# Fire Station Addition

## 90 % Progress Report

Prepared for Mark Lamer

Prepared by:
JAML Engineering Firm
Abdullah Alkhayat
Lionel Goy
Jocelyne Rivas
Marc Wasserman

CENE 486C
4/16/19

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# Acknowledgments:

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# 1.0 Project Introduction

## 1.1 Project Purpose

The Ponderosa Fire Station (Station 82) is located in Bellemont, Arizona. The existing station requires additional living quarters for firefighters, a room for hosting community events, more office spaces for staff, and a vehicle bay for storing a battalion chief vehicle or ambulance. Currently the existing fire station can only comfortably house two firefighters, but occasionally the fire station holds up to five firefighters at a time. The client would like to add a community room as community events are currently held in the firetruck bay. Adding a community room is the client's priority for the project. The goal of this project is to design a building addition that flows with the existing station and meets all codes and regulations, as well as meets the client's requests.

## 1.2 Project Background

Station 82 is in Bellemont, Coconino County, Arizona on 1.4- acre of land. Figure 1 below shows the location of the station in relation to the state of Arizona. The site is located 12 miles west of Flagstaff off Route 66 on Shadow Mountain Drive. Figure 2 and 3 show the street view of the existing station.


*Figure 1: Ponderosa Fire Station in Bellemont in relation to Arizona [1]*

*Figure 2: North Face of the Existing Station*

*Figure 3: Street View of Existing Station*

### 1.3 Original Site Plan

The original site of the fire station has a parking lot on the west side of the building, an entry and exit driveway east of the building, and driveway located north of the building. The existing structure is 81’-2” x 80’. It is constructed of a prefabricated metal frame. Figure 4 shows a site plan with existing and proposed structure.

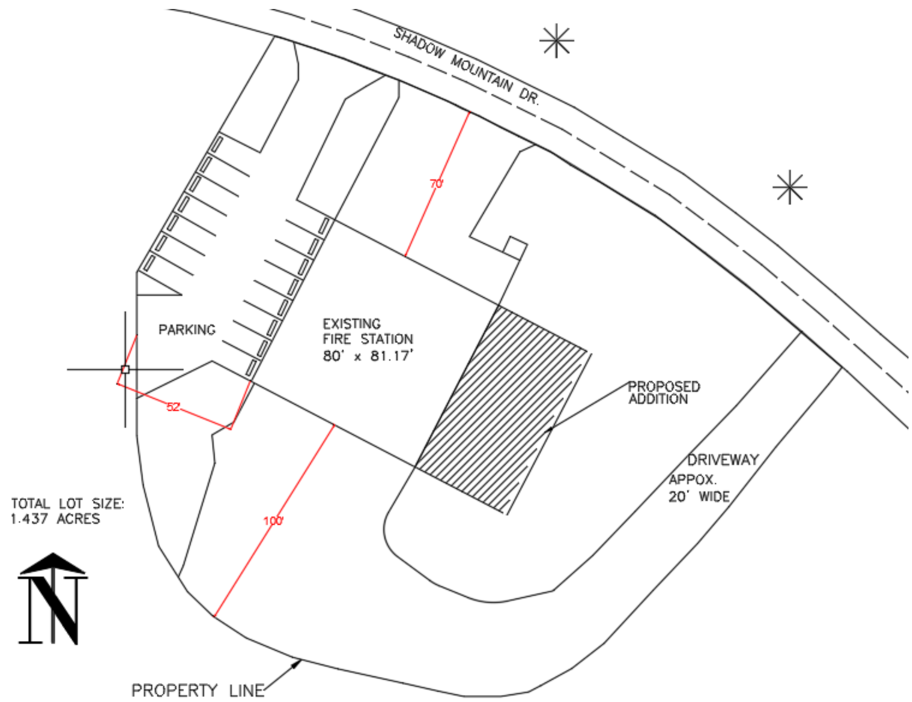


*Figure 4: Job Site with Existing and Proposed Stations*

### 1.4 Project Limitations

The team will not design the structural framing of the building. The building frame design will be provided by a steel manufacturer contracted by the client. The team will not be designing and creating an electric plan for the building addition. The team will also not design mechanical components of the building addition such as the HVAC system.

### 1.5 Project Objectives

The major objectives of the project are to design the floor plan, foundation plan and anchor bolt plans as required to meet the client’s requests. Construction costs and a metal frame company will be determined to potentially start construction in the Fall 2019.

## 2.0 Technical Work

### 2.1 Site Investigation

A site investigation was conducted to get an understanding of the current state of the station and determine the needs for the new addition. The team walked through the site, measured, and recorded the dimensions of the features in the building such as the size of rooms, hallways, windows, and doors.

### 2.1.1 Land Survey

As a team, a land survey of the site was conducted using Spectra Precision SP80 GNSS GPS unit with a Spectra Precision Ranger Pro with Survey Pro data program. Specific points including edge of pavement, trees, sign, and building corners were stored under the 1000 numbers. Topo points were stored under the 2000 numbers. When conducting the main topo for the proposed addition on the existing pad, shots were taken in a grid manner at a 5-6ft intervals.

### 2.1.2 Survey Analysis

Data was uploaded in to AutoDesk Civil 3D and topographic map was created of the site. Figure 5 shows a topographic with the site layout of the existing driveway, parking lot and building.

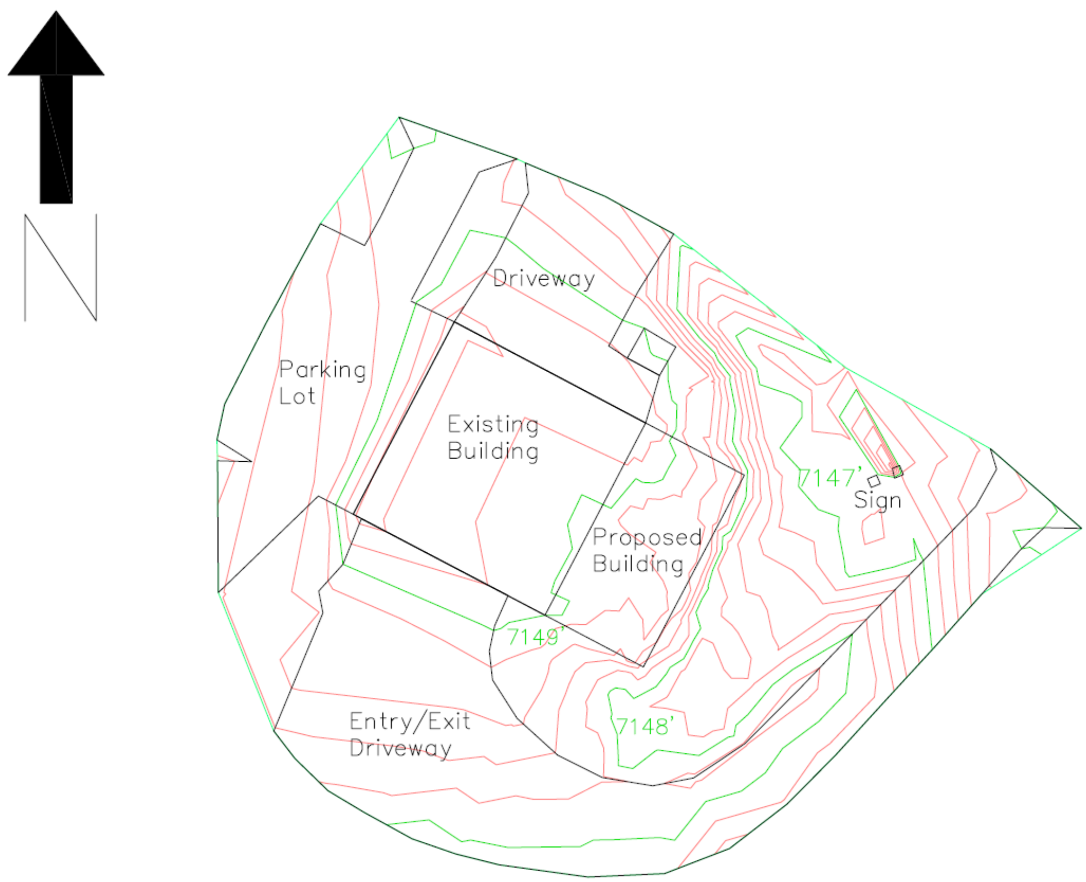


*Figure 5: Topographic map and site layout of fire station area.*

## 2.2 Geotechnical Soil Properties

The design of the foundation requires that certain properties of the surrounding soil be found by performing field and laboratory tests on soil samples. The team was able to obtain these soil properties from a geotechnical report provided by Capstone Homes for their Flagstaff Meadows project located directly south of the fire station, hence no assumptions were needed. The team will design the foundation of the fire station addition based on the soil properties determined in the Flagstaff Meadows geotechnical report since the soil tested in this project is in close proximity to the fire station. The Flagstaff Meadows project consisted of over 30 boring samples over their development site which is located south of the fire station which can be seen below in Figure 6 [2]. The circles around boring samples No.1, 2, 3, 4, 5, 8, 10, 13, and 26 indicate the boring samples that were used to determine the soil properties as these boring samples had laboratory test performed them. The soil properties that are needed for the foundation design are the physical properties of the soil, swelling pressure, expansion index, and the soil bearing capacity. The physical properties of the soil include the sieve analysis of the soil, the liquid limit (LL), and the plasticity index (PI).

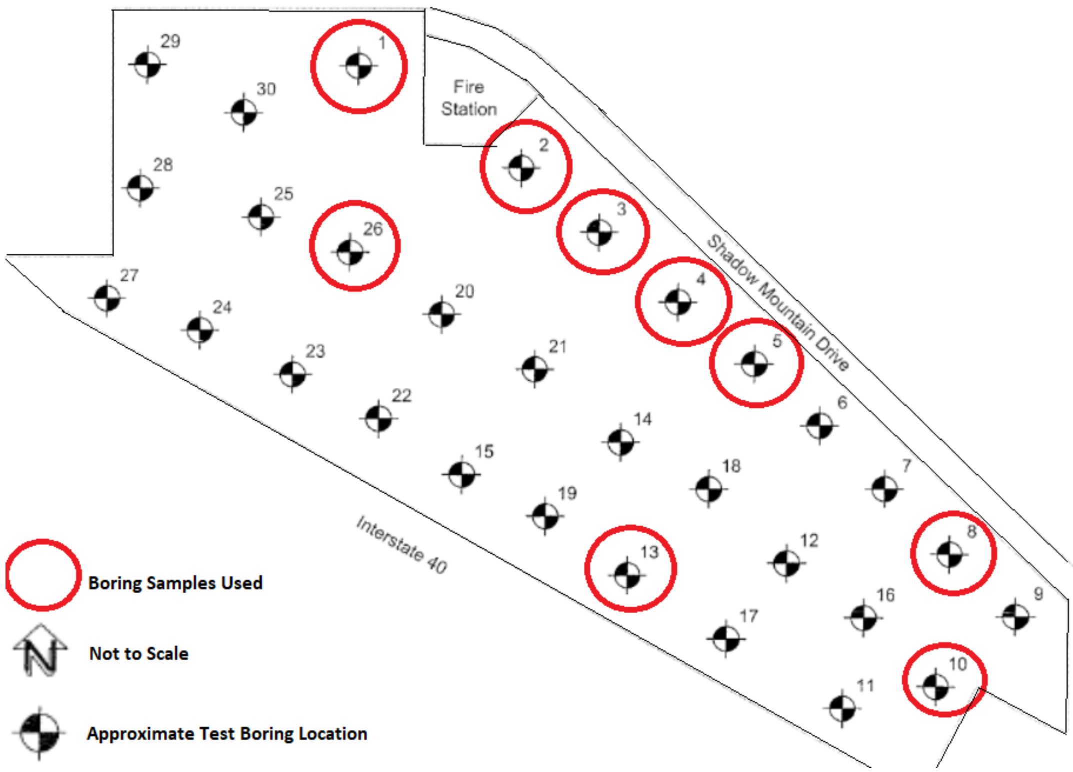


*Figure 6: Site map of boring hole locations with fire station labeled for reference [2].*

### 2.2.1 Physical Properties

The physical properties of the soil provided by the Flagstaff Meadows' geotechnical report can be seen below in Table 1. The soil description for the soil classification group symbols can be seen below in Table 2. Table 3 was used to classify the plasticity of the soil based on the plasticity index (PI) found in Table 1. The boring samples that had a sieve analysis and PI test performed can be found in the left column titled "Boring No." The results of the sieve analysis and plasticity index were used to help determine the classification of the soil where each boring sample was taken. The team also looked at the soil description in the boring logs for Boring No. 2 and Boring No. 26 as these boring samples were closest to where the fire station project is located to help determine the type of soil the foundation was to be built on. The Boring logs can be found in Appendix A: Flagstaff Meadows Boring Logs. Based on the physical properties test results in Table 1 for Boring No. 1 and 3 and the soil description in the boring logs for Boring No. 2 and 26, it was determined that the soil the addition would be built consists of clayey sand and fat clays that have a medium to high plasticity [2]. No groundwater was encountered based on the boring logs found in Appendix A: Flagstaff Meadows Boring Logs [2].

*Table 1. Soil properties from testing [2].*

| PHYSICAL PROPERTIES | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Boring No. | Depth (Feet) | Soil Classification | Particle Size Distribution % Passing By Weight | | | | | | Atterburg Limits | |
| | | | 3 In. | No. 4 | No. 10 | No. 40 | No. 200 | 2µ | LL | PI |
| 1 | 1-2 | SC | 100 | 78 | 68 | 56 | 47 | | 39 | 21 |
| 3 | 3-5 | SC | 100 | 98 | 94 | 82 | 48 | | 43 | 20 |
| 4 | 4-5 | CL | 100 | 96 | 90 | 78 | 50 | 22 | 43 | 21 |
| 5 | 7-8 | SC | 100 | 92 | 86 | 71 | 45 | 24 | 43 | 26 |
| 8 | 5-6 | SC | 100 | 89 | 80 | 66 | 47 | | 38 | 20 |
| 10 | 3-4 | CH | 100 | 91 | 85 | 77 | 55 | 22 | 50 | 29 |
| 13 | 7-8 | CL | 100 | 99 | 96 | 89 | 54 | 19 | 42 | 23 |

*Table 2. Soil description [2].*

| Soil Description | |
|---|---|
| Group Symbols | Description |
| **SC** | Clayey Sands, Sand-Clay Mixtures, More than 12% Fines |
| **CL** | Inorganic Clays of Low to Medium Plasiticity. Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays |
| **CH** | Inorganic Clays of High Plasticity, Fat Clays |

*Table 3. Soil plasticity of fine-grained soils [2].*

| Plasticity of Fine-Grained Soils | |
|---|---|
| Plasticticity Index (PI) | Term |
| 0 | Non-Plastic |
| 1-7 | Low |
| 8-25 | Medium |
| Over 25 | High |

### 2.2.2 Swelling Pressure

The consolidation test results provided by the Flagstaff Meadows project geotechnical report can be seen below in Table 4. The consolidation test reports from the geotechnical report can be found in Appendix B: Flagstaff Meadows Project Consolidation Test Reports. Consolidation tests were done on Boring samples No. 4, No. 5, and No. 7. The swelling pressures and percent swell values determined by the consolidation test for the Flagstaff Meadows project will be used for the foundation design of the fire station addition to help design against heaving and swelling.

*Table 4. Consolidation test results.*

| Consolidation Test Results | | | | |
|---|---|---|---|---|
| Boring No. | Depth (Feet) | Soil Classification | Swelling Pressure (kips) | Percent Swell |
| 4 | 4-5 | CL | 1 | 0.4 |
| 5 | 7-8 | SC | 1.16 | 0.8 |
| 7 | 3-4 | CH | 0.16 | 0.1 |

### 2.2.3 Soil Expansion

The soil expansion properties provided by the Flagstaff Meadows project geotechnical report can be seen below in Table 5. The soil properties tables from the geotechnical report can be found in Appendix C: Flagstaff Meadows Project Soil Properties Tables. Soil expansion test were done on Boring samples No. 4, No.5, No. 10, and No.13. The tests concluded that the soil surrounding the fire station had a very low to low potential of expansion [2]. The team will use this information in the foundation design of the fire station addition to help design against heaving and swelling. Heaving and swelling of the soil underneath the foundation is a concern for this project because of the high amounts of clayey soils on the site.

*Table 5. Soil expansion properties.*

| Soil Expension Properties | | | | | |
|---|---|---|---|---|---|
| Boring No. | Depth (Feet) | Soil Classification | Expansion (%) | Expansion Index | Potential Expansion |
| 4 | 4-5 | CL | 7.7 | 28 | 21-50 (Low) |
| 5 | 7-8 | SC | 3.9 | 9 | 0-20 (Very Low) |
| 10 | 3-4 | CH | 8.4 | 39 | 21-50 (Low) |
| 13 | 7-8 | CL | 9.3 | 43 | 21-50 (Low) |

### 2.2.4 Soil Bearing Capacity

The soil bearing capacity of the soil was found to be 1500 pounds per square foot (psf) based on the Flagstaff Meadows geotechnical report [2]. This is good because it is consistent with what is expected for soil that is classified as clayey sand [3]. This is the soil bearing capacity the team will use for the foundation design.

## 2.3 Structural Design

### 2.3.1 Design Perimeters

The project design will follow the 2018 International Building Code (IBC 2018), which is the adopted code for Coconino County. According to the code, the snow load for a roof must be designed for 40 pounds per square foot (psf) [4]. The international building code also states that the wind load for any structural building in climate zone 5b (which Bellemont is) must be designed for 120 mile per hour which is 30 psf [4]. [5]The areas of the beams and column in the existing fire station were used to estimate the dead load of the steel frame building. The areas of the steel beams and columns were then multiplied by the unit weight of steel to calculate the dead load of the steel of 75 plf and 15 psf for the mechanical, plumbing and electrical [5]. The decking dead load is 10psf and 40 psf for the floor live load which would include people, chairs, table, firetrucks, etc. [6]. The walls that will be installed for the proposed structure is gypsum board walls which has 4 psf as a dead load [5]. For the girder a 30 psf of dead load was used [5]. The team will use the IBC 2018 to figure out the points loads on the concreate slabs. The load combination equation below total load on the foundation was determined from the largest load. It was determined that equation 2 determined the max load of 99.24 kips on the foundation. The tributary areas in figure 10, for the six proposed foundation columns were used to determine the force on each column. For columns 1, 3, 4 and 6 the load was determined to be 29.8 kips. For columns 2 and 5 the load was determined to be 55.1 kips. The shear force from wind for columns 3 and 6 was determined to be 15.2 kips. The max uplift due to wind was determined to be 30 psf. A shear force from wind was determined to be 29.2 psf.

*Table 6. Design Loads Used,*

| Design Loads | |
|---|---|
| Load | PSF |
| Dead (D) | 15 |
| Live (L) | 40 |
| Live Roof (Lr) | 20 |
| Snow (S) | 40 |
| Wind (W) | 30 |

***Equation 1.*** $W_u = 1.4D$

***Equation 2.*** $W_u = 1.2D + 1.6L + 0.5S$

***Equation 3.*** $W_u = 1.2D + 1.6S + 0.5W$ ***(DETERMINNG FACTOR)***

***Equation 4.*** $W_u = 1.2D + 1.0W + L + 0.5S$

***Equation 5.*** $W_u = 1.2D + 1.0E + L + 0.2S$ ***(NOT USED)***

***Equation 6.*** $W_u = 0.9D + 1.0W$

***Equation 7.*** $W_u = 0.9D + 1.0E$ ***(NOT USED)***

*Table 7. Trib Areas*

| Trib Areas | |
|---|---|
| Area | S.F. |
| 1 | 460 |
| 2 | 920 |
| 3 | 460 |
| 4 | 460 |
| 5 | 920 |
| 6 | 460 |

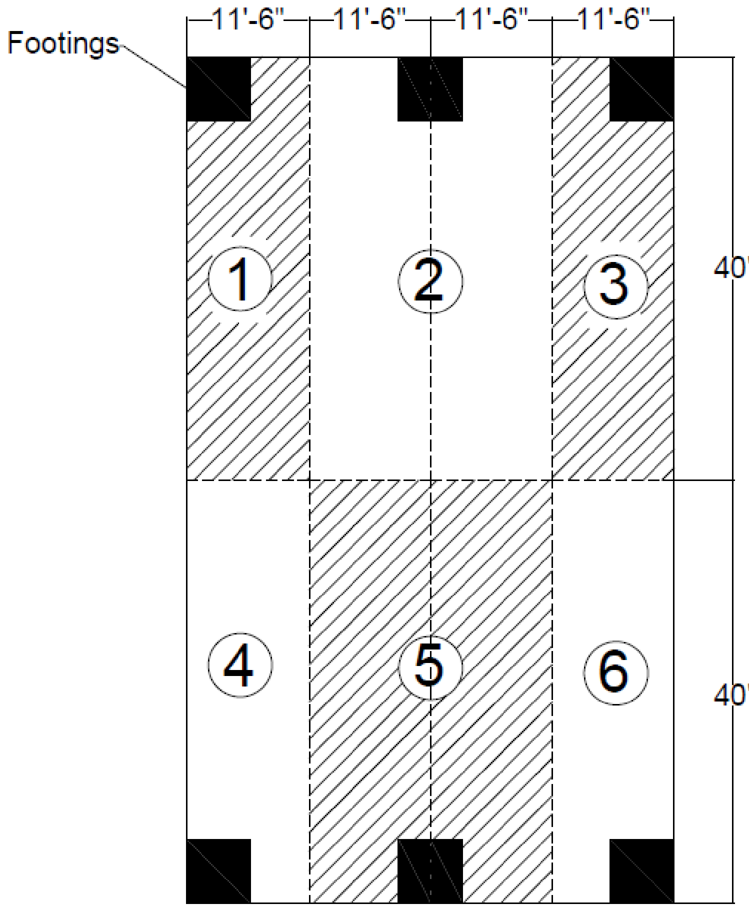


*Figure 7. Tributary area of proposed layout*

### 2.3.2 Anchor Bolt Design

Anchor bolts will be used to secure the six metal frame columns to the foundation. 1-inch ASTM F1554-36 steel bolts will be used in accordance to ACI 318-14. The uplift force was calculated to be 22.7 kips and a shear force of 19.6 kips. Figures 9, 10 and 11 show the detail design of the anchor bolt section. The pullout strength, nominal strength and shear strength of the anchor bolts were checked for failure using ACI 318-14 section 17. It was determined that the anchor bolt design is adequate to with stand the uplift and shear force.

### 2.3.3 Foundation Design

A slab foundation with 6’ x 7’ square footings will be used for areas 1, 3, 4 and 6. A 15’ x 5’ square footing will be used for areas 2 and 3 (see figure 11). Figure 9 and 10 show the foundation specs with rebar locations. Rebar size and spacing was determined using ACI 318-14. 19 #4 rebar with 4” spacing will be used for the footing. #4 rebar with a 16” spacing will be used for the slab. Concrete specifications are class A C40/50 which were determined from ACI-318-14. Table 8 below show the different classes of concrete.

*Table 8. Concrete specifications*

| Class of concrete | Age | Average of Three Consecutive Specimens | Minimum any One Specimen | Note |
|---|---|---|---|---|
| **A** | 28 days | 4,500 psi | 4,000 psi | For all reinforced concrete |
| **B** | 29 days | 3,000 psi | 2,500 psi | For pipe cradles, collars, non-reinforced concrete, etc. |

## 2.4 Construction Documents

### 2.4.1 Floor Plan

The addition will be a 46'x 80' structure. The addition includes two dormitories, a kitchen expansion, a community room, a public restroom, two offices, and a chief bay. The dormitories were designed to replicate the layout of the existing dormitories. The community room is approximately 1066 sf was designed to hold approximately 50 people and complies with the 2018 International Fire Code (IFC). According to the IFC Section 1004, an assembly room without fixed seating must have a minimum of 15sf per occupant [7]. The chief bay was designed considering the dimensions of a TYPE I ambulance which is the largest vehicle that it will store. The 3500 TYPE 1 CHEVY 2018 measures 95"X 105" x 285" and can be seen in Appendix D. Figure 8 shows the existing and proposed floor plan.

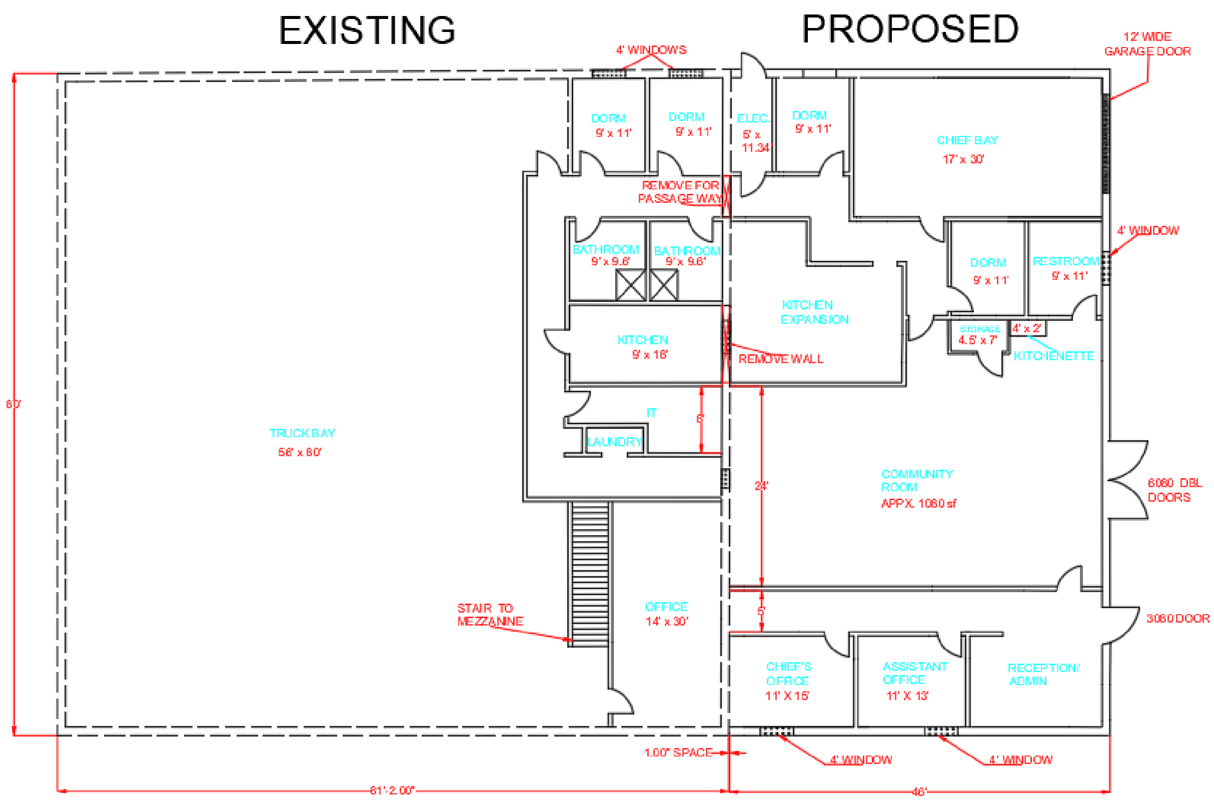


*Figure 8: Floor Plan of Existing and Proposed Structures*

## 2.4.2 Site Plan

The site plan in figure 4 depicts the existing and proposed structures, the existing parking lot and driveway, and shows that the minimum setback requirements are met. According to the Coconino Zoning Ordinance, the setbacks for a semi- public use building such as a fire station must be a minimum of 20 feet from all property lines [8].

## 2.4.4 Foundation Plan and Details

#8 rebar will be used as reinforcing strength bars according to ACI 318-14 [9]. Table 9 shows the design parameters used for to calculate the foundation size

*Table 9. Design parameters for the foundation*

| Design Parameters | | |
|---|---|---|
| **Name** | **Symbol** | **Load** |
| Yield Strength | fy | 40,000 psi |
| Compressive Strength | f'c | 3,00 psi |
| Soil Bearing Capacity | gamma | 1,500 psf |
| Roof Dead Load | DL | 18.3 kips |
| Roof Live Load | LL | 36.8 kips |

Figure 9, and 10 below show the foundation specs with rebar location.

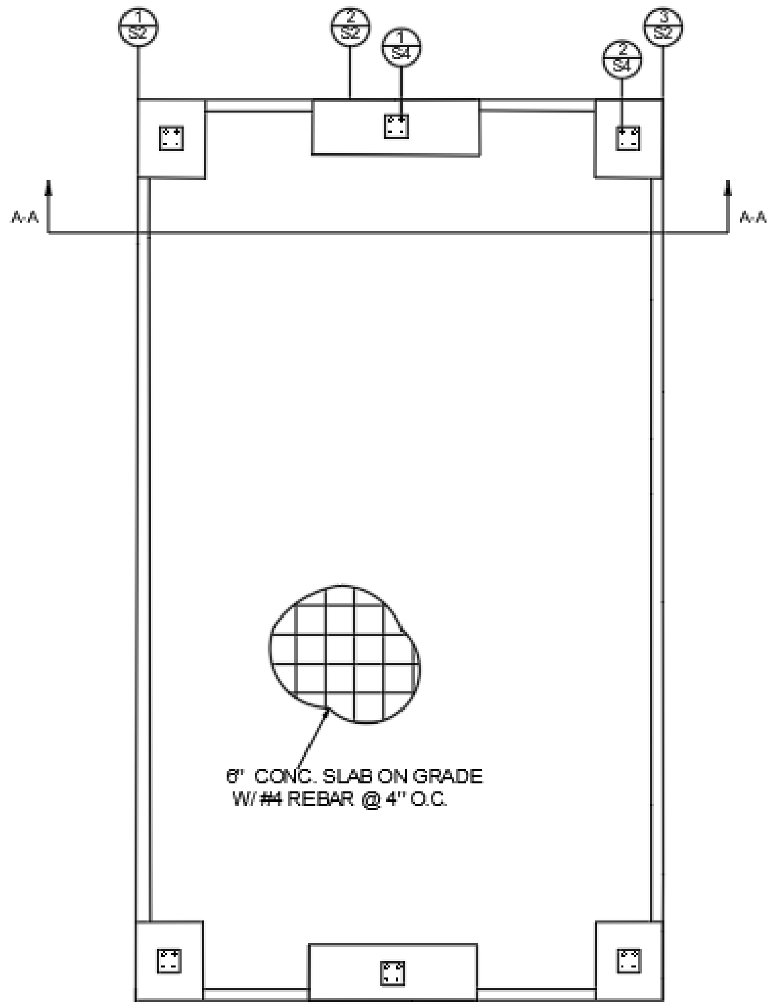


*Figure 9. Foundation Specs with Rebar Location*

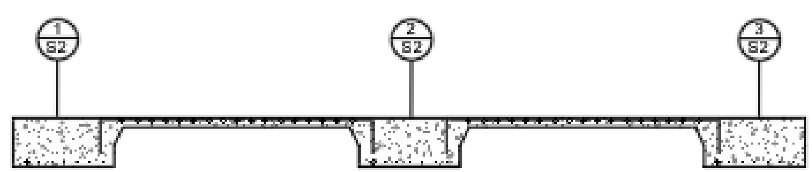


*Figure 10. Foundation Specs with Rebar Location*

Figure 11 below shows the footings that will be used for the design.

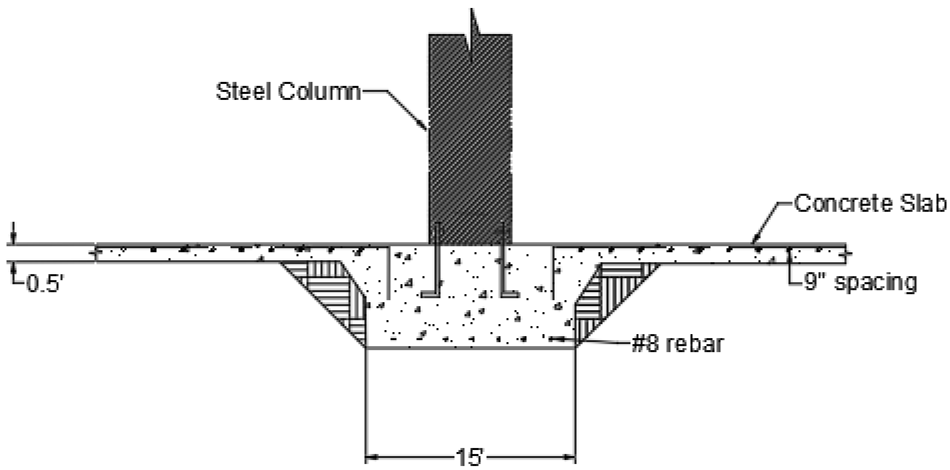


*Figure 11. Design Footing*

## 2.4.5 Anchor Bolt Plan and Details

Table 10 below shows the design parameters for the anchor bolts. Figure 12 and 13 show more details for the anchor bolts.

*Table 10. Design parameters for the anchor bolt.*

| **Design Parameters** | |
|---|---|
| **Name** | **Load** |
| Steel Anchor Bolt | ASTM F1554-36 |
| Shear Load | 19.6 kips |
| Uplift Load | 22.7 kips |

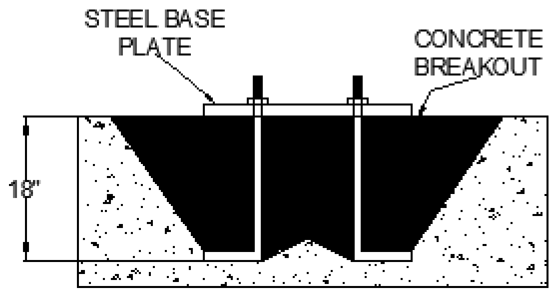


*Figure 12. Cone of failure for the anchor bolts.*

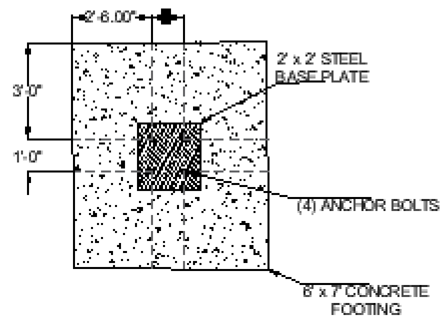


*Figure 13. Detailed layout of the anchor bolt plate on the footing column.*

## 2.5 Design Alternatives

Two design alternatives were developed for the layout of the building addition. Figure 14 below displays Alternative 1 for the proposed building addition. Alternative 1 consisted of three additional dorm rooms, a hallway that connects the community room to the dorm living quarters, an additional restroom, the chief's vehicle bay, an electrical room, and a smaller community room and reception area. Figure 15 below displays Alternative 2 for the proposed building addition. Alternative 2 consisted of two additional dorm rooms, a wall that separates the community room from the dorm living quarters, an additional restroom, the chief's vehicle bay, an electrical room, and a larger community room and reception area.

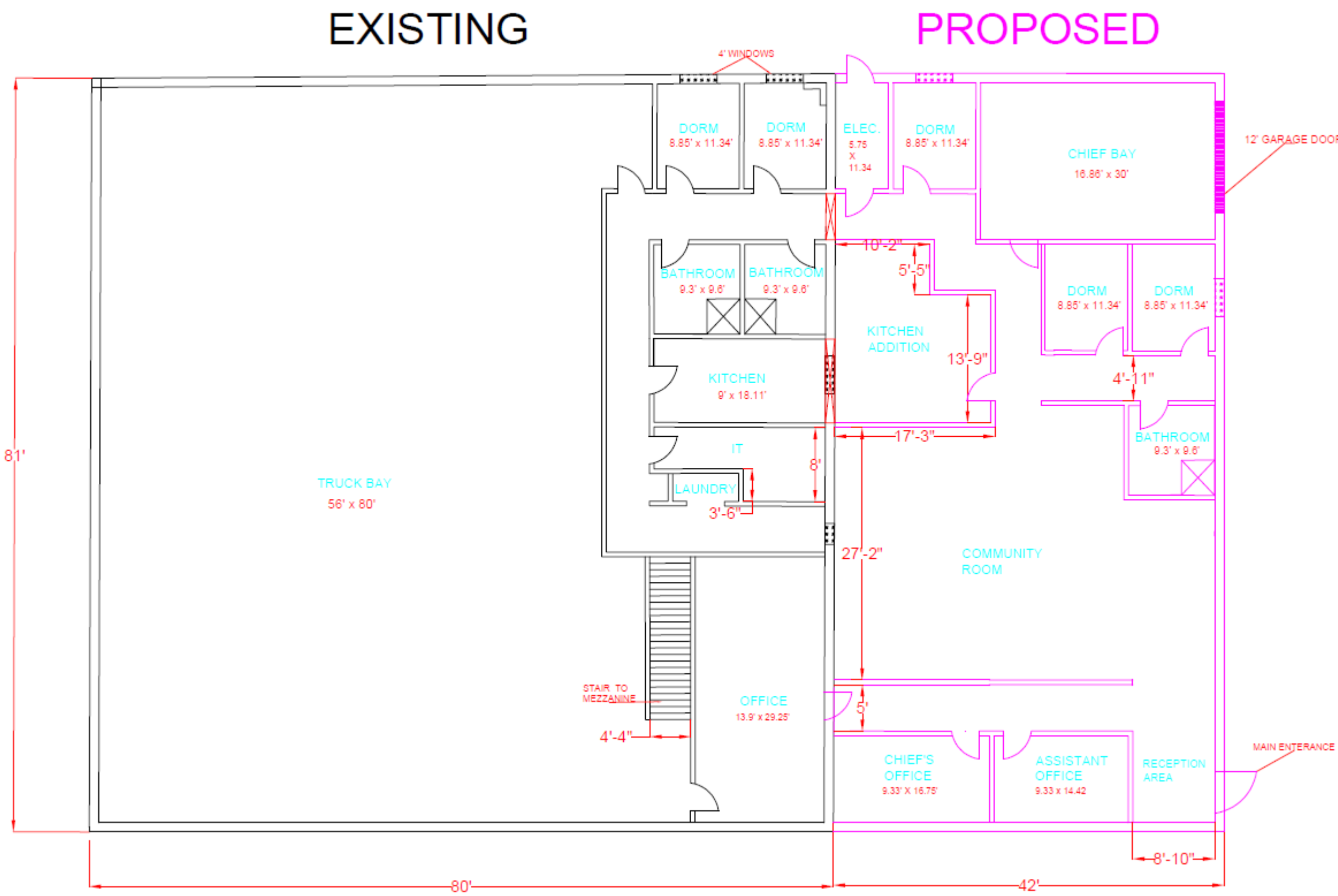


*Figure 14. Design alternatives 1.*

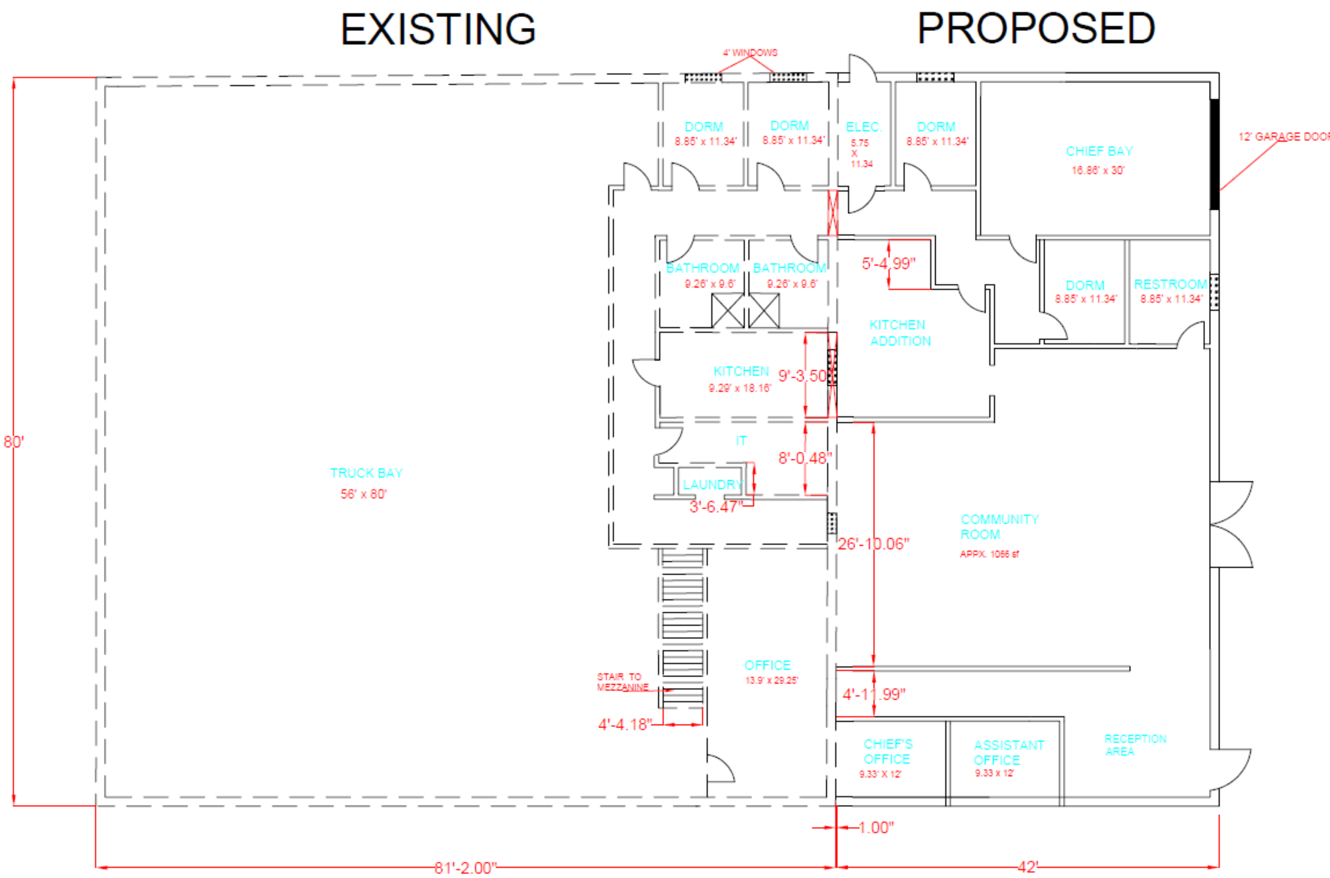


*Figure 15. Design alternative 2.*

## 2.6 Final Design Recommendations

Alternative 2 was chosen as the final design. Alternative 2 was chosen as the client preferred this design alternative. This was due to the wall adding more privacy for the firefighters as opposed to having a hallway that connects the community room and the dorm living quarters. This design also has a larger community room and reception area which was a priority for the client. This design also allows easier access to the restroom for the community members.

# 3.0 Summary of Engineering Work

## 3.1 Scope

The scope of work changed from the initial proposal phase. The original scope order was site investigation, metal frame company research, structural design, construction documents, and project deliverables. Upon further research, the metal frame company research was removed due to the lack of feedback and communication from the different companies contacted. In the initial proposal, a section for conducting a soils analysis of the site was removed because a previous soils reports of the surrounding area was obtained from the client. The new scope order changed to site investigation, structural design, construction documents and project deliverables.

### 3.2 Schedule

The original Gantt Chart in Appendix E had to be adjusted with the changes in the scope of work. The new Gantt Chart can be reference in Appendix E. The new changes do not change the original critical path. However, a major difference in the schedule is the start of construction documents that were expected to be started later. As the scope of the project unfolded, the site plan, cover page and floor plan could be started earlier than expected. Tasks that were with the foundation plans took longer than expected due to the complexity and accuracy needed.

## 4.0 Summary of Engineering Costs

### 4.1 Cost of Implementation

To determine the cost of implementation the team used resources from ADOT construction bids. The cost was broken down in three categories, the excavation and fill, reinforced concrete with rebar and anchor bolts, and proposed metal frame cost. Table 11 below shows a breakdown of the construction costs. The cost for excavation, backfill and concrete work includes labor. The total cost comes to $89,932. This does not include the interior walls, interior furnishings or M.P.E.

*Table 11. Estimated cost of construction.*

| Item Description | Quantity | Unit | Material ($/unit) | Subtotal |
|---|---|---|---|---|
| Excavation | 340 | CY | $9 | $3,060 |
| Backfill | 240 | CY | $7 | $1,680 |
| Reinforced Concrete | 100 | CY | $400 | $40,000 |
| Anchor Bolts | 24 | EA | $8 | $192 |
| Metal Frame | 1 | EA | $45,000 | $45,000 |
| | | | Total Cost: | $89,932 |

### 4.2 Cost of Engineering Services

The scope of work required five positions, a senior engineer, engineer, field technician, drafter and an intern. Table 12 below shows the expected engineering costs associated with the project. The previous cost of services was estimated at $69,494. The new actual cost was determined to be $58,833. The difference in cost was due to the removal of the lab testing and metal frame research tasks. Surveying task took alt less time than previously estimated due to previous experience and usage of new technology. The construction documents and design processes took longer than expected due. In the end there was a saving of $10,661 in engineering services.

*Table 12. New cost of services compared to old cost.*

| | Senior Engineer | Engineer | Field Tech | Drafter | Intern | Estimated Total Hours | Actual Total Hours | Estimated Cost Per Task | Actual Cost Per Task |
|---|---|---|---|---|---|---|---|---|---|
| Billing Rate | $255/hr | $115/hr | $51/hr | $69/hr | $21/hr | | | | |
| 1.0 Site Investigation | 2 | 3 | 6 | 0 | 10 | 64 | 21 | $2,870 | $1,371 |
| 2.0 Lab Testing/Soil Properties | 4 | 0 | 0 | 0 | 0 | 25 | 4 | $759 | $1,020 |
| 3.0 Metal Frame Co Research | 0 | 0 | 0 | 0 | 0 | 60 | 0 | $9,460 | $0 |
| 4.0 Structural Design | 16 | 26 | 2 | 0 | 18 | 120 | 62 | $13,416 | $7,550 |
| 5.0 Construction Documents | 12 | 13 | 0 | 83 | 61 | 213 | 169 | $12,421 | $11,563 |
| 6.0 Project Deliverables | 30 | 35 | 5 | 7 | 19 | 70 | 96 | $11,138 | $12,812 |
| 7.0 Project Management | 43 | 43 | 27 | 27 | 27 | 120 | 167 | $14,630 | $19,717 |
| Hours per Position | 107 | 120 | 40 | 117 | 135 | 672 | 519 | $64,694 | $54,033 |
| | | | | | | | Total Cost: | $69,494 | $58,833 |

## 5.0 Conclusion

The design of the Ponderosa Fire Station building addition required the team to devise a solution that addressed the existing station's current limitations and the client's needs as well as meet all codes and regulations. The final layout of the building addition met the client's needs by adding additional living quarters for the firefighters, a community room for events, offices for the staff and the fire chief, expending the kitchen area, and adding a vehicle bay. The designs of the anchor bolts and foundation were done following the codes and design parameters given by the IBC 2018, Coconino County, and ACI 318-14 Code which meant all codes and regulations were met.

# References


[1] Google Maps, "Google Maps," 2018. [Online]. Available: https://www.google.com/maps/place/Ponderosa+Fire+District/@35.2375028,-111.8175314,1916m/data=!3m1!1e3!4m5!3m4!1s0x0:0x9a3f129a0b7c9664!8m2!3d35.2372423!4d-111.8164742. [Accessed 22 September 2018].

[2] C. Wiedeman, "Flagstaff Meadows Unit III West Shadow Mountain Drive," Flagstaff, 2006.

[3] [Online]. Available: https://www.law.cornell.edu/cfr/text/24/3285.202 . [Accessed 10 Feb 2019].

[4] [Online]. Available: http://www.coconino.az.gov/Faq.aspx?TID=51,49,50,53,52. [Accessed 10 Feb 2019].

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[6] [Online]. Available: https://www.decksgo.com/deck-post-load.html. [Accessed 10 Feb 2019].

[7] International Code Council, "International Fire Code," Country Club Hills, 2018.

[8] Coconino County, "Coconino County Zoning Ordinance," 2017.

[9] A. C. 318, Building Code Requirement for Structural Concrete (ACI 318-14), 2014.

# Appendix

## Appendix A: Flagstaff Meadows Project Boring Logs

DATE DRILLED: **03-07-2006**
DRILL RIG TYPE: **CME-75**
BORING TYPE/SIZE: **HSA/7"**

**BORING NO. 2**

LOCATION: **See Boring Location Diagram**
ELEVATION: **Not Determined**
FIELD ENGR: **WT/C. Cowie**

| WATER CONTENT (%) | DRY DENSITY (LBS/CU.FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. R or N | BLOWS/FT. C | DEPTH (FT.) | USCS | GRAPHIC | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CH | | FAT CLAY; with sand and gravel, dark brown, stiff, moist |
| 24.0 | 98 | R | | 13 | | | | | |
| 28.2 | 94 | R | | 13 | | | | | |
| | | | | | | 5 | | | |
| 22.8 | 99 | R | | 18 | | | | | |
| | | | | | | 10 | | | |
| | | | | | | | CL | | SANDY CLAY; with silt, brown, hard, moist |
| | | N | | 38 | | | | | |
| | | | | | | 15 | | | |
| | | | | | | | CH | | FAT CLAY; dark brown, very stiff, moist |
| | | N | | 18 | | | | | |
| | | | | | | | | | End Of Boring At 18.5 Feet |
| | | | | | | 20 | | | |
| | | | | | | 25 | | | |

GROUNDWATER ENCOUNTERED NO: X YES:____ DEPTH:____ DATE: 03-07-2006

NOTES

FLAGSTAFF MEADOWS III

Boring Log

**Western Technologies Inc.**

Job No.: 2526JW127 | Plate: A-5

DATE DRILLED: **03-09-2006**

DRILL RIG TYPE: **CME-75**

BORING TYPE/SIZE: **HSA/7"**

## BORING NO. 26

LOCATION: **See Boring Location Diagram**

ELEVATION: **Not Determined**

FIELD ENGR: **WT/E. Guerrero**

| WATER CONTENT (%) | DRY DENSITY (LBS/CU.FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. R or N | BLOWS/FT. C | DEPTH (FT.) | USCS | GRAPHIC | SOIL DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | CH | | FAT CLAY; brown, firm, damp |
| | | | | | | | | | BASALT; black, porphyritic, hard |
| | | | | | | | | | **Auger Refusal At 2 Feet** |
| | | | | | | 5 | | | |
| | | | | | | 10 | | | |
| | | | | | | 15 | | | |
| | | | | | | 20 | | | |
| | | | | | | 25 | | | |

GROUNDWATER ENCOUNTERED NO: X YES:____ DEPTH:____ DATE: 03-09-2006

NOTES

FLAGSTAFF MEADOWS III

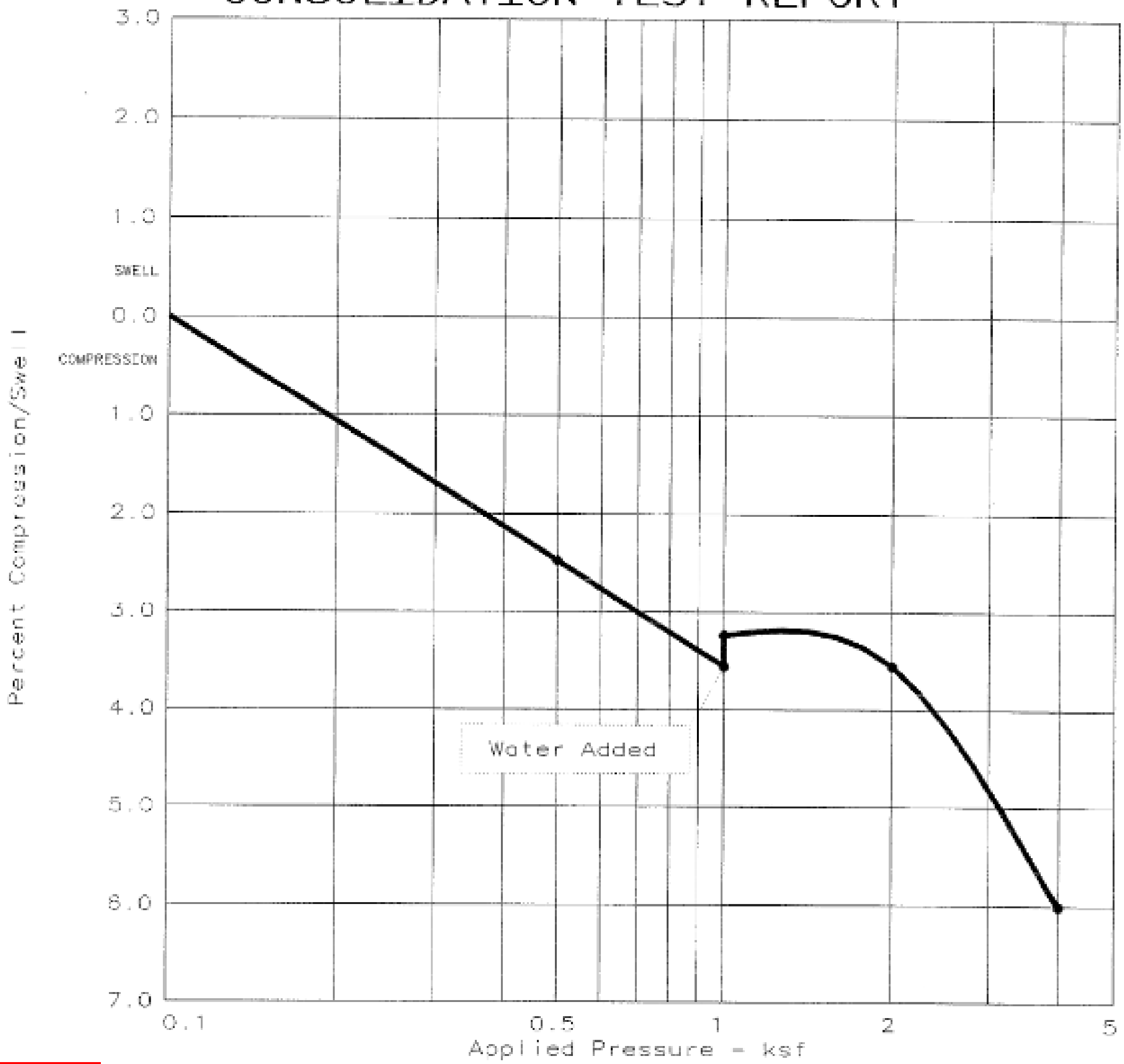
Boring Log

**Western Technologies Inc.**

Job No.: 2526JW127 | Plate: A-29

# Appendix B: Flagstaff Meadows Project Consolidation Test Reports

## CONSOLIDATION TEST REPORT




| Swell press. | Nat. Sat. | Nat. Moist. | Dry Density | LL | PI | Sp.Gr. | Initial void ratio |
|---|---|---|---|---|---|---|---|
| 1 | 62.1 % | 25.6 | 79.0 | | | 2.650 | 1.0934 |

**TEST RESULTS**

Percent swell = 0.4

Project No.: 2526JW127
Project: FLAGSTAFF MEADOWS III
Location: Boring 4
2.5-3.5 feet
Date: 03/30/06

CONSOLIDATION TEST REPORT

WESTERN TECHNOLOGIES, INC.

**MATERIAL DESCRIPTION**

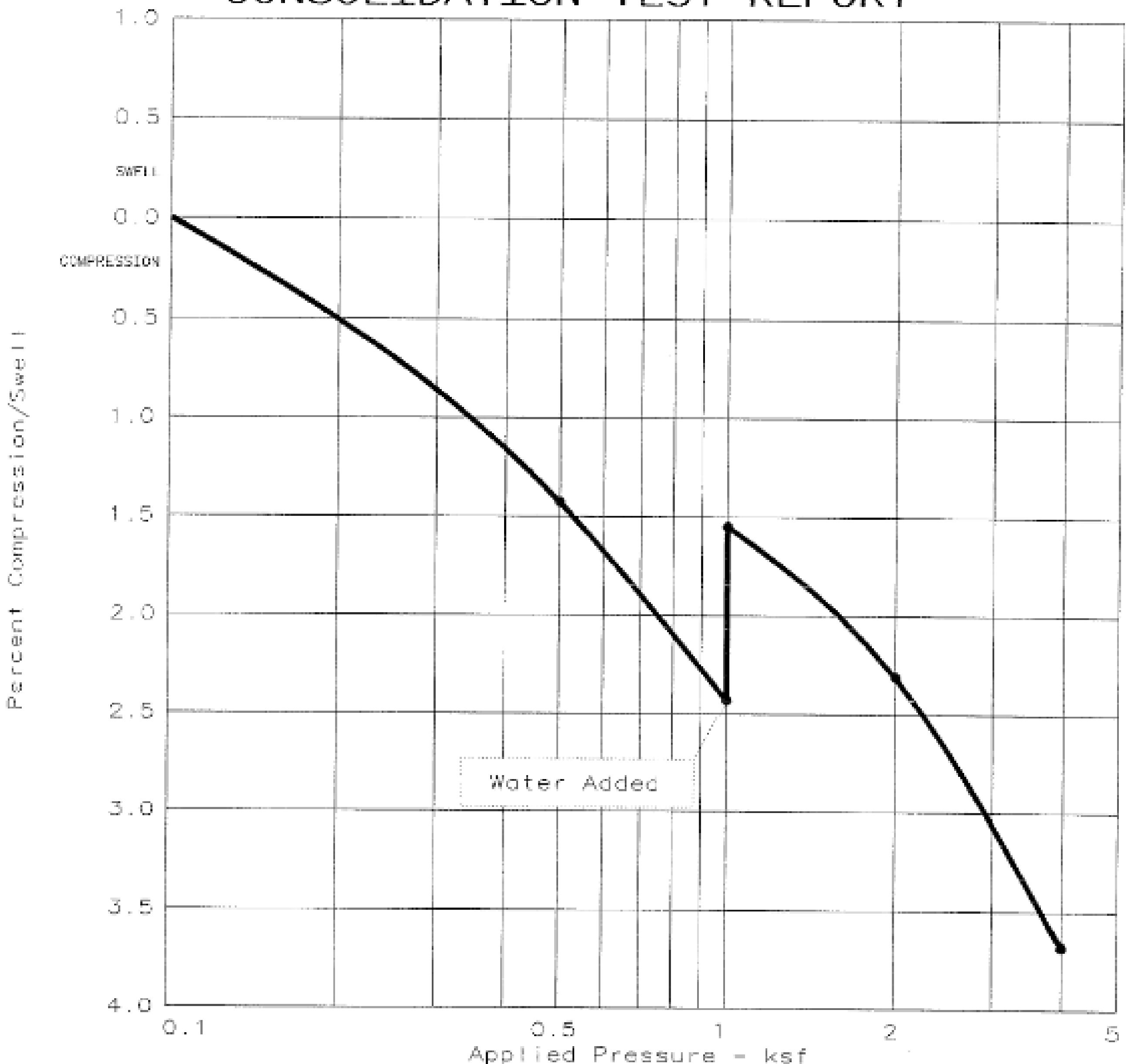
Sandy Clay

Class: CL

Remarks:

Fig. No. B-5

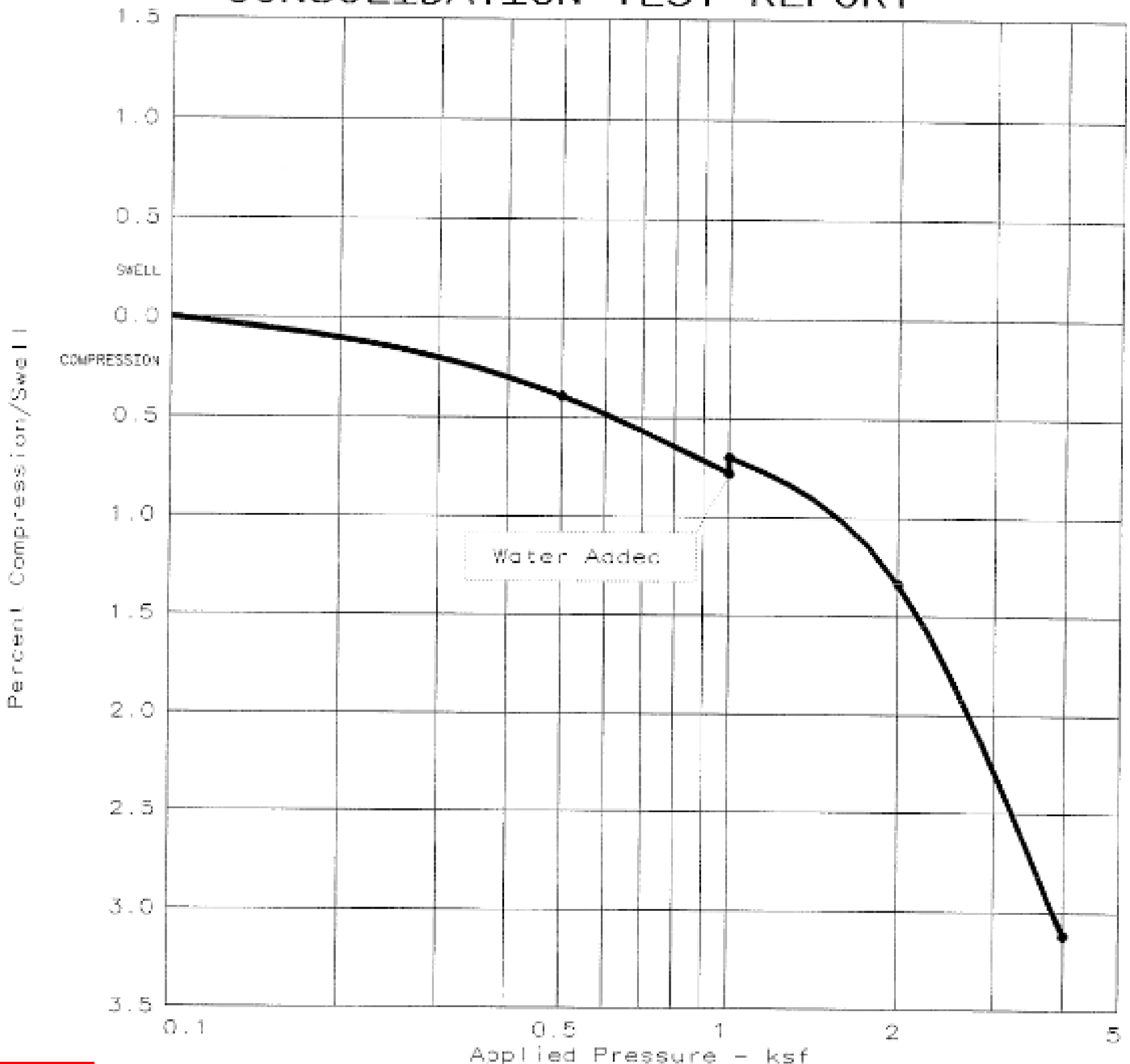
# CONSOLIDATION TEST REPORT




| Swell press. | Nat. Sat. | Nat. Moist. | Dry Density | LL | PI | Sp.Gr. | Initial void ratio |
|---|---|---|---|---|---|---|---|
| 1.16 | 86.4 % | 31.2 | 84.6 | | | 2.650 | 0.9560 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Percent swell = 0.8 | Clayey Sand<br>Class: SC |
| Project No.: 2526JW127<br>Project: FLAGSTAFF MEADOWS III<br>Location: Broring 5<br>10-11 feet<br>Date: 03/30/06 | Remarks: |
| CONSOLIDATION TEST REPORT<br>WESTERN TECHNOLOGIES, INC. | Fig. No. B-6 |

# CONSOLIDATION TEST REPORT




| Swell press. | Nat. Sat. | Nat. Moist. | Dry Density | LL | PI | Sp.Gr. | Initial void ratio |
|---|---|---|---|---|---|---|---|
| 0.16 | 89.1 % | 33.7 | 82.6 | | | 2.650 | 1.0017 |

| TEST RESULTS | MATERIAL DESCRIPTION |
|---|---|
| Percent swell = 0.1 | Fat Clay<br>Class: CH |
| Project No.: 2526JW127<br>Project: FLAGSTAFF MEADOWS III<br>Location: Boring 7<br>5-6 feet<br>Date: 03/30/06 | Remarks: |
| CONSOLIDATION TEST REPORT<br>WESTERN TECHNOLOGIES, INC. | Fig. No. B-7 |

## Appendix C: Flagstaff Meadows Project Soil Properties Tables

**SOIL PROPERTIES**

| BORING NO. | DEPTH (FEET) | SOIL CLASSIFICATION | SOIL PROPERTY: INITIAL DRY DENSITY (PCF) | SOIL PROPERTY: INITIAL WATER CONTENT (%) | COMPRESSION / CONSOLIDATION: SURCHARGE (KSF) | COMPRESSION / CONSOLIDATION: TOTAL COMPRESSION (%) | EXPANSION: SURCHARGE (KSF) | EXPANSION: EXPANSION (%) | EXPANSION: MAXIMUM SWELL PRESSURE (KSF) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4-5 | CL | 108 | 14.0 | | | 0.1 | 7.7 | | 1,2 |
| 5 | 7-8 | SC | 106 | 14.7 | | | 0.1 | 3.9 | | 1,2 |
| 10 | 3-4 | CH | 106 | 14.7 | | | 0.1 | 8.4 | | 1,2 |
| 13 | 7-8 | CL | 9.3 | 15.4 | | | 0.1 | 9.3 | | 1,2 |

NOTE: Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.

REMARKS:
1. Compacted Density (approximately 95% of ASTM D698 maximum density at moisture content slightly below optimum).
2. Submerged to approximate saturation.
3. Dry Density determined from one ring of a multi-ring sample.
4. Visual Classification.

FLAGSTAFF MEADOWS III

Soil Properties

**Western Technologies Inc.**

Job No.: 2528JW127 Plate: B-2

## SOIL PROPERTIES

| BORING NO. | DEPTH (FEET) | SOIL CLASSIFICATION | SOIL PROPERTY: INITIAL DRY DENSITY (PCF) | SOIL PROPERTY: MOLDING WATER CONTENT (%) | SOIL PROPERTY: FINAL WATER CONTENT (%) | EXPANSION INDEX: SATURATION (%) | EXPANSION INDEX: EXPANSION INDEX | REMARKS |
|---|---|---|---|---|---|---|---|---|
| 4 | 4-5 | CL | 83 | 18.4 | 37.4 | 48 | 28 | 1,3,5 |
| 5 | 7-8 | SC | 86 | 17.7 | 30.5 | 50 | 9 | 1,2,5 |
| 10 | 3-4 | CH | 83 | 18.9 | 38.6 | 50 | 39 | 1,2,5 |
| 13 | 7-8 | CL | 89 | 18.1 | 32.7 | 54 | 43 | 1,3,5 |

**NOTE:** ASTM D4829

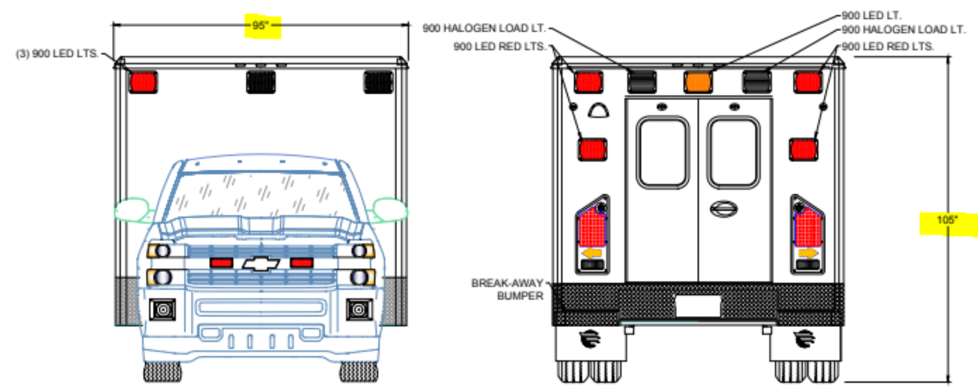
**REMARKS:**

1. Submerged to approximate saturation.
2. $EI_{meas} = (\Delta H/H_1) \times 1000$
3. $EI_{50} = EI_{meas} - (50 - S_{meas}) \times (65 + EI_{meas} / 220 - S_{meas})$
4. Ring Weight = 200.7 grams
5. Ring Weight = 357.0 grams

| FLAGSTAFF MEADOWS III | |
|---|---|
| Soil Properties | |
| **Western Technologies Inc.** | |
| Job No.: 2526JW127 | Plate: B-3 |

## Appendix D: 3500 Type I Chevy 2018 Ambulance Specifications

CA101740 MODEL 1153C 153 x 95 x 67




EXTERIOR COMPARTMENT DIMENSIONS IN INCHES

| INTERIOR DIMENSIONS | | | | PASS THRU | | INTERIOR DIMENSIONS | | | | JAMB OPENING | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COMPT. | HEIGHT | WIDTH | DEPTH | HEIGHT | WIDTH | COMPT. | HEIGHT | WIDTH | DEPTH | HEIGHT | WIDTH |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

50" AISLE

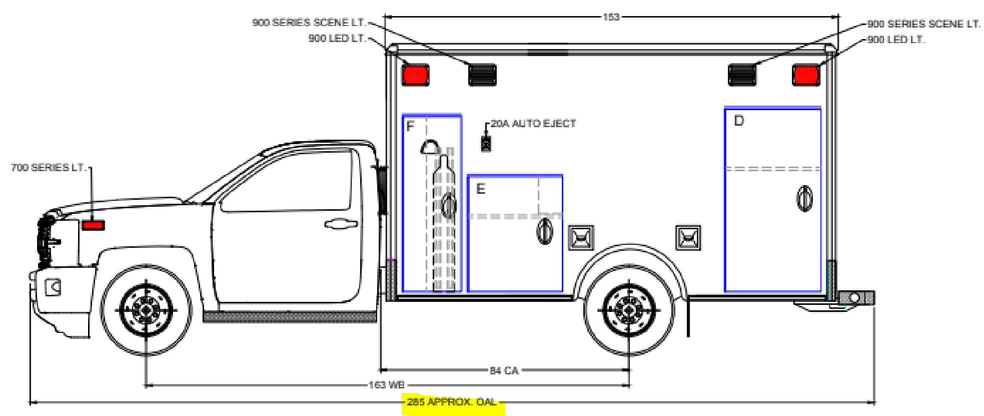
BE ADVISED THAT THESE ARE PRELIMINARY LAYOUTS INTENDED TO ILLUSTRATE DESIGN INTENT AND DIMENSIONS ARE FOR REFERENCE ONLY PRIOR TO FINAL ENGINEERING

Wheeled Coach

3500 TYPE 1 CHEVY 2018
FRONT / REAR
EXTERIOR VIEWS

DATE: 03/21/18 SCALE
DWN BY SG DWG NO 1 / 9

CA101740 MODEL 1153C 153 x 95 x 67




BE ADVISED THAT THESE ARE PRELIMINARY LAYOUTS INTENDED TO ILLUSTRATE DESIGN INTENT AND DIMENSIONS ARE FOR REFERENCE ONLY PRIOR TO FINAL ENGINEERING

EXTERIOR COMPARTMENT DIMENSIONS IN INCHES

| INTERIOR DIMENSIONS | | | | JAMB OPENING | | INTERIOR DIMENSIONS | | | | JAMB OPENING | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| COMPT. | HEIGHT | WIDTH | DEPTH | HEIGHT | WIDTH | COMPT. | HEIGHT | WIDTH | DEPTH | HEIGHT | WIDTH |
| D | 61.75 | 32.75 | 17.00 | 58.50 | 29.25 | | | | | | |
| E | 39.00 | 32.25 | 17.00 | 37.00 | 30.00 | | | | | | |
| F | 59.00 | 20.00 | 17.00 | 58.50 | 16.75 | | | | | | |
| | | | | | | | | | | | |

50" AISLE

Wheeled Coach

3500 TYPE 1 CHEVY 2018
LEFT EXT. VIEW

DATE 03/21/18 SCALE
DRAWN BY SG DWG NO 2 / 9

## Appendix E: Gantt Chart Original and New