans	**138**	**47**	**63**	**7**	**255**
2.1 Architectural Plan	38	12	20	2	
2.2 Plumbing Plan	*18*	*5*	*10*	*1*	
2.3 Electrical Plan	*20*	*7*	*10*	*1*	
2.4 Structural Plan	45	18	14	2	
2.5 Mechanical Plan	17	5	9	1	
3.0 Cost Estimate	**27**	**13**	**9**	**42**	**91**
3.1 Materials Cost	15	6	4	15	
3.2 Construction Cost	12	7	5	27	
4.0 Project Management	**62**	**29**	**9**	**160**	**260**
4.1 Scheduling	42	20	5	110	
4.1.1 Preliminary Design	*10*	*4*	*2*	*28*	
4.1.2 Design Plans	*15*	*5*	*1*	*14*	
4.1.3 Cost Estimate	*8*	*6*	*1*	*32*	
4.1.4 Final Proposal/Final Presentation	*9*	*5*	*1*	*36*	
4.2 Deliverables	0	4	1	22	
4.3 Meetings	20	5	3	28	
Staff Total	**356**	**102**	**120**	**250**	**828**

4.2 Cost of Engineering Services

Table 2 below indicates the different aspects of cost that employing workers will entail. The base pay of the Senior Engineer is the highest due to the vast knowledge and experience that they bring to the project in ensuring that everything is designed properly and in a professional manner. The Engineer receives the highest benefit percentage because the time that they invest into the actual design portion of the project. The Project Manager receives the second highest billing rate due to them managing all the sections of the project to ensure everything is being completed adequately and on time. The Project Manager receives the most liability because of all that is being managed by them and in return they are compensated with a higher billing rate.

Table 2: Billing Rate

Classification	Base Pay $	Benefit %	Actual Pay $	Profit %	Billing Rate
Senior Engineer	80	30	104	10	114
Engineer	33	60	53	10	58
Intern	19	30	25	10	28
Project Manager	60	40	84	10	92

Table three below presents the multipliers used to indicate the billing rate for each employer. The multiplier identified in Table three represents the benefits and profit portions that comes with employment of each worker. This multiplier is used in conjunction with the base pay that each employee receives to calculate the billing rate that the employees will acquire for the services that they will provide for the project.

Table 3: Billing Rate per Hour

Classification	Base Pay $/hr	Multiplier	Billing Rate $/hr
Senior Engineer	80	2.42	194
Engineer	33	2.95	98
Intern	19	2.19	42
Project Manager	60	2.15	129

Table four below presents the total amount of hours that each employee invests into the project. Table four is a combination of Table one total staffing hours and Table 3 engineering billing rates. Table four gives a total budget needed to design a mobile office space. There are no supplies needed due to computers and software needed for design being covered in the overhead costs. Due to there being no site and the client meetings taking place through video conference, there are no travel expenses.

		Classification	Hours	Rate/Hour	Cost
1.0	Personnel	Senior Engineer	102	194	$19,788
		Engineer	356	98	$34,888
		Intern	120	42	$5,040
		Project Manager	250	129	$32,250
				Total Cost	**$91,966**

Table 4: Total Engineering Cost

5.0 References

[1] A. Baca-Spry, ‘Client Meetings’, Flagstaff, AZ. 2018.

[2] "American Institute of Steel Construction", *Aisc.org*, 2018. [Online]. Available: https://www.aisc.org/.

[3] "NFPA", *Nfpa.org*, 2018. [Online]. Available: https://www.nfpa.org/.

[4] "Codes/Ordinances", *Yavapai.us*, 2018. [Online]. Available: http://www.yavapai.us/devserv/codes-ordinances.

[5] ANSI-American National Standards Institute", *Ansi.org*, 2018. [Online]. Available: https://www.ansi.org/.

[6] "Health Information Privacy", *HHS.gov*, 2018. [Online]. Available: https://www.hhs.gov/hipaa/index.html.

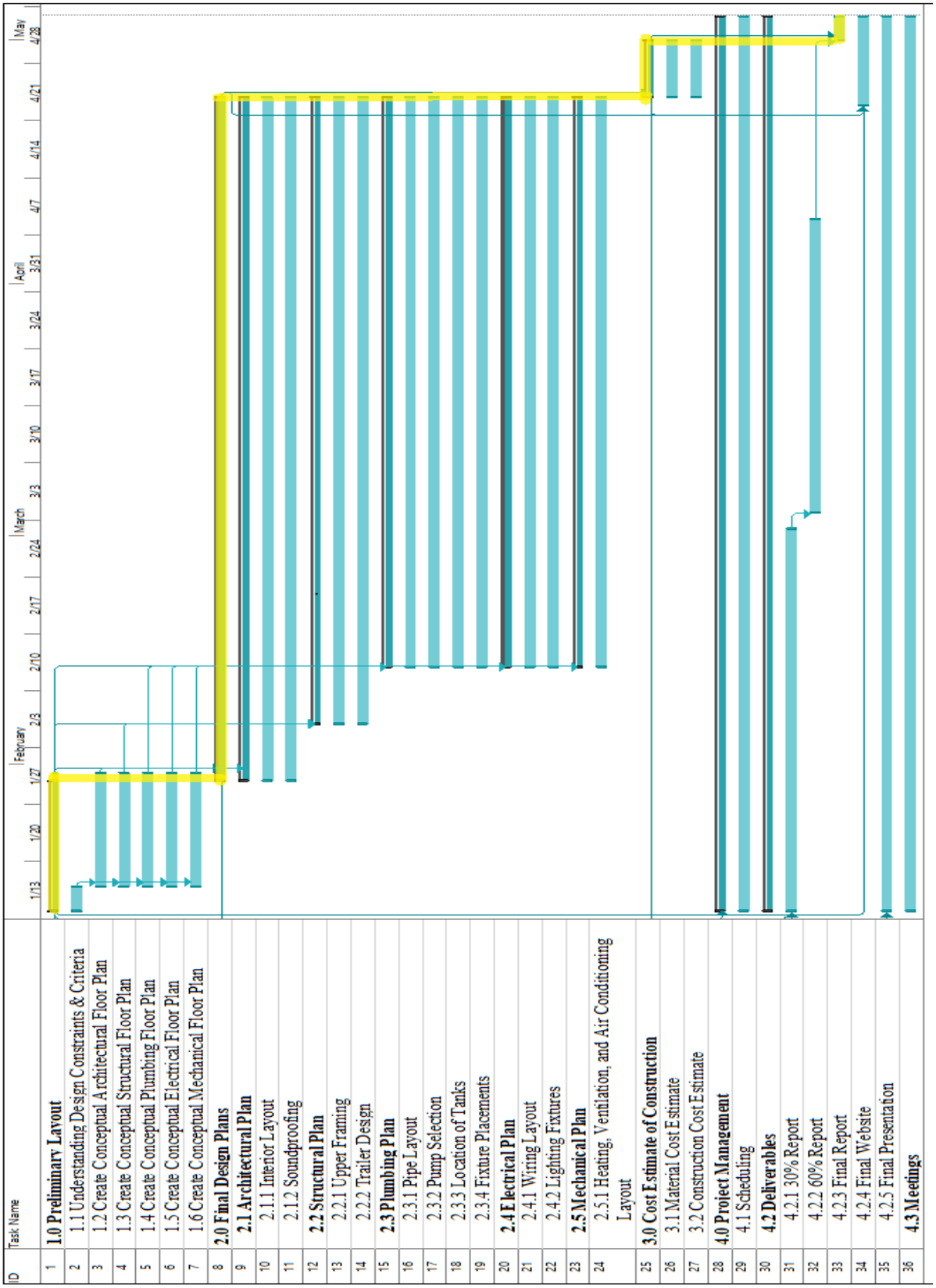

Figure 1: Gantt Chart