CITY OF YUMA - FLEET SERVICE MAINTENANCE SHOP

CITY OF YUMA
FLEET SERVICES MAINTENANCE SHOP
265 W 13TH ST
YUMA, AZ 85364

COST REVIEW STUDY

JULY 25, 2017

WSM ARCHITECTS
4330 NORTH CAMPBELL AVE
SUITE NO 268
TUCSON, ARIZONA 85718
520.408.1044 TEL
520.408.1170 FAX
WSMARCH.COM WEB

thompson design architects pc

Architect Project No. 15-054

TABLE OF CONTENTS

INTRODUCTION

WSM Architects and Thompson Design Architects were asked to consider several options/ alternatives to the current design of the Fleet Maintenance Facility.

Those were:

- Review the costs and pros & cons associated with changing the current design of a conventional tilt-up concrete wall and steel joists and framing with a pre-engineered metal building structure.
- Review the costs associated with providing concrete block masonry walls instead of the tilt-up concrete walls.
- Review the costs associated and life cycle costs associated with an all evaporative cooling conditioning system for the shop space verses a hybrid evaporative / AC system.
- Review alternatives for the two main doors into the shop space in lieu of the four fold door specified.
- Below is a Summary of the cost differences of the options. Note there are performance differences between the options that are outlined in the balance of the report.
-

Pre-Engineered Metal Building Option vs Conventional Concrete Tilt & Steel Frame

Total Difference Construction Costs(savings to go to metal building) **$ 482,100**

Annual difference in 40 year Cost of Ownership for metal exterior building $ 3,321

Concrete Block Exterior walls as an alternate to the tilt up concrete.

Total Construction Cost Difference- Increase for Masonry **($ 15,360.29)**

Evaporative Cooling System for Shop space verses Hybrid Evap / AC.

Total difference Construction Costs (savings) for Alternate Evap Cooler system **$ 231,512**

Annual Operating and Maintenance Cost difference for Evap Cooler system

$ 4,186 or approx $350/month savings $ 11.50 per day

Total 20 year Life Cycle Annual cost of Ownership difference for Evap Cooler

$ 14,042 or approx $1170/month saving $ 39 per day

Cost Comparison Shop Space Door Alternatives

16x16 Fourfold Door	$48,000 Specified Product
16x16 Sectional OH Door	$ 6,300
16x16 Coiling OH Door	$ 8,600

The annual maintenance savings for the four fold doors over sectional overhead doors for 2016 is $6,370. This equals a payback of 6.5 years for the fourfold door at the costs above.

The original bids received April 4, 2017 Escalation from this date to potential re-bid date is 2.9% annual escalation or 1.7% escalation for 7 months.

Approximate original bid amount $7,800,000 x 1.7% =$132,600, or $ 7,932,600 adjusted bid number.
If the metal building and evap cooler options are selected
Approximate new construction estimate $ 7,218,988

OPTION: PRE-ENGINEERED METAL BUILDING

Pre-Engineered Metal Building Option (See attached drawings)

- The design was modified at a schematic level to provide a pre- engineered metal building structure. The framing of the building would be steel columns and beams with intermediate purlins supporting a metal panel skin and roof. Batt insulation is added to the interior face of the walls and hung from the metal roof to meet the energy code. The interior exposed face of the wall and roof would be a white vinyl plastic sheeting. This is the metal building standard.
- The existing floor plan was modified to accommodate the change to a pre-engineered metal building option. The main modifications to layout are:
  - Increased the width of the shop space due to the thickness of the new columns and to maintain the required clear floor space for safety and functional purposes.
  - The addition of a free standing structural frame to support the overhead bridge crane at the heavy truck repair bays.
- Due to the metal skin on the building the electrical engineer has recommended the installation of a lighting protection system for pre-engineered metal building. This would provide for the routing of lightning strikes to the ground through a designed path rather than through the building skin and frame.

Structural Pros and Cons

- Changing this facility from conventional construction to a pre-engineered metal building is a major change in systems and its design approach. Differences between the two systems:

Conventional Structure- Original Design - concrete tilt with steel joists and deck

- Easier to make additions to.
- Robust design for earthquake loads as well as future loads.
- Design can accommodate unique architectural features and column spacing.
- Cost of construction is often more than pre-engineered.
- Longer usable life of the building without major modifications to exterior envelope. Steel and concrete frame have a 100+ year service life.
- Roof system TPO membrane: Regular preventative maintenance would be required and replacement of roof membrane would be required at end of life. 20 year roof warranty provided in current design. The replacement of the roof membrane can be done without impacting day to day operations.
- Costs of concrete tilt panels were verified with a local concrete contractor with experience in this building type.

Pre-engineered Structure

- Thin steel roof decking that does not serve as a building diaphragm which cannot have anything hung from it.
- Building that is not easy to add future loads to or hang heavy items from the different parts of the building.
- Lateral system connections load paths are not direct.
- Lighter in weight so the earthquake has less mass to push around.
- Economy of design is uniform column spacing in the 25 feet on center range.
- Roof system: Structural sheet metal panels: Regular preventative maintenance would be required. 20 year weathertightness warranty can be provided. The replacement of the roof panels could impact day to day operations.
- The overhead crane will need is own structure since interior columns are not needed for PEMB and column spacing does not accommodate vehicle repair spaces.
- Cost of Construction for the building envelope is often less than that of convention systems.
- Long Term Issues for Pre-engineered building
- Thin metal roof and wall panels are easily damaged. Less durable than the conventional wall and roof structures. The conventional concrete walls have a 100+ year service life. The metal walls and roof 30 to 40 years.

OPTION: PRE-ENGINEERED METAL BUILDING

- Slab on grade modifications and cutting is difficult due to thrust bars cast into the slab required to support the building.
- Difficult to add heavy loads to the structure like unforeseen hose reels or equipment. However, we will require higher collateral loads to the building to help minimize this issue. Note that this will add cost to the typical PEMB.
- Harder to add building additions to them.
- Weather tightness warranty impacted with additional loads to structure.
- Costs for the Pre-engineered building components were verified with a local metal building contractor.

Cost Comparison

	Original Design Concrete Tilt-up	Metal Building
Substructure	$ 366,227	$ 361,360
Superstructure	$ 391,337	$ 5,568
Exterior Closure	$ 760,898	$ 210,958
Roofing	$ 396,785	$ 11,386
Special Construction (Metal Building)	$ 0	$ 832,400
Lightning Protection system $0.66/sf	$ 0	$ 28,036
Subtotal	$1,915,247	$1,449,708
Difference in Construction Cost		$ 465,539
Contractor Markup (24.4%)		$ 113,591
Subtotal		$ 579,130
Design Fees to change to metal building design & re-bid		$ 97,030
Total Delta Difference (savings)		**$ 482,100**

Cost of Ownership - Life Cycle Costs

Metal building vs Conventional building (Concrete Tilt up- Metal Joists & Deck)

In comparing the life cycle costs of the two options there are a couple of assumptions for each system.

1. The foundations and substructure are designed to last the lifetime of the building.
2. The main structural frame, beams columns joists and decking are designed to last the lifetime of the building.
3. The doors and windows in the exterior of the building would be the same in either case so there would be no difference in life cycle costs for those elements.
4. Energy usage costs would be the same for either option as the insulation value would be the same for each.

The above assumptions being a given, the systems to be compared between the metal building and conventional building would be the exterior envelope. In the conventional building, this would be the concrete exterior walls and the roofing installed on top of the metal decking. In the metal building, this would be the metal siding and metal roofing.

Estimated installed costs and cost per year*

Original Design	Quantity	cost/unit	total first cost	Ave life cycle	Annual cost / 40 years
Concrete walls	22,135 sf	$16.25	$ 407,452	80 years (lifetime)	$ 5,093
TPO roof	39,923 sf	$ 6.69	$ 267,084	20 years	$ 13,354
Subtotal Envelope Costs			$ 674,536		$ 18,447
Metal Building Option					
Metal roofing	39, 923 sf	$ 9.75	$ 389,249	40 years	$ 9,731
Metal siding	22,135 sf	$ 9.75	$ 215,816	40 years	$ 5,395
Subtotal Envelope Costs			$ 605,065		$ 15,126
Difference Between options			**$ 69,471**	Annual difference	$ 3,321

*This assumes a 40 year timeframe and replacement costs in todays dollars

The metal roofing and siding would need to be replaced at the end of the 40 years while the concrete walls would not need replacement during the life of the building. The concrete and metal siding have a similar cost of ownership over 40 year but the concrete walls are more durable than the metal siding. Use beyond the 40 years would require replacement of the metal siding and roofing and would increase the ownership costs.

OPTION: MASONRY

Concrete Block Exterior walls as an alternate to the tilt up concrete.

As the thickness and design of a masonry or concrete block wall is essentially the same as the concrete wall there are limited impacts to the layout and operation of the facility design. The pricing used for the tilt concrete came from a local Yuma concrete contractor as did the costs for the concrete block. Our estimate included some textured block similar to the texture provided in the concrete wall. There would be limited modifications to the footings and foundation. Per the estimated costs between the two, the concrete block is fractionally more expensive. The difference between the two is not significant and they are essentially the same price.

Cost Comparison

TU concrete Panels 25,074 SF at $16.25	$407,452.50
8” Gray Fluted CMU 9,100 SF at $18.00	$163,800.00
8” Gray Smooth CMU 16,000 SF at $16.00	$256,000.00
Total:	$419,800.00
Delta:	($12,347.50)
Contractor Markup (24.4%)	($ 3,012.79)
Total Difference- Increase for Masonry	**($15,360.29)**

MECHANICAL SYSTEMS

Evaporative Cooling System for Shop space verses Hybrid Evap / AC. (See attached drawings)

TThe current design for the conditioning of the shop space is a hybrid unit that utilizes a combination of indirect and direct evaporative cooling (IEC/DEC) supplemented by mechanical cooling (DX). During those times of the year when humidity is low, the IEC/DEC will provide comfortable conditions very economically. During the monsoon season, the hybrid design uses the indirect evaporative cooling (IEC) and mechanical cooling (DX) as required to achieve the desired temperature and humidity levels. The integral control system monitors room temperature and humidity levels and will turn off the Direct Evaporative Cooling (DEC) when space humidity levels get too high to avoid adding moisture into the building, which will improve employee comfort. The unit includes integral gas heat when needed. The code required exhaust system is built into the unit, which also employs air-to-air energy recovery to reduce operating costs in both heating and cooling modes. The system is designed to maintain the shop in the 72oF (hot & dry conditions) to 80oF (monsoon conditions) range with a maximum humidity level of 55%. These conditions roughly produce a heat index of 80 degrees.

The alternative to this system that we were asked to look at was an all direct evaporative cooled (DEC) space. This system will provide reasonably effective cooling during the low humidity months but will be ineffective during periods of high humidity when indoor temperature and humidity will increase potentially causing discomfort. During these high humidity conditions, the shop temperature will most-likely be in the 80oF to 90oF range with a humidity level pushing 70%. These conditions roughly produce a heat index of 95 degrees.

The 2-speed evaporative coolers will be outfitted with natural gas heaters to maintain comfortable temperatures during the winter season. The code required exhaust system has been added as a separate system without energy recovery to ensure an equivalent comparison.

The cost comparison analysis and 20 year life cycle was done using the equipment costs for the two options and did not include ductwork and other items that would have a longer lifespan than the equipment. It would be anticipated that the internal mechanical components would need to be replaced at the 20 year mark and not the entire unit.

Please see the attached letter and back-up documentation for additional information on the calculations.

Cost Comparison:

Original Total Hybrid AHU System	$ 589,620
Alternate Evaporative Cooler system	$ 392,500
Difference in first cost	$ 197,120
Contractor Markup (24.4%)	$ 48,097
Subtotal	$ 245,217
Mechanical system re-design costs	$ 13,705
Total difference for Alternate Evap Cooler system	**$231,512**
Annual Operating and Maintenance Cost difference	**$ 4,186 or approx $350/month savings $11.50 per day**
Total 20 year life cycle annual cost of Ownership difference	**$ 14,042 or approx $1170/month saving $39 per day**

The increased cost of operation and ownership should be weighed against the potential decrease in productivity due to the higher temperatures and humidity during certain times of the year.

PH MECHANICAL ENGINEERING

Date: July 21, 2017

Address: Mr. Paul Mickelberg
WSM Architects
4330 N. Campbell Ave, Suite 268
Tucson, AZ 85718

RE: 15241 Yuma Fleet Services – HVAC Alternative

Dear Mr. Mickelberg:

This letter is to addresses the difference in cost of ownership between the proposed design and the alternate design. The total cost of ownership includes the first cost, utility cost, and maintenance cost. The maintenance cost includes the evaporative pad replacement cost. Both manufactures recommend pad replacement every eight years. Therefore, the total pad replace cost was spread over eight years, and incorporated into the annual maintenance cost. However, in the "cost of ownership" table a line item called "Pad Replacement Cost" was provided so that the reviewer has a feel for the cost associated with pad replacement.

The proposed system provides conditioned air for the shop space. AHU-1 is a hybrid unit that provides evaporative cooling (direct & indirect) through those times of the year when humidity is low and evaporative cooling is most effective. During the monsoon season and sometimes during the fall and winter humidity levels rise to a point where evaporative cooling is no longer effective. The hybrid design then uses the indirect evaporative cooling section to precool the air and then uses an AC section (DX coil) to cool the air to the desired temperature. AHU-1 also employs energy recovery to extract usable energy from the exhaust air stream prior to discharging it to atmosphere to optimize the efficiency of the unit. The energy recovery unit is the reason why there is a substantial difference between the proposed and alternate systems in natural gas cost. The alternate system doesn't have an energy recovery unit and therefore, it uses more natural gas during the heating cycle. See the "cost of ownership" table below for the total cost of the proposed design system. Note that the proposed construction cost of $1,162,798, which includes all the HVAC systems for the entire design, minus General Contractor markup. This includes the general AC systems for the office areas, and general exhaust systems.

The alternate design replaces AHU-1 with (2) 75,000 cfm evaporative coolers, (1) 60,000 exhaust fan, and (4) 20,000 cfm relief fans. The alternate evaporative coolers employ direct

evaporation only, unlike AHU-1 which is capable of automatic switching from indirect and direct, or a combination thereof depending upon the ambient weather conditions. The alternate systems have natural gas fired heaters inside the unit to provide the necessary heating during the winter months. AHU-1 is an all-inclusive ventilation unit. It has supply fans, as well as exhaust fans built into the AHU. To do an accurate equipment cost comparison, it was necessary to include the relief fans, and exhaust fans as the true total equipment cost for the alternate

	Cost of Ownership		
	Proposed System	Alternate System	Difference
Total HVAC System Cost	$1,162,798	$881,635	$ 281,163
AHU Equipment Cost	$589,620	$392,500	$ 197,120
Annual Electric Cost	$52,863	$39,988	$ 12,875
Annual Water Cost	$1,838	$2,667	$ (829)
Annual Natural Gas Cost	$5,142	$10,205	$ (5,063)
Annual Maintenance Cost	$4,688	$7,125	$ (2,438)
Pad Replacement Cost	$6,000	$8,800	$ (2,800)
Annual Pad Replacement Cost	$759	$1,119	$ (359)
	Subtotals:		
Annual Utilities & Maintenance:	$65,290	$61,104	$ 4,186
Grand Total:	$1,228,088	$942,739	$ 285,349

	20 Year Life Cycle Cost		
AHU Equipment Cost	$589,620	$392,500	$ 197,120
Annual Utilities & Maintenance:	$65,290	$61,104	$ 4,186
20 Years of Utilities & Maintenance:	$1,305,805	$1,222,076	$ 83,729
Total 20 Year Cost	$1,895,425	$1,614,576	$ 280,849
Grand Total:	Proposed System Cost	Alternate System Cost	Total Difference
Yearly Cost for 20 years	$94,771.25	$80,728.78	$ 14,042

evaporative cooler cost. See the "cost of ownership" table above for the total cost of the alternate design system. Like the proposed system, the alternate construction cost of $881,635 includes all the HVAC systems for the entire alternate design, minus the General Contractor markup. This includes the general AC systems for the office areas, and general exhaust systems. The last line item "Grand Total" in the "cost of ownership" table represents the total HVAC cost

plus the annual utility/maintenance cost. The alternate design has the lower grand total cost, and the difference between the two is (delta $285,349).

The next cost table is comparison between the simple 20-year cost of each system. In this comparison, only the equipment cost was used in lieu of the total HVAC cost because not all pieces of the overall system have a 20-year lifespan. The typical lifespan of AHU-1 and the large evaporative coolers will be approximately 20-years. The analysis didn't include bank loan interest, labor, material, and utility cost escalation. The analysis looked at the annual operating cost over a 20-year period plus the equipment first cost. The difference between the two systems is (delta $14,042/year).

In summary, the alternate system has **lower first cost** (delta $281,163) and **lower operating cost** (delta $4,186/year) than the proposed designed system. Because of savings in both categories, there is no payback for going with the proposed design (AHU-1 system).

The proposed system was originally designed to provide maximum human comfort without paying the full price tag of a central plant (chiller & pumps), as we had done for the recently completed the Pima County Fleet Services building. The alternate system reduces the construction cost, and has minimal savings in operational cost, but it will not achieve the same level of human comfort as the proposed system.

Pima County challenged the WSM design team to provide AC like conditions for the maintenance techs, but for less cost than a traditional central cooling plant. The design team used the hybrid approach to cut the anticipated construction cost in half. Designing the hybrid Evap/DX cooling AHU, and not designing a central plant system that utilizes chillers, pumps, and chilled water piping systems, allowed Pima County to achieve their goal of maximizing human comfort for their employees, while not paying a large sum for central cooling plant.

The hybrid system out performs the standard central plant AC systems in construction cost and operational cost, but it comes up short when comparing it to traditional direct evaporative cooling systems. However, there is a value associated with human comfort. For instances, most people choose to pay higher up-front cost and operational cost to have their homes cooled by AC as opposed to evaporative cooling. Most home owners understand this value and don't mind the increased associated cost. For the Yuma Fleet Maintenance Facility that annual cost is about $14,402.

PH MECHANICAL ENGINEERING

4

Respectfully,

PH Mechanical Engineering
P. Eric Hein, P.E., C.P.D.
Principal

Registered Professional Engineer (Mechanical)
CERTIFICATE NO.
32865
PAUL ERIC
HEIN
Date signed 7/21/2017
ARIZONA, U.S.A.

Expires 9/30/19

SHOP DOORS

Review of Shop Door Options

Base bid design called for four-fold doors 16ft wide by 16ft tall. There are two of these doors required for the project and are used at the main entry and exit from the main shop space. All vehicle circulation into and out of the building with the exception of the Fire ladder truck / apparatus repair bay would use these doors. This means a significant amount of traffic daily. Estimated daily cycles for each door would be 25 or an annual total of 6500 cycles annually per door.

The other large doors into and out of the Fire ladder apparatus repair bay and into the loading dock parts area are currently specified to be sectional overhead doors due to the limited cycles required for this space and their reduced cost.

Alternatives to those doors would be Sectional Overhead doors, and Coiling Rolling overhead doors. Fabric overhead doors are not included in this review.

Coiling Rolling doors: A series of steel slats are linked to provide the door face (curtain) and roll up above the door opening when raised. A torsion spring and motor or manual chain provide the means to open the door. They are often used in loading docks at warehouses for security. Insulation is limited due the door slat construction.

The torsion spring supports the door in the open position and are rated for the number of cycles as a guideline. Standard spring cycles are rated at 20,000, a 3 year lifespan at 6500 cycles per year. Upgraded springless doors can provide up to 20 cycles per day with a 2 year warranty.

Sectional Overhead Doors

Sectional Overhead doors fold up and overhead into the building. They are typically supported by the roof structure instead of the wall like coiling doors or four fold doors. The door panels are horizontal and would be constructed of 24 ga steel skins filled with insulation.
Damage to overhead doors is often caused by drivers not waiting until the door is completely open. This makes the door unusable and the building is not secure until it is repaired. Access to the building is blocked. Estimated cost for maintenance of OH doors including replacement of sections can run about $5,000 annually.

The torsion spring supports the door in the open position and are rated for the number of cycles as a guideline. Standard spring cycles are typically 10,000 but can be upgraded to 100,000 cycles maximum or in this project, a 15 year lifespan at 6500 cycles per year. 25 cycles a day is considered continuous use and would be

Four Fold Doors, or Bifold Doors

Door panels are constructed of welded 14 gauge steel tubular frames and 14 gauge face panels (insulated) or glazed infill panels. A factory supplied steel tube frame is anchored to the wall construction and supports the door assembly.
Standard preventative maintenance (PM) on Four-Fold doors includes applying grease to hinges and operators. With general yearly maintenance, Four-Fold door operators and components are designed and tested to perform over 1 million cycles. This represents a 40+ year lifespan. Conventional sectional and coiling doors require constant spring and cable maintenance and replacement to keep them in safe working condition. Failure to keep up with preventative maintenance on sectional and coiling steel doors can result in door failure, which can cause both damage to equipment and injury to personnel.

Four fold or bi fold doors are installed in Yuma Fire Station No. 6 and the police department and the durability and maintenance of those can be compared with the Sectional overhead doors used in the other City fire stations.

OVERHEAD DOORS

Per City of Yuma Facilities Manager, Justin Lewis the four fold doors have 1 maintenance call for every 10 of the sectional doors. **The annual savings for the four fold doors over sectional overhead doors for 2016 was $6,370**. **This equals a payback of 6.5 years at the costs below**. See appendix for further information.

Four-Fold doors clear the opening at an average speed of 24 inches per second. Conventional overhead and coiling doors operate between 8 to 12 inches per second. The high-speed operation of the Four-Fold door minimizes heating and cooling losses and reduces waiting time, increasing productivity and energy efficiency. Manual operation is simple and requires no springs under tension, chain hoists or heavy lifting.

The Four-Fold door moves horizontally rather than vertically. As a result, the door is visible throughout the opening motion allowing the driver to know the precise second the doorway is clear to exit

Cost Comparison

16x16 Fourfold Door	$48,000
16x16 Sectional OH Door	$ 6,300
16x16 Coiling OH Door	$ 8,600

APPENDIX

1. STRUCTURAL SUMMARY Pre-Engineered Building

A. Governing Design Codes and Standard

1. Design Building Codes

- 2012 IBC.

2. Referenced Standards

- ASCE 7-10 - for load determination and application
- ACI 318-11 - for structural concrete design

B. New Construction: It is anticipated that the structural frame of the Center will be detailed as a lateral load resisting system consisting of a pre-engineered metal building (PMB), assumed with soil having a minimum bearing capacity of 3,000 lbs/SF. Elements of the construction could consist of:

- Roof live load = 20 psf (reducible)
- Collateral load = 10 psf
- Wind: V = 115 mph (3 sec gust) Ultimate, Exposure Category = C, Risk Category = II
- Seismic Design Category = D,
  Site Class = D,
  Ss = 0.710,
  S1 = 0.266,
  Sds = 0.583,
  Sd1 = 0.331,
  Ie = 1.0
- Allowable bearing pressure = 3000 psf. All construction to conform to the requirements of soil report No. 016-0090 by Nicklaus Engineering, Inc.
- Typical column spacing of 25' with steel columns as part of the PMB system
- 5" thick concrete slab-on-grade over 4" granular base course at offices
- 8" thick concrete slab-on-grade over 4" granular base course at all other locations
- The minimum ultimate compressive strength of the concrete at 28 days shall be 3,000 PSI
- Foundation design will be spread footings with tie beams to resist thrust from PMB columns. Footings will be based on PMB requirements.
- All slab edges between columns will be a concrete turn down
- Masonry wainscot may occur in some locations
- Major CSI Divisions
  a. 03 00 01; Concrete
  b. 03 30 00; Cast-in-place Concrete
  c. 04 22 00; Concrete Unit Masonry
  d. 05 12 00; Structural Steel
  e. 13 34 19; Metal Building Systems

APPENDIX

Discussion of Four fold doors vs Sectional Overhead Doors

From: Lewis, Justin - Facilities Maintenance Manager
Sent: Wednesday, June 21, 2017 5:30 PM
To: Lawrence, Timothy A. - Engineering Project Manager
Cc: Cota, Jaime - Facilities Maintenance Supervisor
Subject: Bi-Fold Doors

2016 Door Repair Cost

Comparison: FD Station 1 Roll up doors / FD 6 Bi-Fold Doors

Cost per year	Roll Up Doors	Bi-Fold Door	Bi-Fold Doors Savings
Repair labor cost COY	$1,760.00	$544.00	$1,216.00
Contractor Invoicing Repairs	$5,711.77	$407.62	$5,304.15
Parts for COY Repairs	$300.00	$450.00	-$150.00
Total 2016	$7,771.77	$1,401.62	**$6,370.15**

Hi Tim,
As we discussed today bi-fold doors have been much more reliable and require less repairs and maintenance. This is stated in the information I pasted below from one of the bi-fold door company's. For all the benefits stated below I would recommend bi-fold doors in any facility with high o/c cycles. We spend a lot of time and money maintaining and repairing the roll up doors we have now, and that means more down time. I would say it's about 10 to 1, for every 10 breakdowns on the roll up doors we only have 1 on the bi-fold doors. We have also found the bi-fold doors to be more durable, the ones at the PD have survived several vehicle collisions.

Bi-fold doors, also referred to as four-fold doors are an ideal choice when side space is available and there is a need for long lasting, low maintenance doors. With no springs to break and jamb the door, the bi-fold's design is ideal for high cycle environments such as fire stations, parking garages, and auto dealerships.

SPEED
Bi-fold doors often open faster than a conventional overhead door. Bi-folds operate at typical speeds of 24 inches per second compared to operation speeds of 8 to 12 inches per second for other door styles. A 14' x 14' bi-fold takes less than 7 seconds to open!

Faster operation has several key benefits including:
- More throughput
- Less energy loss
- Greater security

For larger door openings and vehicles, the faster speed allows more vehicles to move through the opening. Because the door closes quicker, there is less opportunity for intrusion and less air loss; an important consideration.

HORIZONTAL MOVEMENT
The bi-fold door moves horizontally rather than vertically, making the door visible throughout the opening motion, and giving the diver a better view of the door clearance. With overhead doors drivers can misjudge the clearance available and drive into the bottom of the door as it is opening. In addition, bi-fold doors are more tolerant of dents and dings from impact in that the door will still continue to operate.

Justin Lewis
Facilities Manager, City of Yuma
One City Plaza, Yuma, AZ 85364
928.373.5121 / Fax: 928.373.5122
Justin.Lewis@YumaAZ.gov / www.YumaAZ.gov

APPENDIX

See Following pages for back-up data for HVAC analysis of systems.

			H.V.A.C. Original Design										Material	Labor	Total
01	1571	1599.900	Rooftop Unit, 6,000 CFM	1	Each	15000.00	15,000	40.000	40	2,000	3,060	20,060	17,700.00	2,360.00	20,060.00
01	1571	1599.900	Rooftop Unit, 4,000 CFM	1	Each	10000.00	10,000	32.000	32	1,600	2,088	13,688	11,800.00	1,888.00	13,688.00
01	1571	1599.900	Rooftop Unit, 3,000 CFM	1	Each	8250.00	8,250	32.000	32	1,600	1,773	11,623	9,735.00	1,888.00	11,623.00
01	1571	1599.900	Ductless Split System	1	Each	2100.00	2,100	16.000	16	800	522	3,422	2,478.00	944.00	3,422.00
01	1571	1599.900	Refrigerant Piping	200	Lnft	8.50	1,700	0.160	32	1,600	594	3,894	10.03	9.44	19.47
01	1571	1599.900	Refrigerant Insulation	100	Lnft	7.00	700	0.000	0	0	126	826	8.26	-	8.26
01	1571	1599.900	Indirect/Direct Air Handler w/Evap 55,000 CFM	1	Each	589620.00	589,620	120.000	120	6,000	107,212	702,832	695,751.60	7,080.00	702,831.60
01	1571	1599.900	Evaporative Cooler, 5,000 CFM	1	Each	1500.00	1,500	12.000	12	600	378	2,478	1,770.00	708.00	2,478.00
01	1571	1599.900	Compressor Hood	1	Each	2500.00	2,500	8.000	8	400	522	3,422	2,950.00	472.00	3,422.00
01	1571	1599.900	Exhaust Fan, Ceiling	1	Each	200.00	200	3.000	3	150	63	413	236.00	177.00	413.00
01	1571	1599.900	Exhaust Fan, 900 CFM	1	Each	650.00	650	8.000	8	400	189	1,239	767.00	472.00	1,239.00
01	1571	1599.900	Exhaust Fan, 5,000 CFM In-Line	1	Each	1650.00	1,650	10.000	10	500	387	2,537	1,947.00	590.00	2,537.00
01	1571	1599.900	Vehicle Exh Hose Reel, OFCI	14	Each	200.00	2,800	4.000	56	2,800	1,008	6,608	236.00	236.00	472.00
01	1571	1599.900	Louver, 48x24	1	Each	350.00	350	4.000	4	200	99	649	413.00	236.00	649.00
01	1571	1599.900	Supply Air Diffuser	25	Each	70.00	1,750	0.500	13	625	428	2,803	82.60	29.50	112.10
01	1571	1599.900	Supply Air Diffuser, Duct Mt	76	Each	150.00	11,400	1.500	114	5,700	3,078	20,178	177.00	88.50	265.50
01	1571	1599.900	Return Register	5	Each	70.00	350	0.500	3	125	86	561	82.60	29.50	112.10
01	1571	1599.900	Exhaust Grille	7	Each	60.00	420	1.000	7	350	139	909	70.80	59.00	129.80
01	1571	1599.900	Exhaust Grille, Duct Mt	21	Each	95.00	1,995	1.000	21	1,050	548	3,593	112.10	59.00	171.10
01	1571	1599.900	Return Grille, Wall	4	Each	65.00	260	0.750	3	150	74	484	76.70	44.25	120.95
01	1571	1599.900	Return Grille, Wall 42x36	2	Each	315.00	630	3.000	6	300	167	1,097	371.70	177.00	548.70
01	1571	1599.900	Manual Dampers	30	Each	60.00	1,800	1.500	45	2,250	729	4,779	70.80	88.50	159.30
01	1571	1599.900	Spin-in	27	Each	8.50	230	0.220	6	297	95	621	10.03	12.98	23.01
01	1571	1599.900	Flex Duct	216	Lnft	2.25	486	0.063	14	675	209	1,370	2.66	3.69	6.34
01	1571	1599.900	Clamps	54	Each	4.00	216	0.000	0	0	39	255	4.72	-	4.72
01	1571	1599.900	Flexible Connection	100	Lnft	4.50	450	0.150	15	750	216	1,416	5.31	8.85	14.16
01	1572	1593.000	Supply Air Duct, Shop	16,155	Lbs	1.95	31,502	0.053	861	43,053	13,420	87,975	2.30	3.14	5.45
01	1574	1593.000	LPSA Duct	3,775	Lbs	1.95	7,361	0.053	201	10,060	3,136	20,558	2.30	3.14	5.45
01	1574	1594.000	Duct Insulation	2,825	Sqft	1.50	4,238	0.000	0	0	763	5,000	1.77	-	1.77
01	1573	1593.000	LPRA Duct	1,925	Lbs	2.95	5,679	0.053	103	5,130	1,946	12,754	3.48	3.14	6.63
01	1576	1593.000	General Exhaust Duct	780	Lbs	1.95	1,521	0.053	42	2,079	648	4,248	2.30	3.14	5.45
01	1576	1593.000	Exhaust Duct, Shop	16,340	Lbs	1.95	31,863	0.053	871	43,546	13,574	88,983	2.30	3.14	5.45
01	1576	1593.000	Exhaust Duct, Tail Pipe	1,400	Lbs	1.95	2,730	0.053	75	3,731	1,163	7,624	2.30	3.14	5.45
01	1571	1599.900	Vibration Isolation	1	Lsum	1000.00	1,000	120.000	60	3,000	720	4,720	1,180.00	3,540.00	4,720.00
01	1571	1599.900	Commissioning	1	Lsum	2000.00	2,000	360.000	360	18,000	3,600	23,600	2,360.00	21,240.00	23,600.00
01	1571	1596.000	Test & Balance Systems	1	Lsum	20000.00	20,000	0.000	0	0	3,600	23,600	23,600.00	-	23,600.00
01	1571	1597.000	Controls	60	Pts	900.00	54,000	0.000	0	0	9,720	63,720	1,062.00	-	1,062.00
01	1571	1597.000	Controls, BACnet	1	Lsum	7000.00	7,000	0.000	0	0	1,260	8,260	8,260.00	-	8,260.00

			Total HVAC					Hours	3,190	Cost/GSF		29.89	**1,162,798**		

Original Hybrid design **$589,620**

			H.V.A.C. - Alternate Design										Material	Labor	Total
01	1571	1599.900	Split System Heat Pump, 5 Tons	2	Each	4000.00	8,000	16.000	32	1,600	1,728	11,328	4,720.00	944.00	5,664.00
01	1571	1599.900	Split System Heat Pump, 4 Tons	2	Each	3200.00	6,400	16.000	32	1,600	1,440	9,440	3,776.00	944.00	4,720.00
01	1571	1599.900	Ductless Split System	2	Each	2100.00	4,200	16.000	32	1,600	1,044	6,844	2,478.00	944.00	3,422.00
01	1571	1599.900	Refrigerant Piping	500	Lnft	8.50	4,250	0.160	80	4,000	1,485	9,735	10.03	9.44	19.47
01	1571	1599.900	Refrigerant Insulation	250	Lnft	7.00	1,750	0.000	0	0	315	2,065	8.26	-	8.26
01	1571	1599.900	Evap Cooler with VFD, 75,000 CFM	2	Each	167500.00	335,000	120.000	240	12,000	62,460	409,460	197,650.00	7,080.00	204,730.00
01	1571	1599.900	Evaporative Cooler, 5,000 CFM	1	Each	1500.00	1,500	12.000	12	600	378	2,478	1,770.00	708.00	2,478.00
01	1571	1599.900	Compressor Hood	1	Each	2500.00	2,500	8.000	8	400	522	3,422	2,950.00	472.00	3,422.00
01	1571	1599.900	Exhaust Fan, Ceiling	1	Each	200.00	200	3.000	3	150	63	413	236.00	177.00	413.00
01	1571	1599.900	Exhaust Fan, 900 CFM	1	Each	650.00	650	8.000	8	400	189	1,239	767.00	472.00	1,239.00
01	1571	1599.900	Exhaust Fan, 5,000 CFM In-Line	1	Each	1650.00	1,650	10.000	10	500	387	2,537	1,947.00	590.00	2,537.00
01	1571	1599.900	Exhaust Fan, 55,000 CFM	1	Each	27500.00	27,500	24.000	24	1,200	5,166	33,866	32,450.00	1,416.00	33,866.00
01	1571	1599.900	Exhaust Fan, 25,000 CFM	4	Each	7500.00	30,000	16.000	64	3,200	5,976	39,176	8,850.00	944.00	9,794.00
01	1571	1599.900	Vehicle Exh Hose Reel, OFCI	14	Each	200.00	2,800	4.000	56	2,800	1,008	6,608	236.00	236.00	472.00
01	1571	1599.900	Louver, 48x24	1	Each	350.00	350	4.000	4	200	99	649	413.00	236.00	649.00
01	1571	1599.900	Supply Air Diffuser	25	Each	70.00	1,750	0.500	13	625	428	2,803	82.60	29.50	112.10
01	1571	1599.900	Supply Air Diffuser, Duct Mt	41	Each	150.00	6,150	1.500	62	3,075	1,661	10,886	177.00	88.50	265.50
01	1571	1599.900	Return Register	5	Each	70.00	350	0.500	3	125	86	561	82.60	29.50	112.10
01	1571	1599.900	Exhaust Grille	7	Each	60.00	420	1.000	7	350	139	909	70.80	59.00	129.80
01	1571	1599.900	Exhaust Grille, Duct Mt	21	Each	95.00	1,995	1.000	21	1,050	548	3,593	112.10	59.00	171.10
01	1571	1599.900	Return Grille, Wall	4	Each	65.00	260	0.750	3	150	74	484	76.70	44.25	120.95
01	1571	1599.900	Return Grille, Wall 42x36	2	Each	315.00	630	3.000	6	300	167	1,097	371.70	177.00	548.70
01	1571	1599.900	Manual Dampers	30	Each	60.00	1,800	1.500	45	2,250	729	4,779	70.80	88.50	159.30
01	1571	1599.900	Spin-in	27	Each	8.50	230	0.220	6	297	95	621	10.03	12.98	23.01
01	1571	1599.900	Flex Duct	216	Lnft	2.25	486	0.063	14	675	209	1,370	2.66	3.69	6.34
01	1571	1599.900	Clamps	54	Each	4.00	216	0.000	0	0	39	255	4.72	-	4.72
01	1571	1599.900	Flexible Connection	100	Lnft	4.50	450	0.150	15	750	216	1,416	5.31	8.85	14.16
01	1572	1593.000	Supply Air Duct, Shop	9,280	Lbs	1.95	18,096	0.053	495	24,731	7,709	50,536	2.30	3.14	5.45
01	1574	1593.000	LPSA Duct	3,775	Lbs	1.95	7,361	0.053	201	10,060	3,136	20,558	2.30	3.14	5.45
01	1574	1594.000	Duct Insulation	2,825	Sqft	1.50	4,238	0.000	0	0	763	5,000	1.77	-	1.77
01	1573	1593.000	LPRA Duct	1,925	Lbs	2.95	5,679	0.053	103	5,130	1,946	12,754	3.48	3.14	6.63
01	1576	1593.000	General Exhaust Duct	780	Lbs	1.95	1,521	0.053	42	2,079	648	4,248	2.30	3.14	5.45
01	1576	1593.000	Exhaust Duct, Shop	16,340	Lbs	1.95	31,863	0.053	871	43,546	13,574	88,983	2.30	3.14	5.45
01	1576	1593.000	Exhaust Duct, Tail Pipe	1,400	Lbs	1.95	2,730	0.053	75	3,731	1,163	7,624	2.30	3.14	5.45
01	1571	1599.900	Vibration Isolation	1	Lsum	1000.00	1,000	120.000	60	3,000	720	4,720	1,180.00	3,540.00	4,720.00
01	1571	1599.900	Commissioning	1	Lsum	2000.00	2,000	360.000	360	18,000	3,600	23,600	2,360.00	21,240.00	23,600.00
01	1571	1596.000	Test & Balance Systems	1	Lsum	20000.00	20,000	0.000	0	0	3,600	23,600	23,600.00	-	23,600.00
01	1571	1597.000	Controls	60	Pts	900.00	54,000	0.000	0	0	9,720	63,720	1,062.00	-	1,062.00
01	1571	1597.000	Controls, BACnet	1	Lsum	7000.00	7,000	0.000	0	0	1,260	8,260	8,260.00	-	8,260.00

			Total HVAC				Hours	3,003	Cost/GSF		22.66	**881,635**			

392,500

Post Bid Alternate (197,120) Savings from Original Design

PHMech
Yuma Fleet
15241

This spreadsheet is a cost analysis for two different AC systems for Yuma Fleet in Yuma, Arizona.
This spreadsheet will combine the annual cost to run a system along with the initial cost of it
There are a total of 10 sheets, each sheet is a different calculation.
The Weather Data sheet references the annual temperature distribution over Yuma, Arizona
Some calculations that have more time restrictions have more detailed weather data attached to them.

This sheet is a summary of both systems. It is linked to the other sheets to display the calculations
The cost of each utility is in dollars

	Cost of Ownership		
	Proposed System	**Alternate System**	**Difference**
Total HVAC System Cost	$1,162,798	$881,635	$ 281,163
AHU Equipment Cost	$589,620	$392,500	$ 197,120
Annual Electric Cost	$52,863	$39,988	$ 12,875
Annual Water Cost	$1,838	$2,667	$ (829)
Annual Natural Gas Cost	$5,142	$10,205	$ (5,063)
Annual Maintenance Cost	$4,688	$7,125	$ (2,438)
Pad Replacement Cost	$6,000	$8,800	$ (2,800)
Annual Pad Replacement Cost	$759	$1,119	$ (359)
	Subtotals:		
Annual Utilities & Maintenance:	$65,290	$61,104	$ 4,186
Grand Total:	$1,228,088	$942,739	$ 285,349

	20 Year Life Cycle Cost		
AHU Equipment Cost	$589,620	$392,500	$ 197,120
Annual Utilities & Maintenance:	$65,290	$61,104	$ 4,186
20 Years of Utilities & Maintenance:	$1,305,805	$1,222,076	$ 83,729
Total 20 Year Cost	$1,895,425	$1,614,576	$ 280,849
Grand Total:	**Proposed System Cost**	**Alternate System Cost**	**Total Difference**
Yearly Cost for 20 years	$94,771.25	$80,728.78	**$ 14,042**

This spreadsheet displays the temperature data for Yuma, Arizona over an annual basis.
The data displays how many hours/month a dry bulb temperature is met, and what the MCWB is at that DB temperature
All weather is in degrees of Fahrenheit

Cooling Required (greater than 70°)
Heating Required (Less than 50°)

January			February		March		April		May		June			Total Cooling Hours:	
DB	MCWB	Hours	MCWB	Hours	MCWB	Hours	MCWB	Hours	MCWB	Hours	MCWB	Hours	DB	5231	Hours
120													120		
115											72.8	2	115		
110									70.5	1	70.2	18	110	Put April - August on DX + IEC	
105							67.4	1	67.7	6	69.2	56	105	3216	Hours
100							65	4	65.6	23	67.3	79	100		
95					62.7	1	63	18	64.1	60	66	93	95	Average Temp	
90			61.8	1	60.6	7	60.9	40	62.4	82	64.7	97	90	DB(°F)	MCWB(°F)
85			58.2	6	59	24	58.9	68	60.9	88	63.3	107	85	86.13	64.54
80	55.4	2	57	23	57.1	47	57.3	81	59.3	105	61.2	110	80		
75	54.1	17	55	48	55	72	55.5	98	57.7	123	59.2	90	75	IEC + DEC	
70	53.1	46	53.2	72	53.5	103	53.6	116	55.6	115	57.1	48	70	2015	Hours/Year
65	50.9	83	51.4	102	51.7	127	51.8	116	53.5	80	54.3	15	65		
60	49.1	126	49.9	126	49.7	142	49.6	97	50.8	43	51.8	3	60	Annual Cooling Temperatures	
55	46.6	165	46.9	124	47.1	123	47.2	56	47.9	16	51	0	55	Average Cooling DB(°F)	Average Cooling MCWB(°F)
50	43.6	161	43.3	96	44.4	72	44.7	22	45.3	3			50	80.31	59.99
45	39.8	98	40	53	40.9	22	40.8	5					45		
40	35.6	33	36.1	17	37	3	40.2	0					40	Total Heating Hours:	
35	< 32	11	< 32	4	33	0							35	421	
Total Cooling Hours/Month															
Cooling Hours		65		150		254		426		603		700			
Total Hours		742		672		743		722		745		718			
Percent Cooling:		8.76		22.32		34.19		59.00		80.94		97.49			
AVG DB per cooling		71.62		73.87		75.33		78.74		81.72		87.94			
AVG MCWB/Cooling		53.43		54.62		55.34		56.81		59.74		63.70			

July			August		September		October		November		December		
DB	MCWB	Hours	MCWB	Hours	MCWB	Hours	MCWB	Hours	MCWB	Hours	MCWB	Hours	DB
120	73.5												120
115	73.5	1	74.7	1	72.5								115
110	72.9	21	74.5	14	72.7	5							110
105	72.6	79	74	70	72.8	25	69.5	4					105
100	72.3	115	73.2	112	71.9	71	68.4	13					100
95	71.9	108	72.9	111	70.2	93	66.4	31	64.5				95
90	70.9	133	72.3	135	69.5	109	64.9	63	62.2	2			90
85	69.9	156	71.6	158	69.3	131	63.6	81	60.2	16			85
80	68.3	104	69.6	102	67.4	133	32.2	102	58.3	41	56.3	1	80
75	63.5	22	65.6	35	63.4	89	60.6	132	56.2	64	54.6	18	75
70	58.1	4	60.4	6	60.2	46	58	136	54.3	91	52.6	49	70
65	58.3	0	58.5	0	56.4	15	54.5	101	51.8	119	50.6	82	65
60					53.3	2	51.2	55	49.2	147	48.5	118	60
55					50.7	0	47.1	19	46	129	46.8	163	55
50							44.1	6	42.7	77	43.2	164	50
45							40.3	1	38.8	27	39.3	101	45
40							37	0	35.8	5	35	35	40
35									32.3	1	31.3	11	35
Total Cooling Hours/Month													
Cooling Hours		743		744		702		562		214		68	
Total Hours		743		744		719		744		719		742	
Percent Cooling:		100.00		100.00		97.64		75.54		29.76		9.16	
AVG DB per cooling		91.47		90.77		86.31		79.72		74.72		71.47	
AVG MCWB/Cooling		70.64		71.80		68.16		56.29		56.15		53.18	

Use this to calculate elecitrcal cost per equipment
This spreadsheet works with the Electrical Summary sheet

Inputs:
HP/Kilowatts
Hours/day (Summer & Winter)
Cents/kWHour (Summer & Winter)

Calculations for Fluctuating rate between Summer and Winter

Horse Power	Kilowatts	Hours/Day (Summer)	Hours/Day (winter)	Cents/KWHour (summer)	Cents/KWHour (Winter)
80	59.66	10	10	$0.05	$0.03

Summer Length	Total Summer Hours:	Summer Cost (Dollars)
6	1830	**$5,458.52**

How Many Winter Months?	Total Winter Hours	Winter Cost (Dollars)
6	1818	**$3,253.64**

Total Cost for 12 Months of operation is (Dollars):
$8,712.16

Fixed Rate Calculations

Horse Power	Kilowatts	Hours/Day	Hours/Year	Cents/KWHour (fixed)
79.3	59.13	24	8760	$0.05

Total Cost for 12 Months of operation is (Dollars):
$25,900.69

Use this sheet to organize your final calculations.
This sheet will display the electrical loads from the supply fans, exhaust fans, and cooling apparatus for Yuma, Arizona.

Cooling hours are considered if the DB is over 70°F
Summer and Winter have different Dollars/kWHour rates
Rates are hard coded in this sheet.

Inputs:
Supply/Exhaust HP
Compressor/Pump KW

Proposed Design

The existing unit has 9 supply fans at 7.5 HP and 2 exhaust at 30 HP that all run 24/7
The unit has cooling loads that are different depending on if its summer or winter (see note 1)

			Summer Only Loads		Winter Only Loads			
Totals:	**Supply *(9) 7.5 HP***	**Exhaust *(2) 30 HP***	**Compressor**	**IEC Pump**	**Compressor**	**DEC Pump**	**IEC Pump**	**Totals:**
HP	**67.5**	**60**						**HP**
Kilowatts	50.33	44.74	**88.6**	**1.2**	**79.3**	**0.7**	**1.2**	**Kilowatts**
Summer Hours	4392	4392	3216	3216	0	0	0	**Summer Hours**
Summer Fee (.05 Dollars/kWHour)	$11,054	$9,825	$14,247	$193	0	0	0	**Summer Fee (.05 Dollars/kWHour)**
Winter Hours	4363	4363	0	0	2015	2015	2015	**Winter Hours**
Winter Fee (.03 Dollars/kWHour)	6588	5856	0	0	$4,794	$42	$73	**Winter Fee (.03 Dollars/kWHour)**
Total Hours	8755	8755	3216	3216	2015	2015	2015	**Total Hours**
Cost/Year (dollars)	$17,642	$15,681	$14,439	$193	$4,794	$42	$73	**Cost/Year (dollars)**

Existing Unit
Final Cost per Year (dollars)
$52,863

NOTE 1
There are 5231 Hours of Cooling/Year
During months April-August the DX + IEC is operating. (3216 Hours, Summer Rate)
The rest of the cooling hours are put on the IEC + DEC (2015 Hours, Winter Rate)
All hour calculations can be found on the Weather Data sheet

Alternate Design

The alternate is (2) 40 HP VFD units. During occupied hours (7AM-6PM) units operate at 100%, other hours the units operate at 60% (24 HP each)
There are (2) exhaust systems and (2) pumps (see note 2)

Supply Fan HP *(2) 40 HP VFD*	**80**	**48**	**Totals:**	
Kilowatts	**59.66**	**35.79**		**Kilowatts**
Summer Hours (11/Day, 13/Day)	2013	2379	4392	**Summer Hours (11/Day, 13/Day)**
Summer Fee (.05 Dollars/kWHour)	$6,004	$4,258	$10,262	**Summer Fee (.05 Dollars/kWHour)**
Winter Hours (11/Day, 13/Day)	2000	2363	4363	**Winter Hours (11/Day, 13/Day)**
Winter Fee (.03 Dollars/kWHour)	$3,579	$2,537	$6,117	**Winter Fee (.03 Dollars/kWHour)**
Cost (Dollars)	$9,584	$6,795	$16,379	**Cost (Dollars)**
Total Cost of Supply:	$16,379			**Total Cost of Supply**

Exhaust Fan HP *(1) 75.8 HP (4) 7.5 HP*	**75.8**	**30**	**Totals:**	
Kilowatts	**56.52**	**22.37**		**Kilowatts**
Summer Hours (24/7, 10/Day)	4392	1830	6222	**Summer Hours (11/Day, 13/Day)**
Summer Fee (.05 Dollars/kWHour)	$12,413	$2,047	$14,460	**Summer Fee (.05 Dollars/kWHour)**
Winter Hours (24/7, 10/Day)	4363	1818	6181	**Winter Hours (11/Day, 13/Day)**
Winter Fee (.03 Dollars/kWHour)	$7,398	$1,220	$8,619	**Winter Fee (.03 Dollars/kWHour)**
Cost (Dollars)	$19,811	$3,267	23078	**Cost (Dollars)**
Total Cost of Exhaust:	$23,078			**Total Cost of Exhaust**

Pump *(2) 1.2 kW*	
Kilowatts	**2.40**
Summer Hours (24/7)	3,216
Summer Fee (.05 Dollars/kWHour)	$386
Winter Hours (24/7)	2015
Winter Fee (.03 Dollars/kWHour)	$145
Total Cost (Dollars)	$531

Alternate Units
Final Cost per Year (dollars)
$39,988

NOTE 2
The supply fans run 11 Hours/day at 80 HP, and for 13 Hours/day at 48 HP, all year
The 75.8 HP exhaust fan runs 24/7 and the (4) 7.5 HP fans run 10 hours/day all year
The pumps (2) run 5231 hours/year for cooling.

Proposed System Water Calcs

This spreadsheet will calculate how many gallons of water the unit evaporates and purges
DB = Dry Bulb Temperature
MCWB = Mean Coincident Wet Bulb Temperature
Delta = Temperature Gradiant between DB and MCWB

GPH (Gallons Per Hour) = (CFM*EFF*DeltaT)/8700
Gallons = GPH * Hours Ran
1 Unit = 748 Gallons

[0,10] Units = $1.50/Unit
[11,30] Units = $1.75/Unit
[31,∞] Units = $2.02/Unit

Constants:	
Eff	90%
CFM	55000
GPH Constant	8700
1 Unit	748 Gallons
[0,10] Units	1.5
[11,30] Units	1.75
[31,∞] Units	2.02

Reservoir Capacity:	
24	Feet Cubed
179.5	Gallons

Note:
1) There is (1) unit that blows at 55,000 CFM during all cooling hours
2) Dump both 24ft^3 Reservoir twice A day

Total Gallons evaporated:	Gallons Dumped (730 times/Year)	Total Gallons Used for AH-1	**Total Units:**	**Total Cost**
605186	131059	736245	**984**	**$1,838**

Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
January	80	55.4	24.6	2	140	280	**24**	
	75	54.1	20.9	17	119	2022	10	[0,10] Units
31	70	53.1	16.9	46	96	4423	14.0	[11,30] Units
				Dumping		11131	0	[31,∞] Units
				Gallons/Month:		17856	**24**	**CHECK**
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
February	90	61.8	28.2	1	160	160	**35**	
	85	58.2	26.8	6	152	915	10	[0,10] Units
	80	57	23	23	131	3010	25	[11,30] Units
	75	55	20	48	114	5462	0	[31,∞] Units
28	70	53.2	16.8	72	96	6882	**35**	**CHECK**
				Dumping		10054		
				Gallons/Month:		26483		
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
March	95	62.7	32.3	1	184	184	**54**	
	90	60.6	29.4	7	167	1171	10	[0,10] Units
	85	59	26	24	148	3550	30	[11,30] Units
	80	57.1	22.9	47	130	6124	14	[31,∞] Units
	75	55	20	72	114	8193	**54**	**CHECK**
31	70	53.5	16.5	103	94	9670		
				Dumping		11131		
				Gallons/Month:		40023		
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
April	105	67.4	37.6	1	214	214	**85**	
	100	65	35	4	199	797	10	[0,10] Units
	95	63	32	18	182	3277	30	[11,30] Units
	90	60.9	29.1	40	166	6623	45	[31,∞] Units
	85	58.9	26.1	68	149	10098	**85**	**CHECK**
	80	57.3	22.7	81	129	10462		
	75	55.5	19.5	98	111	10873		
30	70	53.6	16.4	116	93	10824		
				Dumping		10772		
				Gallons/Month:		63939		
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
May	110	70.5	39.5	1	225	225	**116**	
	105	67.7	37.3	6	212	1273	10	[0,10] Units
	100	65.6	34.4	23	196	4502	30	[11,30] Units
	95	64.1	30.9	60	176	10549	76	[31,∞] Units
	90	62.4	27.6	82	157	12877	**116**	**CHECK**
	85	60.9	24.1	88	137	12067		
	80	59.3	20.7	105	118	12366		
	75	57.7	17.3	123	98	12107		
31	70	55.6	14.4	115	82	9422		
				Dumping		11131		
				Gallons/Month:		86518		
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
June	115	72.8	42.2	2	240	480	**143**	
	110	70.2	39.8	18	226	4076	10	[0,10] Units
	105	69.2	35.8	56	204	11407	30	[11,30] Units
	100	67.3	32.7	79	186	14698	103	[31,∞] Units
	95	66	29	93	165	15345	**143**	**CHECK**
	90	64.7	25.3	97	144	13963		
	85	63.3	21.7	107	123	13211		
	80	61.2	18.8	110	107	11766		
	75	59.2	15.8	90	90	8091		
30	70	57.1	12.9	48	73	3523		
				Dumping		10772		
				Gallons/Month:		107332		

Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
July	115	73.5	41.5	1	236	236	**133**	
	110	72.9	37.1	21	211	4433	10	[0,10] Units
	105	72.6	32.4	79	184	14563	30	[11,30] Units
	100	72.3	27.7	115	158	18124	93	[31,∞] Units
	95	71.9	23.1	108	131	14195	**133**	**CHECK**
	90	70.9	19.1	133	109	14453		
	85	69.9	15.1	156	86	13403		
	80	68.3	11.7	104	67	6923		
	75	63.5	11.5	22	65	1439		
31	70	58.1	11.9	4	68	271		
				Dumping		11131		
				Gallons/Month:		99172		
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
August	115	74.7	40.3	1	229	229	**122**	
	110	74.5	35.5	14	202	2828	10	[0,10] Units
	105	74	31	70	176	12347	30	[11,30] Units
	100	73.2	26.8	112	152	17078	82	[31,∞] Units
	95	72.9	22.1	111	126	13957	**122**	**CHECK**
	90	72.3	17.7	135	101	13595		
	85	71.6	13.4	158	76	12046		
	80	69.6	10.4	102	59	6036		
	75	65.6	9.4	35	53	1872		
31	70	60.4	9.6	6	55	328		
				Dumping		11131		
				Gallons/Month:		91447		
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
September	110	72.7	37.3	5	212	1061	**111**	
	105	72.8	32.2	25	183	4580	10	[0,10] Units
	100	71.9	28.1	71	160	11351	30	[11,30] Units
	95	70.2	24.8	93	141	13123	71	[31,∞] Units
	90	69.5	20.5	109	117	12714	**111**	**CHECK**
	85	69.3	15.7	131	89	11702		
	80	67.4	12.6	133	72	9535		
	75	63.4	11.6	89	66	5874		
30	70	60.2	9.8	46	56	2565		
				Dumping		10772		
				Gallons/Month:		83276		
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
October	105	69.5	35.5	4	202	808	**92**	
	100	68.4	31.6	13	180	2337	10	[0,10] Units
	95	66.4	28.6	31	163	5044	30	[11,30] Units
	90	64.9	25.1	63	143	8997	52	[31,∞] Units
	85	63.6	21.4	81	122	9862	**92**	**CHECK**
	80	62.2	17.8	102	101	10330		
	75	60.6	14.4	132	82	10815		
31	70	58	12	136	68	9286		
				Dumping		11131		
				Gallons/Month:		68611		
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
November	90	62.2	27.8	2	158	316	**45**	
	85	60.2	24.8	16	141	2258	10	[0,10] Units
	80	58.3	21.7	41	123	5062	30	[11,30] Units
	75	56.2	18.8	64	107	6846	5	[31,∞] Units
30	70	54.3	15.7	91	89	8129	**45**	**CHECK**
				Dumping		10772		
				Gallons/Month:		33383		
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Units:	
December	80	56.3	23.7	1	135	135	**24**	
	75	54.6	20.4	18	116	2089	10	[0,10] Units
31	70	52.6	17.4	49	99	4851	14	[11,30] Units
				Dumping		11131	0	[31,∞] Units
				Gallons/Month:		18206	**24**	**CHECK**

Quantities of Each Unit		
[0,10]	[11,30]	[31,∞]
120	323	541
Cost per Section		
$ 180.00	$ 565.25	$ 1,092.82

Alternative System Water Calcs

This spreadsheet will calculate how many gallons of water the unit uses
DB = Dry Bulb Temperature
MCWB = Mean Coincicent Wet Bulb Temperature
Delta = Temperature Gradiant between DB and MCWB

GPH (Gallons Per Hour) = (CFM*EFF*DeltaT)/8700
Gallons = GPH * Hours Ran
Dump Reservoir Twice A Day

Daytime Constants:		Universal		Nighttime Constants:	
Eff	70%	1 Unit	748 Gallons	Eff	70%
CFM	140000	[0,10] Units	1.5	CFM	70000
GPH Constant	8700	[11,30] Units	1.75	GPH Constant	8700
		[31,∞] Units	2.02		

[0,10] Units = $1.50/Unit
[11,30] Units = $1.75/Unit
[31,∞] Units = $2.02/Unit

Reservoir Capacity:	
15.75	Feet Cubed
117.8	Gallons
235.6	Total (2 units)

Gallons Evaporated	
873516	

Gallons Dumped (730 Times/Year
172015

Total Gallons used
1045531

Total Units
1398

Total Cost (Dollars/Year)
$2,667

Note:
1) If cooling is required during the daytime, the CFMs are 140,000. If the cooling is required at nighttime the CFMs are 70,000. Cooling is split between day and night
2) Dump both 15.75 ft^3 reservoirs twice a day

Quantities of Each Unit		
[0,10]	[11,30]	[31,∞]
120	351	927
Cost per Section		
$ 180.00	$ 614.25	$ 1,872.54

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	35	
January	80	55.4	24.6	2	277	554	0	139	0	10	[0,10] Units
	75	54.1	20.9	12	235	2825	5	118	589	25	[11,30] Units
	70	53.1	16.9	32	190	6092	15	95	1428	0	[31,∞] Units
31				Daytime Gallons		9471	Nighttime Gallons		2016	**35**	**CHECK**
				Dumped		14609					
				Gallons/Month		**26097**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	52	
February	90	61.8	28.2	1	318	318	0	159	0	10	[0,10] Units
	85	58.2	26.8	4	302	1208	2	151	302	30	[11,30] Units
	80	57	23	14	259	3627	8	130	1036	12	[31,∞] Units
	75	55	20	30	225	6759	18	113	2028	**52**	**CHECK**
	70	53.2	16.8	41	189	7759	31	95	2933		
28				Daytime Gallons		19670	Nighttime Gallons		6299		
				Dumped		13196					
				Gallons/Month		**39165**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	81	
March	95	62.7	32.3	1	364	364	1	182	182	10	[0,10] Units
	90	60.6	29.4	5	331	1656	3	166	497	30	[11,30] Units
	85	59	26	15	293	4393	9	146	1318	41	[31,∞] Units
	80	57.1	22.9	28	258	7223	18	129	2322	**81**	**CHECK**
	75	55	20	43	225	9687	30	113	3379		
	70	53.5	16.5	53	186	9851	51	93	4739		
31				Daytime Gallons		33174	Nighttime Gallons		12437		
				Dumped		14609					
				Gallons/Month		**60220**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	123	
April	105	67.4	37.6	1	424	424	0	212	0	10	[0,10] Units
	100	65	35	3	394	1183	2	197	394	30	[11,30] Units
	95	63	32	11	360	3965	6	180	1081	83	[31,∞] Units
	90	60.9	29.1	24	328	7867	15	164	2458	**123**	**CHECK**
	85	58.9	26.1	41	294	12054	26	147	3822		
	80	57.3	22.7	45	256	11507	35	128	4475		
	75	55.5	19.5	43	220	9445	45	110	4942		
	70	53.6	16.4	37	185	6835	79	92	7297		
30				Daytime Gallons		53279	Nighttime Gallons		24470		
				Dumped		14138					
				Gallons/Month		**91888**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	164	
May	110	70.5	39.5	1	445	445	0	222	0	10	[0,10] Units
	105	67.7	37.3	4	420	1681	2	210	420	30	[11,30] Units
	100	65.6	34.4	14	387	5425	9	194	1744	124	[31,∞] Units
	95	64.1	30.9	36	348	12530	24	174	4177	**164**	**CHECK**
	90	62.4	27.6	49	311	15234	33	155	5130		
	85	60.9	24.1	47	271	12759	41	136	5565		
	80	59.3	20.7	43	233	10026	62	117	7228		
	75	57.7	17.3	29	195	5651	94	97	9159		
	70	55.6	14.4	16	162	2595	99	81	8029		
31				Daytime Gallons		66347	Nighttime Gallons		41452		
				Dumped		14609					
				Gallons/Month		**122409**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	199	
June	115	72.8	42.2	1	475	475	1	238	238	10	[0,10] Units
	110	70.2	39.8	11	448	4932	8	224	1793	30	[11,30] Units
	105	69.2	35.8	32	403	12904	24	202	4839	159	[31,∞] Units
	100	67.3	32.7	48	368	17681	31	184	5709	**199**	**CHECK**
	95	66	29	53	327	17313	41	163	6697		
	90	64.7	25.3	46	285	13109	51	142	7267		
	85	63.3	21.7	30	244	7333	77	122	9411		
	80	61.2	18.8	13	212	2753	97	106	10271		
	75	59.2	15.8	5	178	890	85	89	7564		
	70	57.1	12.9	2	145	291	46	73	3342		
30				Daytime Gallons		77681	Nighttime Gallons		57131		
				Dumped		14138					
				Gallons/Month		**148951**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	184	
July	115	73.5	41.5	1	467	467	1	234	234	10	[0,10] Units
	110	72.9	37.1	12	418	5015	10	209	2090	30	[11,30] Units
	105	72.6	32.4	45	365	16423	34	182	6204	144	[31,∞] Units
	100	72.3	27.7	69	312	21530	46	156	7177	**184**	**CHECK**
	95	71.9	23.1	60	260	15612	47	130	6115		
	90	70.9	19.1	43	215	9251	90	108	9682		
	85	69.9	15.1	15	170	2551	140	85	11906		
	80	68.3	11.7	2	132	264	102	66	6721		
	75	63.5	11.5	0	130	0	22	65	1425		
	70	58.1	11.9	0	134	0	4	67	268		
31				Daytime Gallons		71114	Nighttime Gallons		51822		
				Dumped		14609					
				Gallons/Month		**137545**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	170	
August	115	74.7	40.3	1	454	454	0	227	0	10	[0,10] Units
	110	74.5	35.5	8	400	3199	6	200	1200	30	[11,30] Units
	105	74	31	43	349	15015	27	175	4714	130	[31,∞] Units
	100	73.2	26.8	68	302	20528	44	151	6641	**170**	**CHECK**
	95	72.9	22.1	59	249	14688	52	124	6473		
	90	72.3	17.7	43	199	8573	92	100	9171		
	85	71.6	13.4	20	151	3019	138	75	10415		
	80	69.6	10.4	5	117	586	96	59	5623		
	75	65.6	9.4	1	106	106	34	53	1800		
	70	60.4	9.6	0	108	0	5	54	270		
31				Daytime Gallons		66168	Nighttime Gallons		46308		
				Dumped		14609					
				Gallons/Month		**127085**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	155	
September	110	72.7	37.3	3	420	1260	2	210	420	10	[0,10] Units
	105	72.8	32.2	17	363	6166	8	181	1451	30	[11,30] Units
	100	71.9	28.1	46	317	14560	25	158	3957	115	[31,∞] Units
	95	70.2	24.8	55	279	15365	39	140	5447	**155**	**CHECK**
	90	69.5	20.5	52	231	12008	58	115	6697		
	85	69.3	15.7	36	177	6367	96	88	8489		
	80	67.4	12.6	20	142	2839	113	71	8019		
	75	63.4	11.6	8	131	1045	81	65	5292		
	70	60.2	9.8	3	110	331	43	55	2373		
30				Daytime Gallons		59941	Nighttime Gallons		42145		
				Dumped		14138					
				Gallons/Month		**116224**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	131	
October	105	69.5	35.5	3	400	1200	1	200	200	10	[0,10] Units
	100	68.4	31.6	9	356	3204	4	178	712	30	[11,30] Units
	95	66.4	28.6	21	322	6765	10	161	1611	91	[31,∞] Units
	90	64.9	25.1	41	283	11592	22	141	3110	**131**	**CHECK**
	85	63.6	21.4	47	241	11330	34	121	4098		
	80	62.2	17.8	46	201	9223	57	100	5714		
	75	60.6	14.4	41	162	6650	92	81	7462		
	70	58	12	24	135	3244	112	68	7570		
31				Daytime Gallons		53208	Nighttime Gallons		30476		
				Dumped		14609					
				Gallons/Month		**98294**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	68	
November	90	62.2	27.8	2	313	626	0	157	0	10	[0,10] Units
	85	60.2	24.8	13	279	3632	3	140	419	30	[11,30] Units
	80	58.3	21.7	29	244	7089	12	122	1467	28	[31,∞] Units
	75	56.2	18.8	41	212	8683	23	106	2435	**68**	**CHECK**
	70	54.3	15.7	48	177	8489	44	88	3891		
30				Daytime Gallons		28518	Nighttime Gallons		8212		
				Dumped		14138					
				Gallons/Month		**50868**					

				Daytime			Nighttime			Units:	
Month	DB	MCWB	Delta	Hours	GPH	Gallons	Hours	GPH	Gallons	36	
December	80	56.3	23.7	1	267	267	0	133	0	10	[0,10] Units
	75	54.6	20.4	14	230	3217	4	115	460	26	[11,30] Units
	70	52.6	17.4	35	196	6860	14	98	1372	0	[31,∞] Units
31				Daytime Gallons		10344	Nighttime Gallons		1832	**36**	**CHECK**
				Dumped		14609					
				Gallons/Month		**26785**					

Constants:	
CFM	55000
Sens. Const.	1.08
1 Therm	100000 BTU
1 Therm	$0.57117
Delta	30

This spreadsheet will calculate the cost of natural gas for the proposed unit.
BTU/Hour = CFM * 1.08 * Delta
CFM = Cubic Feet per Minute
Delta = Dry bulb temperature difference across the coil

Note:
1) The Delta T across the heating coil is a constant 30°F
2) Add an extra 20% of required BTU/Hour to total to account for Efficiency

BTU/Hour	Extra 20% For Eff	Hours of Heating/Year	BTU/Year	Therms/Year	**Cost/Year**
1782000	2138400	421	900266400	9003	**$5,142**

Jan			
DB°F	**1 AM - 8 AM**	**9 AM - 4 PM**	**5 PM - 12 AM**
45	69	13	16
40	27	3	3
35	9	1	0
30	1	0	0

Feb			
DB°F	**1 AM - 8 A**	**9 AM - 4 PM**	**5 PM - 12 AM**
45	41	6	6
40	15	1	1
35	4	0	0
30	0	0	0

March			
DB°F	**1 AM - 8 A**	**9 AM - 4 PM**	**5 PM - 12 AM**
45	21	0	1
40	3	0	0
35	0	0	0
30	0	0	0

November			
DB°	**1 AM - 8 AM**	**9 AM - 4 PM**	**5 PM - 12 AM**
45	23	1	3
40	5	0	0
35	1	0	0
30	0	0	0

December			
DB°F	**1 AM - 8 A**	**9 AM - 4 PM**	**5 PM - 12 AM**
45	73	12	16
40	28	3	4
35	8	0	1
30	2	0	0

Total Hours				
DB°F	**1 AM - 8 A**	**9 AM - 4 PM**	**5 PM - 12 A**	**Total Hours**
45	227	32	42	301
40	78	7	8	93
35	22	1	1	24
30	3	0	0	3

Constants:	
CFM	70000
Sens. Const.	1.08
1 Therm	100000 BTU
1 Therm	$0.57117

This spreadsheet will calculate the cost of natural gas for the alternate unit.
BTU/Hour = CFM * 1.08 * Delta
CFM = Cubic Feet per Minute
Delta = Dry bulb temperature difference across the coil

Note:
1) There are (2) units operating at 35,000 CFM each
2) Delta **is not** constant, air is heated to 90°F
3) Add an extra 20% of required BTU/Hour to total to account for Efficiency

DB°F	Delta°F	BTU/Hour	Extra 20%	Hours Operated	BTU/Year	Total BTU/year	Therms/Year	Cost/Year
45	45	3402000	4082400	301	1228802400	1786730400	17867	$10,205
40	50	3780000	4536000	93	421848000			
35	55	4158000	4989600	24	119750400			
30	60	4536000	5443200	3	16329600			

Jan			
DB°F	1 AM - 8 AM	9 AM - 4 PM	5 PM - 12 AM
45	69	13	16
40	27	3	3
35	9	1	0
30	1	0	0

Feb			
DB°F	1 AM - 8 AM	9 AM - 4 PM	5 PM - 12 AM
45	41	6	6
40	15	1	1
35	4	0	0
30	0	0	0

March			
DB°F	1 AM - 8 AM	9 AM - 4 PM	5 PM - 12 AM
45	21	0	1
40	3	0	0
35	0	0	0
30	0	0	0

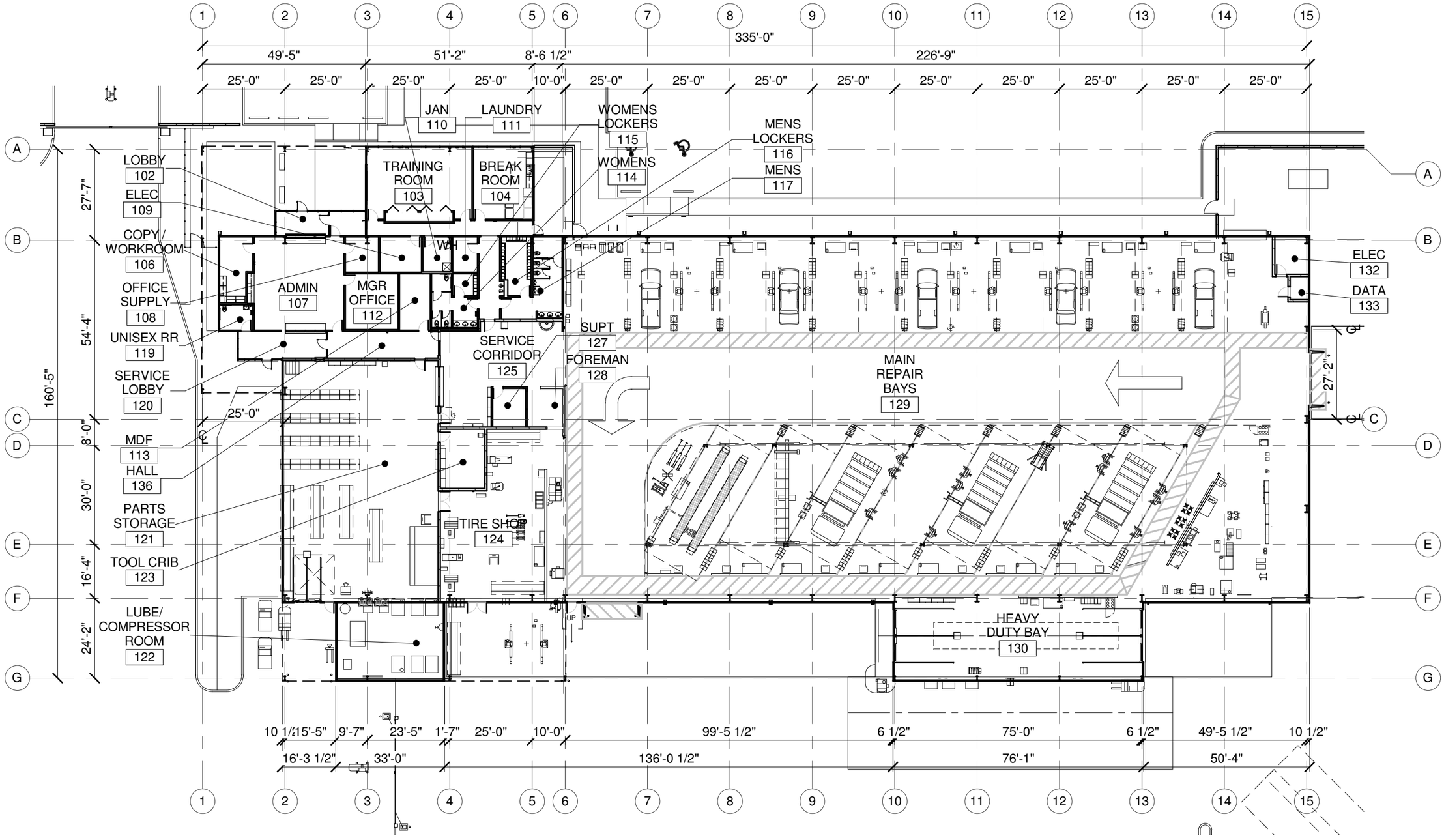
November			
DB°	1 AM - 8 AM	9 AM - 4 PM	5 PM - 12 AM
45	23	1	3
40	5	0	0
35	1	0	0
30	0	0	0

December			
DB°F	1 AM - 8 AM	9 AM - 4 PM	5 PM - 12 AM
45	73	12	16
40	28	3	4
35	8	0	1
30	2	0	0

Total Hours				
DB°F	1 AM - 8 AM	9 AM - 4 PM	5 PM - 12 AM	Total Hours
45	227	32	42	301
40	78	7	8	93
35	22	1	1	24
30	3	0	0	3

Proposed System Maintenance:		Maintenance rate:	
		$ 75.00	
This is the annual cost of maintenance for the proposed unit			
Rate of maintenance is $75/hour			
Replace one pad every 8 years at $6,000			
Description	**Occurrence/Year**	**Time (hours)**	**Annual Cost**
1) Fan Equipment + Accessories			
Visual Inspections	2	0.5	$75
Grease fan bearing	2	1	$150
Adjust Fan Wheel	2	1	$150
Grease slide rail bolts/check motor	2	1	$150
Adjust Fan Belt	12	1	$900
Adjust Drive Alignment	1	1	$75
Adjust Propeller	2	1	$150
Grease Motor Hold Down	2	1	$150
Coolers			
Visual Inspections	2	1	$150
Sump Cleaning	12	2	$1,800
Pad Replacement over 8 years (6000 for pad)	0.125	1	$759
3) Misc. Inspections/Maintenance			
Visually Inspect/adjust if needed:			
Outside air inlet Louvers/Dampers	2	1	$150
Filters/filter system	2	1	$150
Water overflow connection	2	1	$150
4) Initial Start up			
Clean System/Flush Water	1	1	$75
Check/Adjust: Fans, Belt Tension	1	1	$75
Check/Adjust: Float, Water Distribution	1	1	$75
Check/Adjust Locking Collar + Fan Wheel	1	1	$75
5) Seasonal Shutdown			
Drain/Clean Cold Water Sump	1	1	$75
Grease Fan/Motor bearings	1	1	$75
Final inspection	1	0.5	$38
		Total Cost w/o pads:	
		$4,688	

Alternative System Maintenance:		Maintenance rate:	
		$ 75.00	
This is the annual maintenance cost for two units.			
Rate of maintenance is $75/hour			
Replace 2 pads every 8 years for $8,800			
Description	**Occurrence/Year**	**Time (hours)**	**Annual Cost**
1) Fan Equipment + Accessories			
Visual Inspections	2	1	$ 150
Grease fan bearing	2	2	$ 300
Adjust Fan Wheel	2	2	$ 300
Grease slide rail bolts/check motor	2	2	$ 300
Adjust Fan Belt	12	2	$ 1,800
Adjust Drive Alignment	1	2	$ 150
Adjust Propeller	2	2	$ 300
Grease Motor Hold Down	2	2	$ 300
2) Evap Coolers			
Visual Inspections	2	2	$ 300
Sump Cleaning	12	2	$ 1,800
Pad Replacement over 8 years (8,800 for pads)	0.125	2	$ 1,119
3) Misc. Inspections/Maintenance			
Visually Inspect/adjust if needed:			
Outside air inlet Louvers/Dampers	2	1	$ 150
Filters/filter system	2	1	$ 150
Water overflow connection	2	1	$ 150
4) Initial Start up			
Clean System/Flush Water	1	2	$ 150
Check/Adjust: Fans, Belt Tension	1	2	$ 150
Check/Adjust: Float, Water Distribution	1	2	$ 150
Check/Adjust Locking Collar + Fan Wheel	1	2	$ 150
5) Seasonal Shutdown			
Drain/Clean Cold Water Sump	1	2	$ 150
Grease Fan/Motor bearings	1	2	$ 150
Final inspection	1	1	$ 75
		Total Cost w/o pads:	
		$	7,125



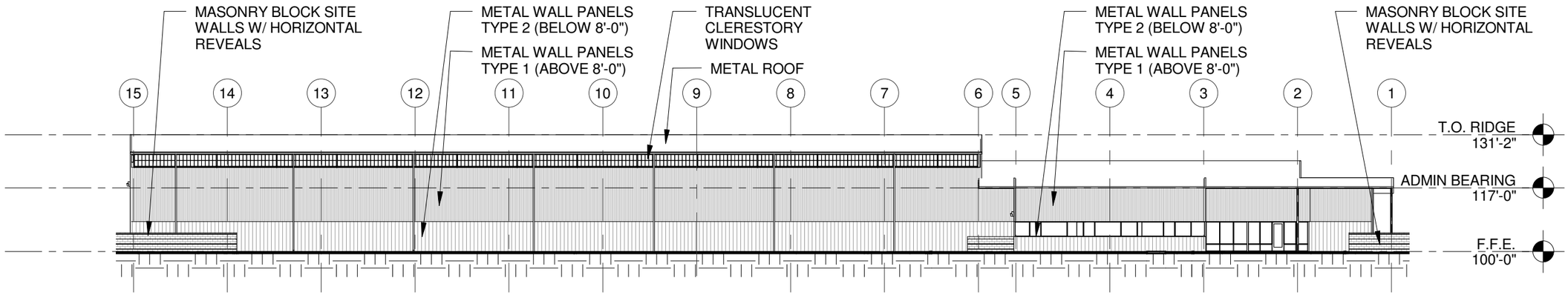
1 COMPREHENSIVE FLOOR PLAN

1" = 30'-0"

BUILDING MAX HEIGHT	31'-2"
GROSS FLOOR AREA	39,604 SF
OVERHANG	2,876 SF
TOTAL AREA:	42,480 SF

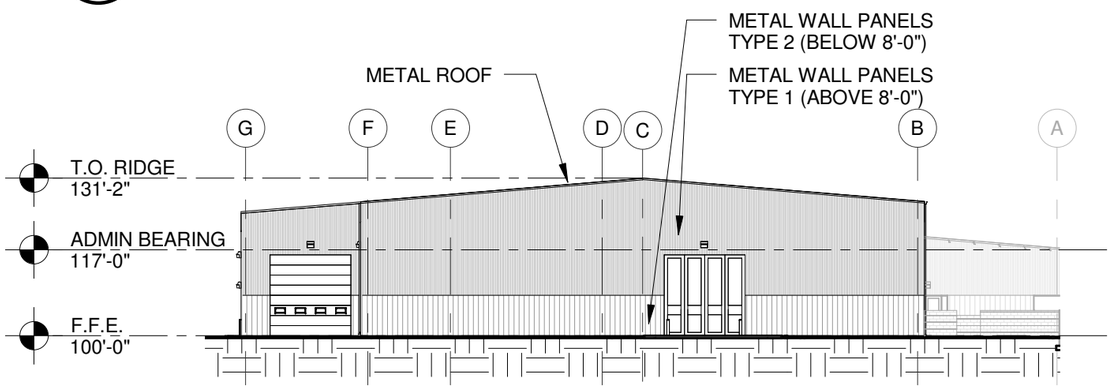
YUMA FLEET MAINTENANCE FACILITY

WSM ARCHITECTS



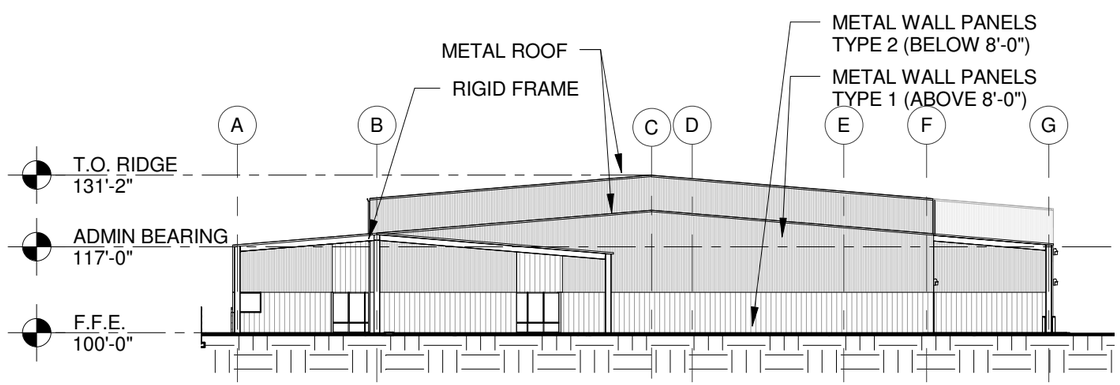
1 NORTH ELEVATION

1" = 30'-0"



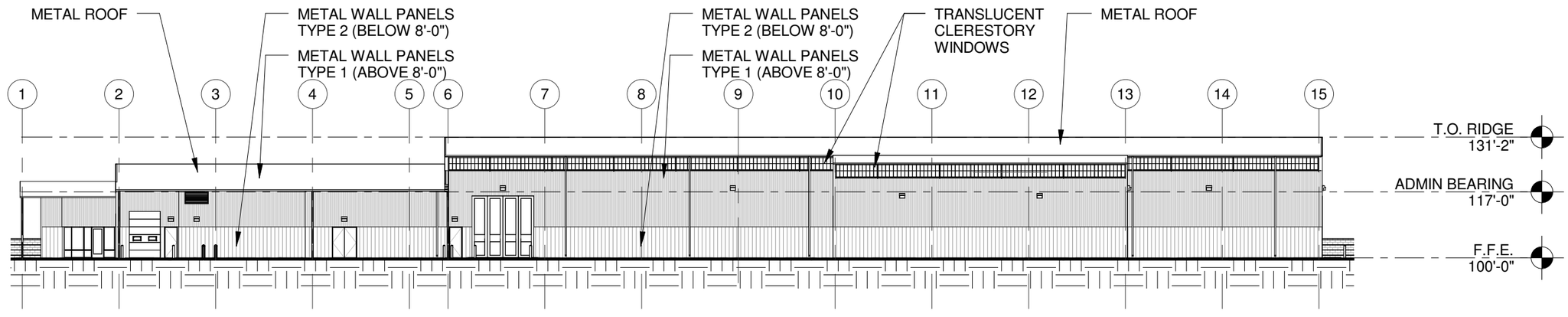
2 EAST ELEVATION

1" = 30'-0"



3 WEST ELEVATION

1" = 30'-0"

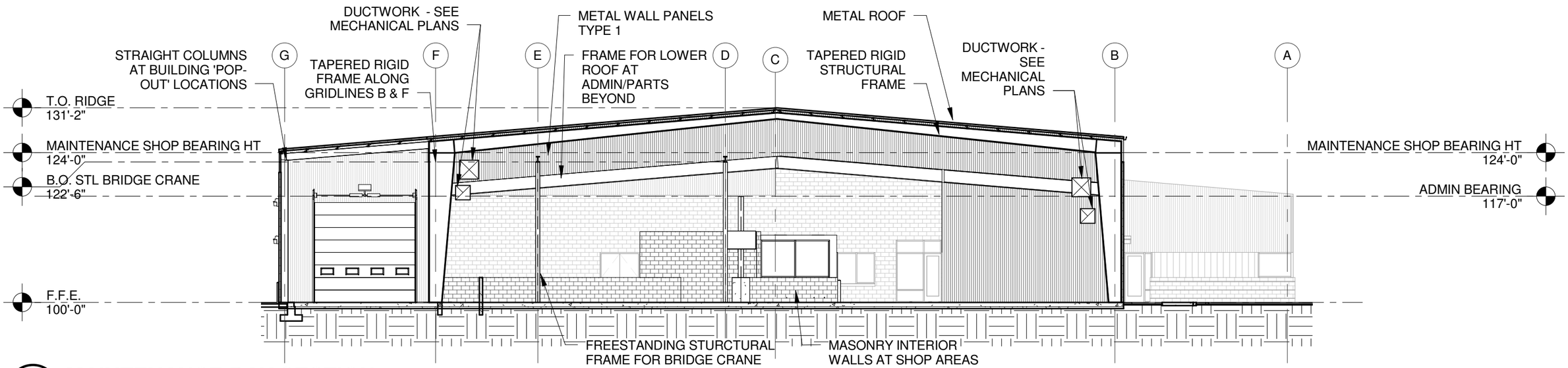


4 SOUTH ELEVATION

1" = 30'-0"

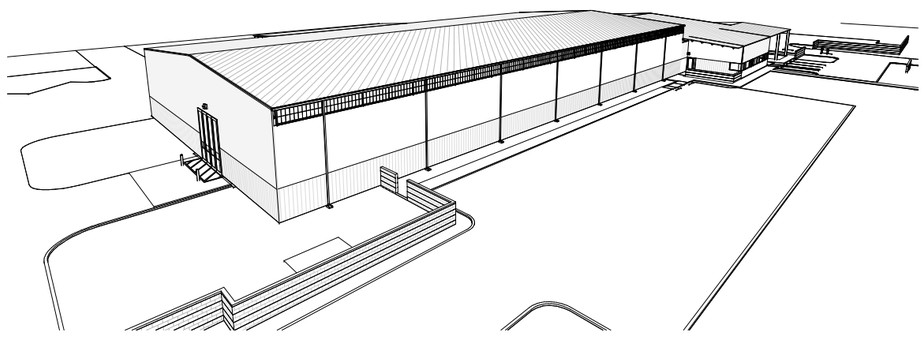
METAL BUILDING OPTION

WSM ARCHITECTS

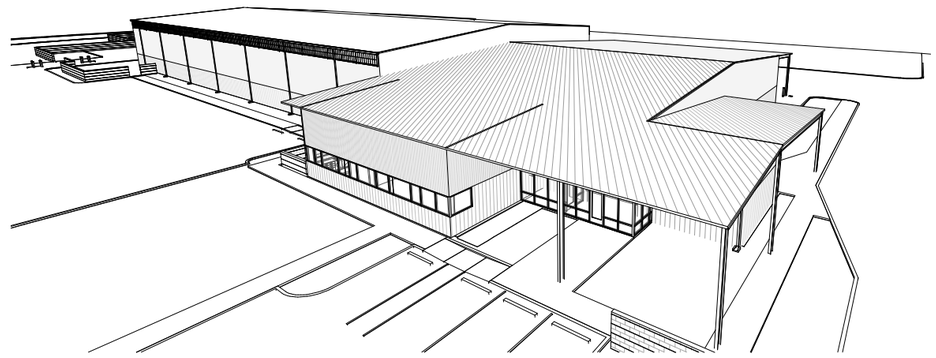


1 MAINTENANCE BAY SECTION

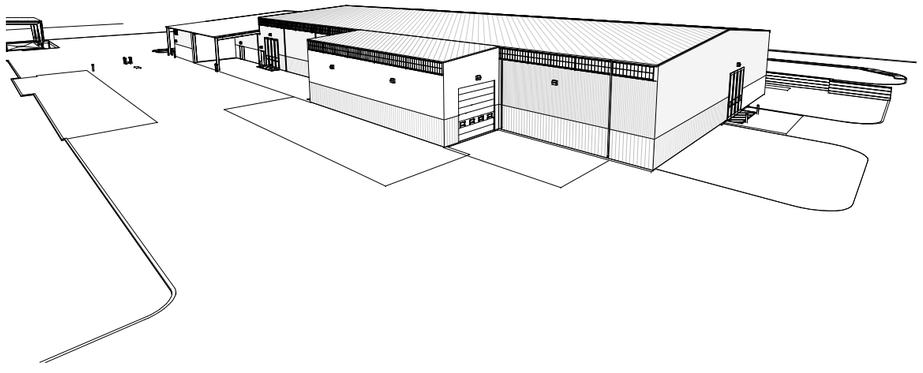
1/16" = 1'-0"



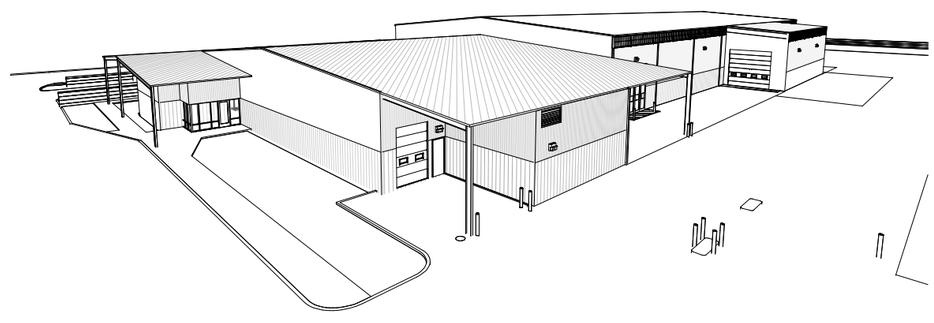
VIEW FROM NORTHEAST



VIEW FROM NORTHWEST



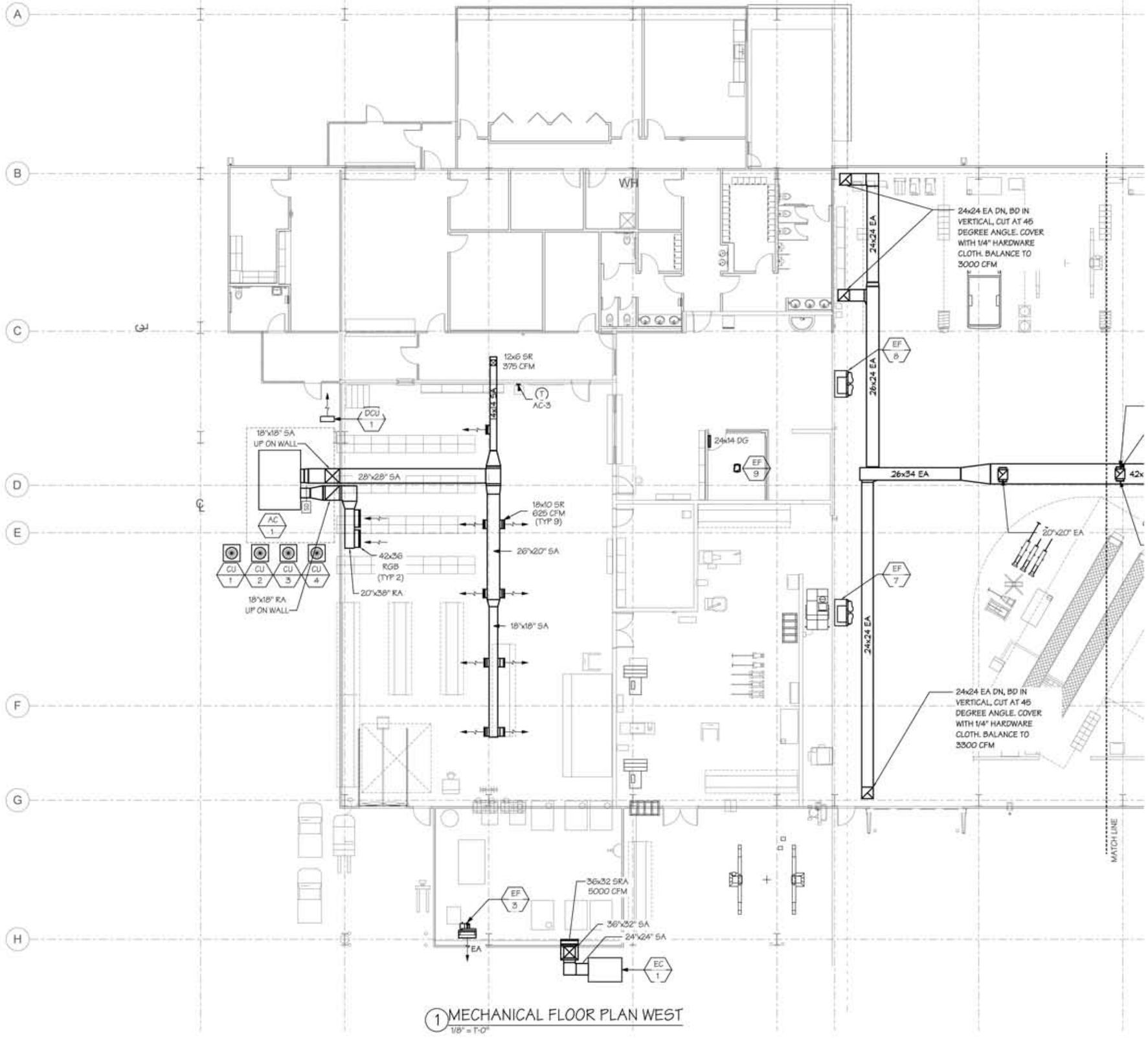
VIEW FROM SOUTHEAST



VIEW FROM SOUTHWEST

YUMA FLEET MAINTENANCE FACILITY

WSM ARCHITECTS



1 MECHANICAL FLOOR PLAN WEST
1/8" = 1'-0"

WSM
ARCHITECTS
4330 NORTH CAMPBELL AVE
SUITE NO 268
TUCSON, ARIZONA 85718
520.408.1044 TEL
520.408.1170 FAX
WSMARCH.COM WEB

thompson design architects pc
875 west 18th street
yuma, arizona 85364
tel(928)343-1694

PROJECT:

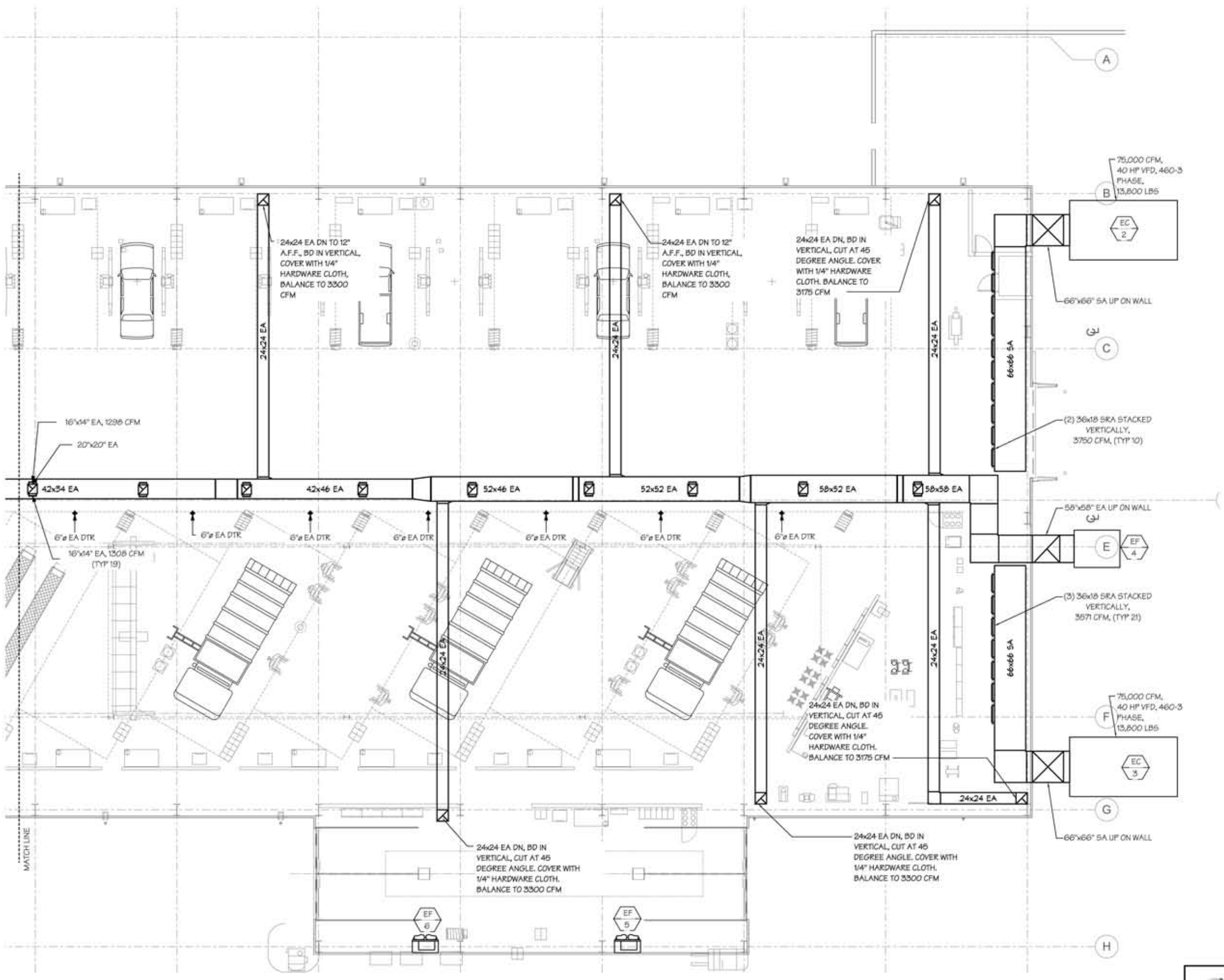
REVISIONS:
1 C.O.Y. COMMENTS 2/3/17
2 ADDENDUM #2 3/29/17

PROJECT NO.:
DRAWN: LAS
CHECKED:
DATE:
PLOT DATE:

SHEET TITLE:
MECHANICAL FLOOR PLAN WEST

SHEET NO.:
M100

PH
MECHANICAL ENGINEERING
PROJECT NO. 15241 P: (520) 731-2060
www.phmech.com F: (520) 731-2061



1 MECHANICAL FLOOR PLAN EAST
1/8" = 1'-0"

WSM ARCHITECTS
4330 NORTH CAMPBELL AVE
SUITE NO 268
TUCSON, ARIZONA 85718
520.408.1044 TEL
520.408.1170 FAX
WSMARCH.COM WEB

thompson design architects pc
575 west 18th street
yuma, arizona 85364
tel(928)343-1594

PROJECT:

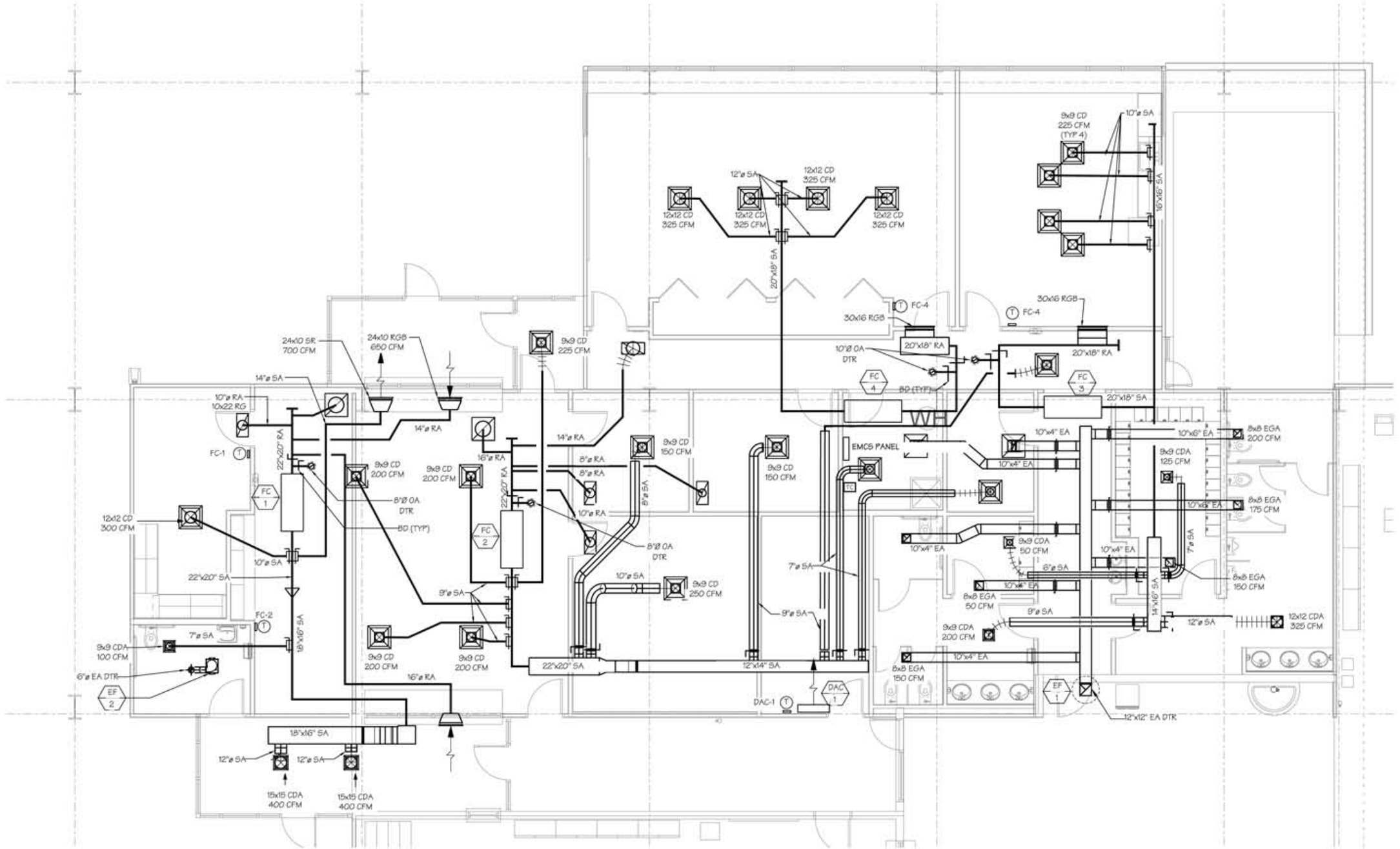
REVISIONS:
1 C.O.Y. COMMENTS 2/3/17
2 ADDENDUM #2 3/29/17

PROJECT NO.:
DRAWN: LAS
CHECKED:
DATE:
PLOT DATE:

SHEET TITLE:
MECHANICAL FLOOR PLAN EAST

SHEET NO.:
M100

PH MECHANICAL ENGINEERING
PROJECT NO. 15241 P: (520) 731-2060
www.phmech.com F: (520) 731-2061



1 MECHANICAL FLOOR PLAN-ENLARGED OFFICE AREA
1/8" = 1'-0"

WSM ARCHITECTS
4330 NORTH CAMPBELL AVE
SUITE NO 268
TUCSON, ARIZONA 85718
520.408.1044 TEL
520.408.1170 FAX
WSMARCH.COM WEB

thompson design architects pc
875 west 18th street
yuma, arizona 85364
tel(928)343-1094

PROJECT:

REVISIONS:
1 C.O.Y. COMMENTS 2/3/17
2 ADDENDUM #2 3/29/17

PROJECT NO.:
DRAWN: LAS
CHECKED:
DATE:
PLOT DATE:

SHEET TITLE:
MECHANICAL
ENLARGED
OFFICE AREA

SHEET NO.:
M102

PH MECHANICAL ENGINEERING
PROJECT NO. 15241 P: (520) 731-2060
www.phmech.com F: (520) 731-2061

EXHAUST FAN SCHEDULE

MARK	SERVES	MFGR AND MODEL	(1) TYPE	CFM	ESP IN WG	FAN RPM	MOTOR DATA				DISCONNECT	BACK DRAFT DAMPER	SONES	WEIGHT	REMARKS
							SPEED	WATTS	HP	ELECTRIC					
EF-1	RESTROOMS-LOCKERS	COOK 120 ACEB	ROOF MOUNTED	900	0.5	1669	1	--	1/4	115-1-60	YES	YES	7.3	75	3,4,5
EF-2	RESTROOM	COOK GC 148	CEILING MOUNTED	100	0.3	1075	1	42.0	--	115-1-60	YES	YES	2.5	25	2,4,5
EF-3	COMPRESSOR	COOK 30XMN	WALL MOUNTED	5000	0.3	717	1	--	3/4	115-1-60	YES	YES	17.0	175	2,4,6,7
EF-4	VEHICLE BAY	COOK CF SWSI	UTILITY SET, UPBLAST	55,000	0.5	956	1	--	75.8	460-3-60	YES	YES	-	5300	2,4,5
EF-5	VEHICLE BAY	COOK XLWH	WALL MOUNTED PROP FAN	25,000	0.5	582	1	--	7.5	460-3-60	YES	YES	38	715	2,4,5,7
EF-6	VEHICLE BAY	COOK XLWH	WALL MOUNTED PROP FAN	25,000	0.5	582	1	--	7.5	460-3-60	YES	YES	38	715	2,4,5,7
EF-7	VEHICLE BAY	COOK XLWH	WALL MOUNTED PROP FAN	25,000	0.5	582	1	--	7.5	460-3-60	YES	YES	38	715	2,4,5,7
EF-8	VEHICLE BAY	COOK XLWH	WALL MOUNTED PROP FAN	25,000	0.5	582	1	--	7.5	460-3-60	YES	YES	38	715	2,4,5,7
EF-9	OFFICE	COOK GC 542	CEILING MOUNTED	300	0.3	1600	1	121	--	115-1-60	YES	YES	5.5	30	5

1. BASIS OF DESIGN.
2. PROVIDE MANUFACTURER'S HANGING ISOLATION KIT, ALUMINUM GRILLE.
3. PROVIDE MANUFACTURER'S ROOF CURB AND DISCONNECT.
4. INTERLOCKING, WIRING, & CONDUIT PER ELECTRICAL DIVISION SPECIFICATIONS. PROVIDE INTERLOCK RELAYS & CONTACTS PER ELECTRICAL DRAWINGS.
5. INTERLOCK WITH TIME CLOCK. FAN TO OPERATE DURING OCCUPIED HOURS.
6. INTERLOCK WITH EC-1.
7. PROVIDE MANUFACTURER'S WIRE GUARD, BAROMETRIC BACKDRAFT DAMPER, AND DISCONNECT SWITCH.

EVAPORATIVE COOLER SCHEDULE

MARK	SERVES	MFGR	MODEL	DISCHARGE	CFM	ESP.	SPEED	HP	ELECTRIC	OPERATING WEIGHT	DIMS LxWxH	REMARKS
EC-1	COMPRESSOR ROOM	AEROCOOL	15500	SIDE	5000	0.5	1	3/4	115-1-60	575	70x50x52	1,2,3,4,5
EC-1	VEHICLE BAY	MESSCO	CUSTOM	SIDE	15,000		VFD	40	460-3-60	1,800	126x228x122	1,2,4,6
EC-1	VEHICLE BAY	MESSCO	CUSTOM	SIDE	15,000		VFD	40	460-3-60	1,800	126x228x122	1,2,4,6

1. UNIT COMPLETE WITH MEDIA PADS & 115 VOLT CLEAN MACHINE PUMP.
2. PROVIDE BELTS AND SHEAVES AS REQUIRED TO BALANCE TO CFM SHOWN.
3. PROVIDE FOUR POSITION WALL SWITCH.
4. INTERLOCKING WIRING & CONDUIT PER DIVISION 16 SPECIFICATIONS.
5. SEE EXHAUST FAN SCHEDULE FOR INTERLOCKING.
6. PROVIDE CONTROL PANEL.

REFRIGERANT PIPING NOTES:

A. REFRIGERANT LINE SIZES AND CONNECTIONS PER MFR'S RECOMMENDATIONS. MECHANICAL CONTRACTOR TO FIELD ROUTE REFRIGERANT LINES PER MFR'S RECOMMENDATIONS. (TYPICAL FOR ALL UNITS.)
B. ALL REFRIGERANT PIPING SHALL BE INSULATED. ALL EXPOSED PIPING SHALL BE PROVIDED WITH AN ALUMINUM JACKET.
C. REFRIGERANT LINES EXCEEDING MANUFACTURER'S MAXIMUM LENGTH AND VERTICAL DIFFERENTIAL SHALL COMPLY WITH MANUFACTURER'S LONG-LINE APPLICATION GUIDELINES.

PACKAGE ROOFTOP AIR CONDITIONING UNIT SCHEDULE

MARK	NOM TONS	MFGR	MODEL	DISCH	CFM	(1) OA	ESP	COOLING CAPACITY AT CONDITIONS (110/80/66)			(2) HEATING CAPACITY		ELECTRICAL DATA				MFG'S CURB HEIGHT	FILTERS	UNIT WEIGHT	DIMENSIONS HxLxW	REMARKS
								TOTAL MBH	SENS MBH	IEER	TYPE	TOTAL INPUT MBH	ELECTRICAL	MAX HP	MCA	MOCP					
AC-1	15	TRANE	GAC-180	SIDE	6000	SEE OA SCHED	0.5	161.3	125.3	12.8	GAS	240/192	208/3/60	3	79	100	14"	2" PLEATED	1864	80x124x87	3,4,5,6,7,8

1. SET MINIMUM O.A. DAMPER STOP TO MINIMUM O.A. REQUIREMENT.
2. HEATING CAPACITY AT STANDARD CONDITIONS.
3. SET THE SUPPLY FAN ON DURING OCCUPIED HOURS THROUGH THE PROGRAMMABLE THERMOSTAT.
4. PROVIDE LOCKING 7-DAY PROGRAMMABLE THERMOSTAT. T'STAT SHALL HAVE MIN. 5° SET POINT OVERLAP RESTRICTION; AND OFF-HOUR CONTROLS CAPABLE OF AUTOMATIC STARTUP, AUTOMATIC SETBACK & SHUTDOWN, AND 2 HOUR OVERRIDE. THERMOSTAT SHALL COMPLY WITH THE 2012 IECC SECTIONS C403.2.4.1, C403.2.4.2 & C403.2.4.3.
5. PROVIDE MEDIUM STATIC, BELT DRIVE MOTOR.
6. PROVIDE FACTORY INSTALLED ECONOMIZER WITH A DRY BULB SENSOR AND BAROMETRIC RELIEF DAMPER CAPABLE OF RELIEVING UP TO 100% RETURN AIR.
7. ELECTRICAL CONTRACTOR TO PROVIDE AND WIRE SMOKE DETECTOR, MECHANICAL CONTRACTOR TO INSTALL IN DUCTWORK.
8. PROVIDE SEISMIC ROOF CURB.

HEAT PUMP SPLIT SYSTEM SCHEDULE

INDOOR FAN COIL UNIT																	OUTDOOR UNIT								
						COOLING CAPACITY AT (104/75/67)			HEATING CAPACITY @ 65° EDB 27° OA		ELECTRICAL DATA									ELECTRICAL					
MARK	MFGR AND MODEL	DISCH	CFM	MIN OA CFM	ESP "WG	TOTAL MBH	SENS MBH	SEER	MBH	ELEC HEAT KW	HSPF	ELECTRICAL	MAX HP	MCA	MOCP	DIMENSIONS LxWxH	LBS	MARK	NOM TONS	MFG AND MODEL	V/PH/HZ	MCA	MOCP	DIMS	LBS	REMARKS
FC-1	CARRIER FV4CNB006	HORIZ	2000	(6)	0.5	52.2	41.6	16.0	43.3	NA	9.0	208/1/60	3/4	8.5	15	60x23x25	225	CU-1	5	CARRIER 25HCB660	208-1-60	37.5	60	35x35x45	350	1,2,3,4,5,7
FC-2	CARRIER FV4CNB006	HORIZ	2000	(6)	0.5	52.2	41.6	16.0	43.3	NA	9.0	208/1/60	3/4	8.5	15	60x23x25	225	CU-2	5	CARRIER 25HCB660	208-1-60	37.5	60	35x35x45	350	1,2,3,4,5,7
FC-3	CARRIER FV4CNB005	HORIZ	1600	(6)	0.5	44.8	34.6	16.0	47.4	NA	9.0	208/1/60	1/2	5.4	15	54x23x22	200	CU-3	4	CARRIER 25HCB648	208-1-60	29.8	50	35x35x40	300	1,2,3,4,5,7
FC-4	CARRIER FV4CNB005	HORIZ	1600	(6)	0.5	44.8	34.6	16.0	47.4	NA	9.0	208/1/60	1/2	5.4	15	54x23x22	200	CU-4	4	CARRIER 25HCB648	208-1-60	29.8	50	35x35x40	300	1,2,3,4,5,7

1. ELECTRICAL CONTRACTOR TO PROVIDE SEPARATE POWER POINT CONNECTIONS TO FAN COIL UNIT AND OUTDOOR UNIT.
2. PROVIDE ALL FEATURES STANDARD TO THE UNIT SCHEDULED.
3. PROVIDE LOW VOLTAGE CONTROL POWER TRANSFORMER, FAN RELAY, LIQUID LINE FILTER DRYER, AND ANTI-CYCLING CONTROL TO PREVENT RAPID COMPRESSOR CYCLING.
4. PROVIDE LOCKING 7-DAY PROGRAMMABLE, AUTOMATIC CHANGEOVER, HEAT PUMP THERMOSTAT. T'STAT SHALL HAVE SUPPLEMENTARY HEAT CONTROL (IF REQUIRED); MIN. 5° SET POINT OVERLAP RESTRICTION; AND OFF-HOUR CONTROLS CAPABLE OF AUTOMATIC STARTUP, AUTOMATIC SETBACK & SHUTDOWN, AND 2 HOUR OVERRIDE. THERMOSTAT SHALL COMPLY WITH THE 2012 IECC SECTIONS C403.2.4.1, C403.2.4.2 & C403.2.4.3.
5. SET THE SUPPLY FAN ON DURING OCCUPIED HOURS THROUGH THE PROGRAMMABLE THERMOSTAT.
6. SET MINIMUM OUTSIDE AIR DAMPER STOP TO THE MINIMUM OUTSIDE AIR REQUIREMENT. SEE OA SCHEDULE FOR AMOUNT.
7. FAN COIL SHALL HAVE FACTORY INSTALLED SINGLE POINT POWER CONNECTION.

DUCTLESS COOLING ONLY SPLIT SYSTEM SCHEDULE

INDOOR UNIT (FAN COIL)										OUTDOOR UNIT (HEAT PUMP)									
MARK	SERVES	MFGR/ MODEL	NOM TONS	DISCHARGE/ TYPE	CFM-HIGH/MED/LOW	COOLING CAP. MBH	ELECTRICAL	LxWxH (IN)	LBS	MARK	MFGR/ MODEL	SEER	ELECTRICAL	MCA	MFA	FLA	LxWxH (IN)	LBS	REMARKS
DAC-1	MDF	SANYO KSI27I	1	WALL MOUNTED	212/259/294	11.9	115/1/60	33x8x12	20	DCU-1	SANYO C12TI	17	115/1/60	10.9	20	0.35	29x11x22	100	1,2,3,4,5,6,7,8,9
DAC-2	DATA	SANYO KSI27I	1	WALL MOUNTED	212/259/294	11.9	115/1/60	33x8x12	20	DCU-2	SANYO C12TI	17	115/1/60	10.9	20	0.35	29x11x22	100	1,2,3,4,5,6,7,8,9

1. BASIS OF DESIGN OR EQUAL.
2. PROVIDE LOW AMBIENT CONTROL TO 0° F.
3. PROVIDE WALL MOUNTING KIT.
4. PROVIDE 24V WIRED WALL CONTROLLER (THERMOSTAT) W/ ADAPTER AS REQUIRED.
5. PROVIDE INTEGRAL FACTORY CONDENSATE PUMP, SEE PLUMBING PLANS FOR CONDENSATE ROUTING AND TERMINATION.
6. PROVIDE ALL FEATURES STANDARD TO THE UNIT SCHEDULED.
7. INSULATE BOTH GAS AND LIQUID LINES W/ ARMIFLEX PIPE INSULATION.
8. ELECTRICAL CONTRACTOR TO SINGLE POWER POINT CONNECTION TO OUTDOOR UNIT. INDOOR UNIT TO BE SUB-FED BY OUTDOOR UNIT.
9. UNIT SHALL BE SET FOR 24/7 COOLING.

WSM ARCHITECTS
4330 NORTH CAMPBELL AVE
SUITE NO 268
TUCSON, ARIZONA 85718
520.408.1044 TEL
520.408.1170 FAX
WSMARCH.COM WEB

thompson design architects pc
875 west 18th street
yuma, arizona 85364
tel(928)343-1094

PROJECT:

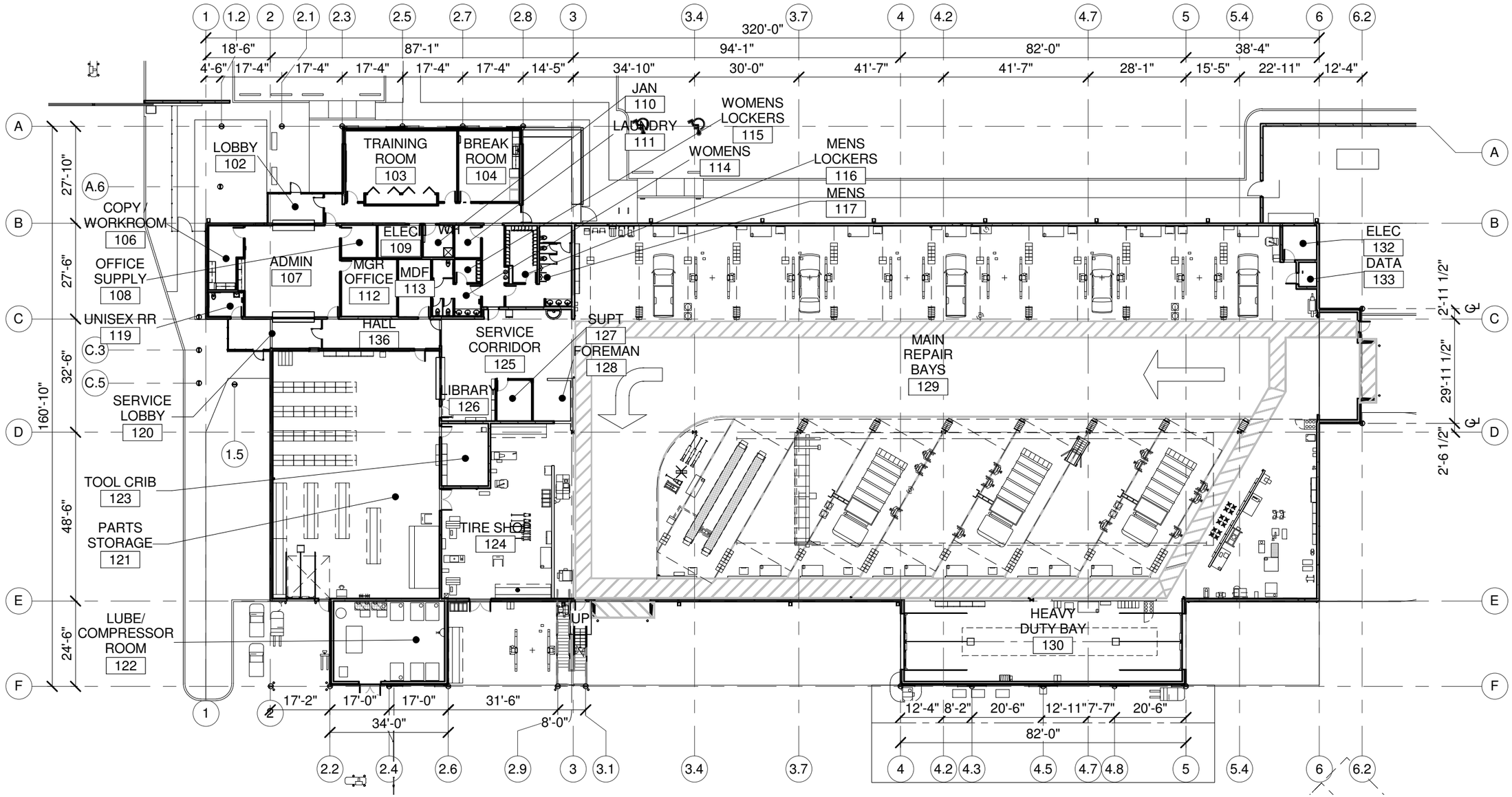
REVISIONS:
1. C.O.Y. COMMENTS 2/3/17
2. ADDENDUM #2 3/29/17

PROJECT NO.:
DRAWN: LAS
CHECKED:
DATE:
PLOT DATE:

SHEET TITLE:
MECHANICAL SCHEDULES

SHEET NO.:
M3.0

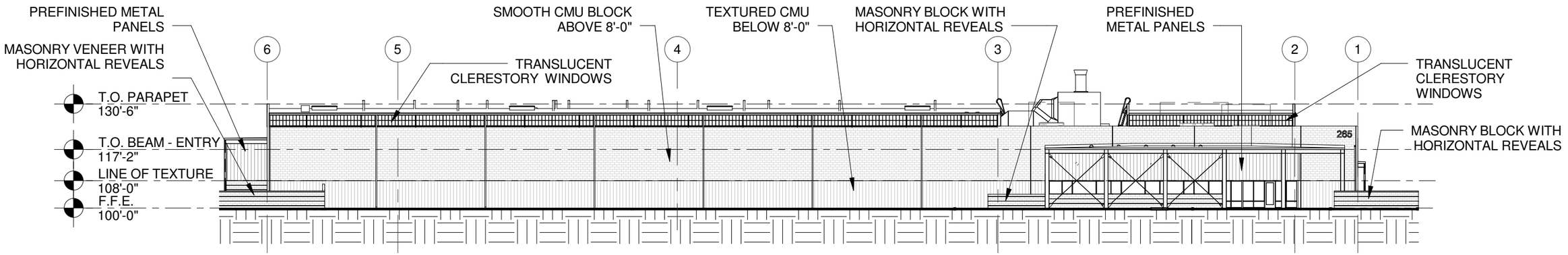
PH MECHANICAL ENGINEERING
PROJECT NO. 15241 P: (520) 731-2060
www.phmech.com F: (520) 731-2061



BUILDING MAX HEIGHT	30'-6"
GROSS FLOOR AREA	38,236 SF
OVERHANG	2,397 SF
TOTAL AREA:	40,633 SF

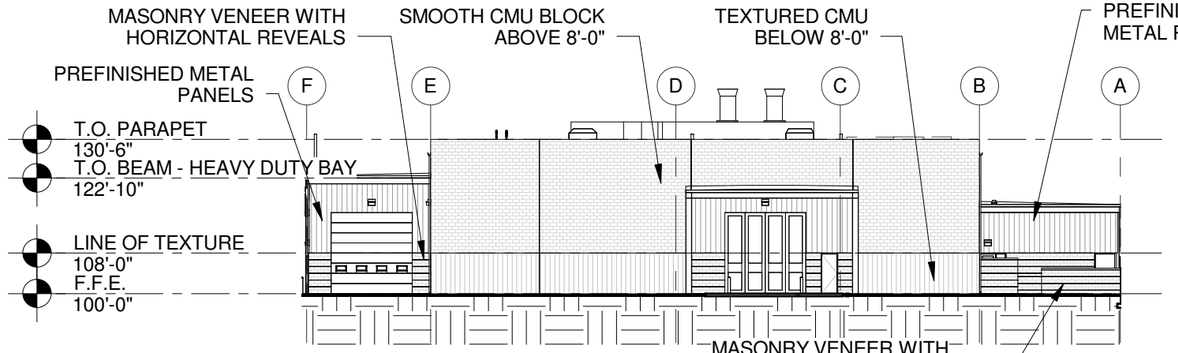
MASONRY OPTION

WSM ARCHITECTS



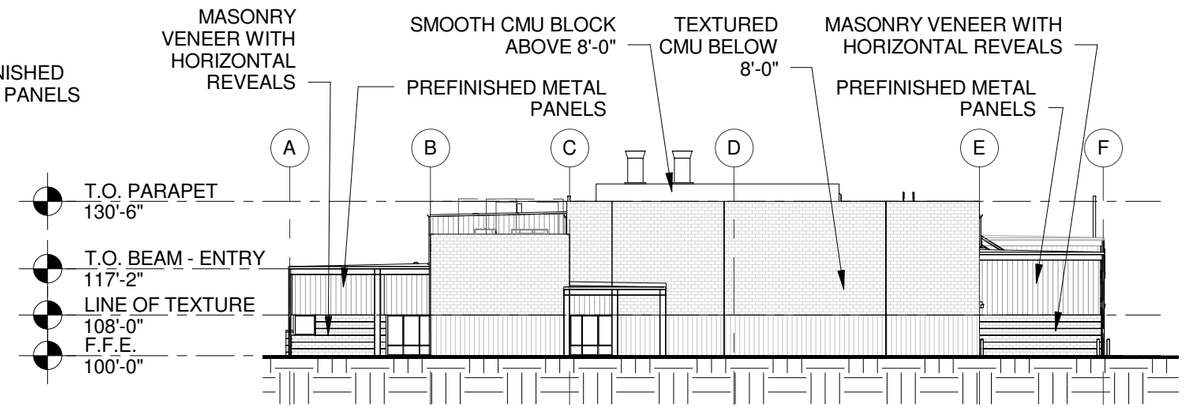
1 NORTH ELEVATION

1" = 30'-0"



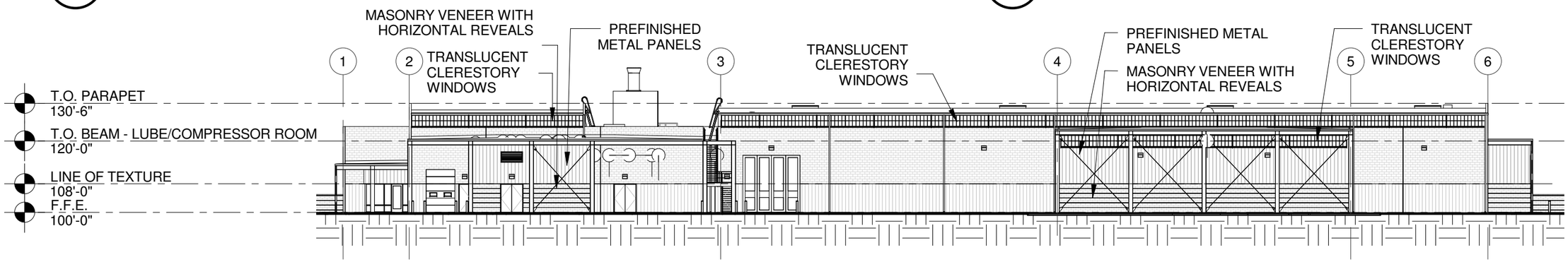
2 EAST ELEVATION

1" = 30'-0"



3 WEST ELEVATION

1" = 30'-0"



4 SOUTH ELEVATION

1" = 30'-0"

MASONRY OPTION

WSM ARCHITECTS