Modular Construction at Los Alamos National Laboratory

Presented by Karen Marsh, LANL Project Engineer

June 8, 2023

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Introduction

Presenter: Karen Marsh, LANL Architect and Project Engineer since 2010

- Represented LANL on the CMRR Nuclear Facility and provided architectural expertise and project engineering for nuclear and non-nuclear projects at LANL

- Started working modular projects at LANL in 2017

What is Modular Construction?

- "Modular construction is the process in which buildings are constructed off site, under controlled plant conditions, using the same materials and designing to the same codes and standards as conventionally built facilities…."
  - *Modular Building Institute*

- Buildings are typically constructed with a collection of modules or boxes that when put together on site, reflect the design and intent of the project.

- Modules may be five- or six-sided boxes that are trucked from the factory to the site and placed on the site-built foundation with a crane.

Why Modular Construction at LANL?

- LANL is located in an area of New Mexico that is far enough away from dense population making construction resources not readily available.

- Modular construction was employed to save time and money:
  - Reduce cost
    - Fewer onsite inspections
    - Reduced need for local construction subcontractors
  - Time Saving
    - Modular Construction normally saves onsite construction time

Benefits of Modular Construction

- Enhances quality control due to the controlled manufacturing environment.
- Reduces onsite construction time: typically, the work in the factory begins at the same time that the onsite foundation work and utilities begin.
- Accommodates single or multi-story structures, typically one to three stories but projects should not be limited to this.
- Environmentally sustainable
  - Reduces waste
  - Reduction in onsite weather-related damage
  - Future building demolition and repurposing, when planned properly

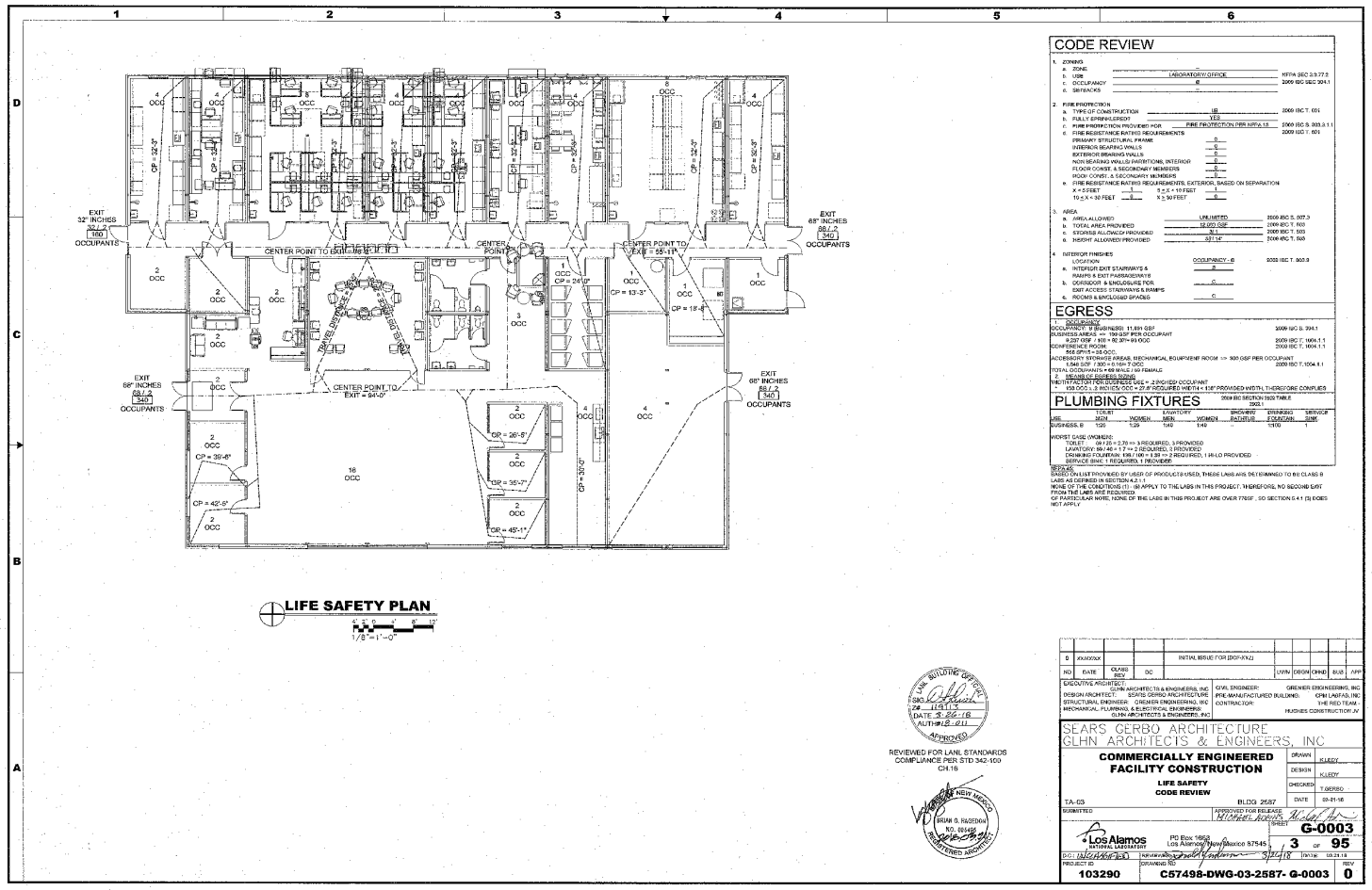
LANL Modular Project
TA03-2587 BSL-2 Laboratory

- SUBCONTRACTOR: The Red Team with Fabricator Silvercreek

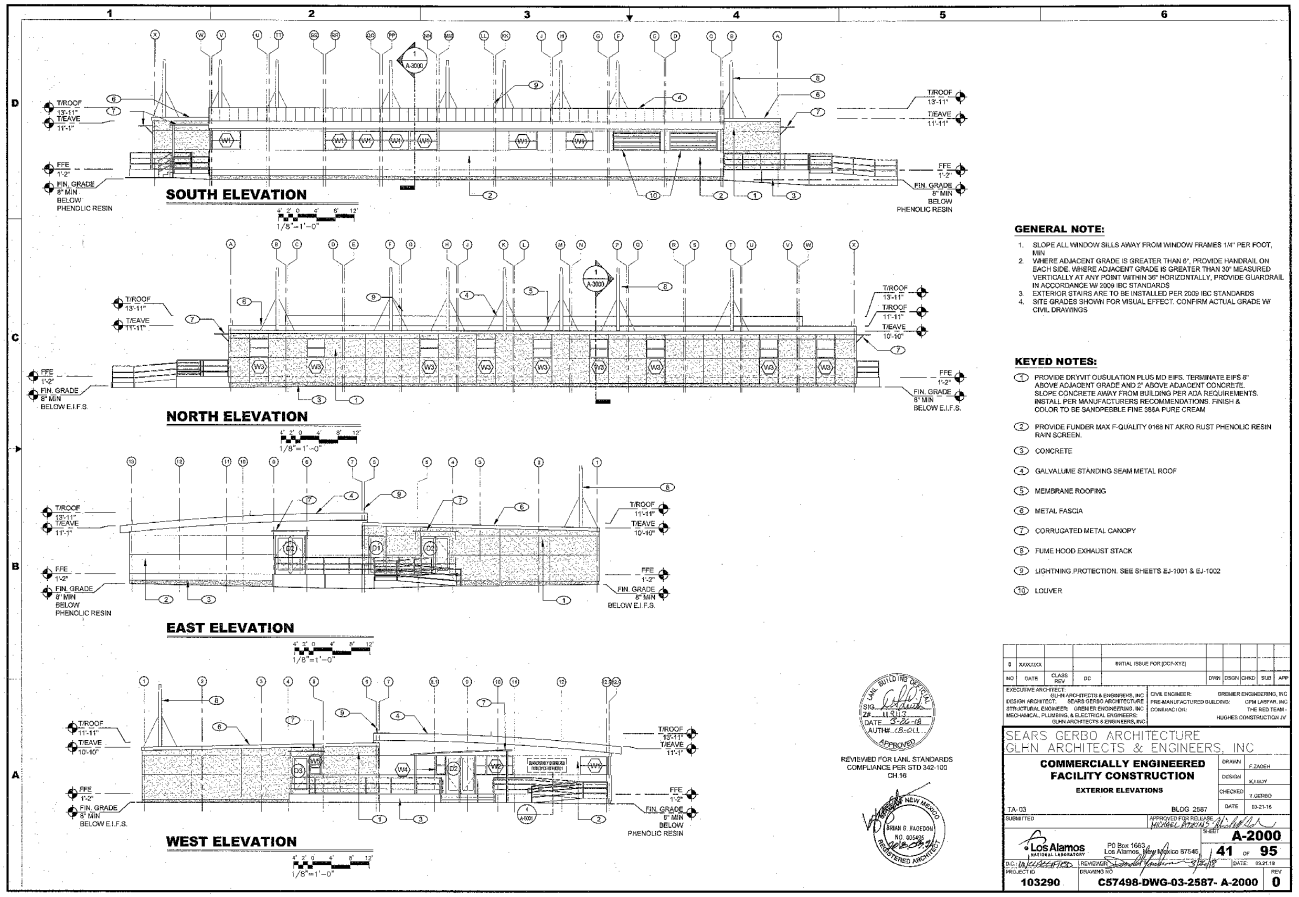
- SUBCONTRACTOR COST:
  - TOTAL $7,255,509 / 12,083 gross sq. ft. = $600 per sq. ft. (Not including LANL internal cost)

- SCHEDULE:
  - BSL-2 Laboratory bid the RFP in 2017
  - Design complete in March of 2018
  - Construction complete in February of 2021

LANL Modular Projects
TA03-2587 BSL-2 Laboratory – Floor Plan



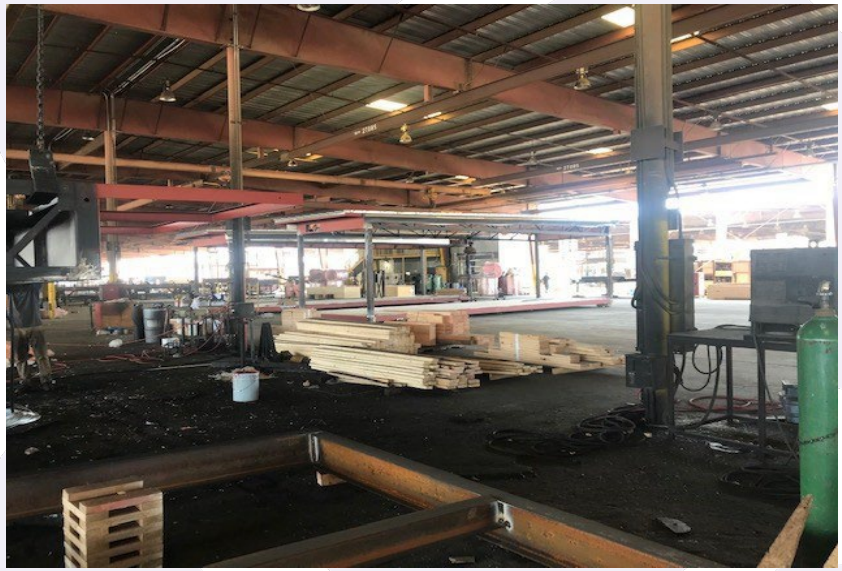
LANL Modular Projects
TA03-2587 BSL-2 Laboratory – Exterior Elevations



LANL Modular Project
TA03-2587 BSL-2 Laboratory

Six–sided modules at the factory

Silver Creek Industries, LLC – Perris, CA



TA03-2587 BSL-2 Laboratory

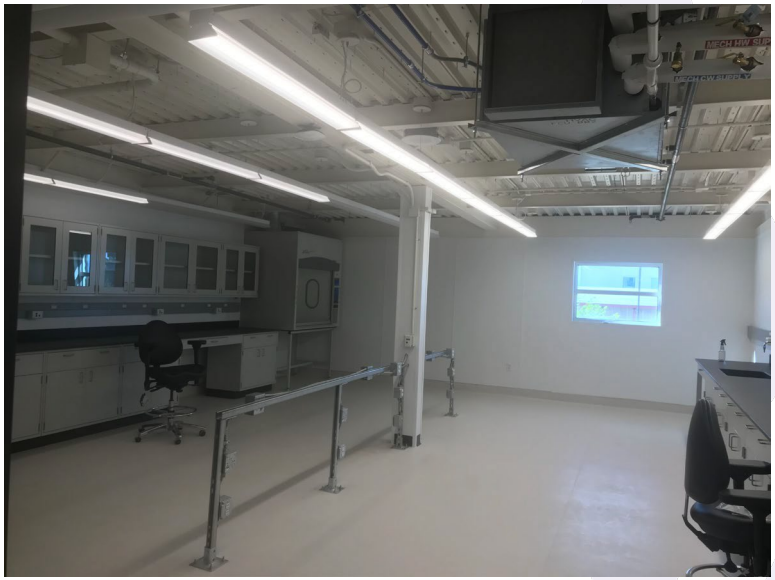
Crane placing modules over the crawl space and foundation

LANL Modular Project
TA03-2587 BSL-2 Laboratory

Building Exterior

TA03-2587 BSL-2 Laboratory

Double Wide Laboratory and Office Area Interior



LANL Modular Project
TA03-2618 SCIF Office Building

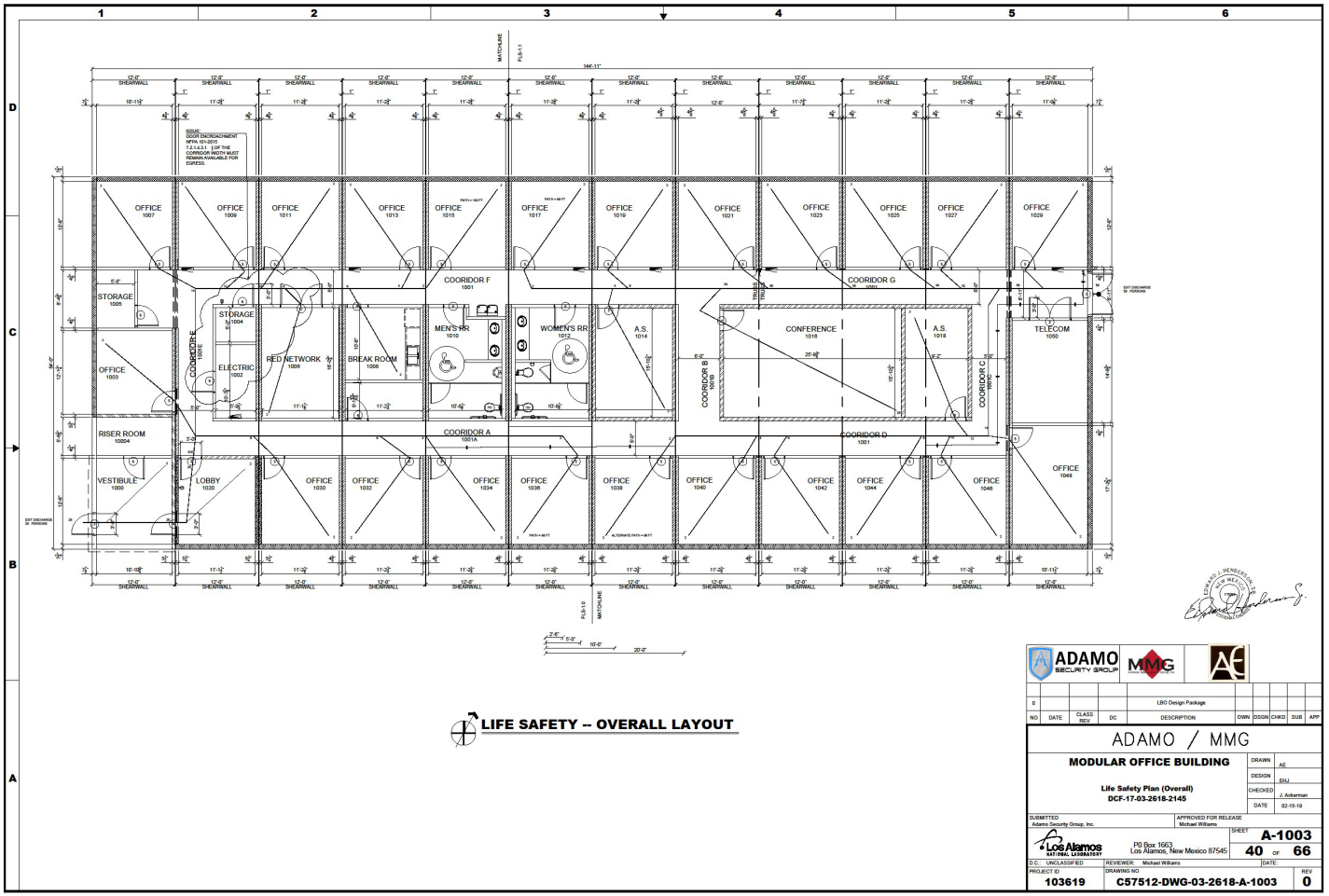
- SUBCONTRACTOR: Adamo with Fabricator Phoenix Modular (PMI)

- SUBCONTRACTOR COST
  - TOTAL $7,800,000 / 7,825 gross sq. ft. = $ 881 per sq. ft. (Not including LANL internal costs)

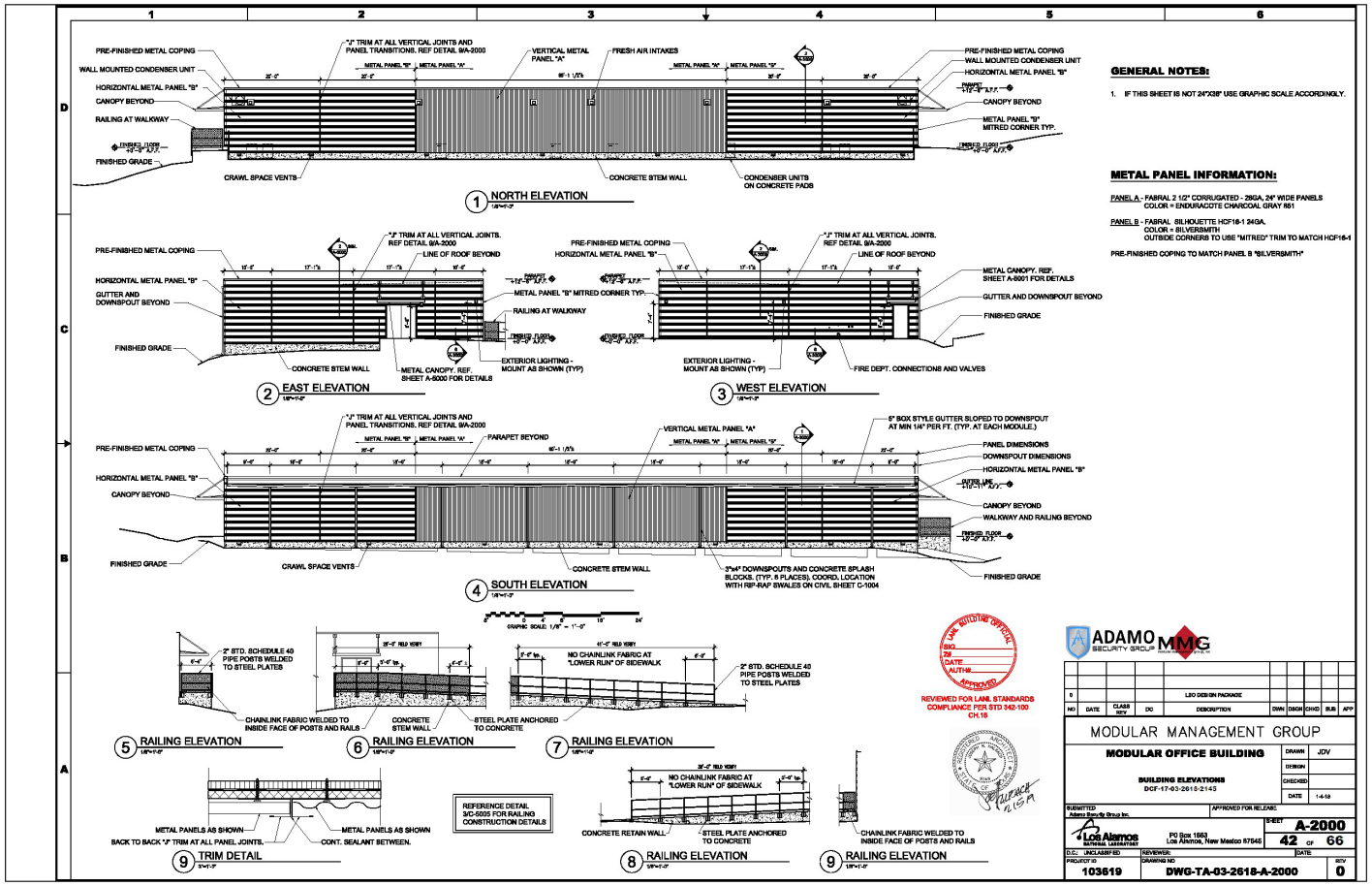
- SCHEDULE
  - SCIF bid the RFP in 2018
  - Design complete in 2019
  - Construction complete in 2020

- PROJECT DESCRIPTION
  - A new secure office building. Part of the project requirements were accreditation of the SCIF.

LANL Modular Project
TA03-2618 SCIF Office Building



LANL Modular Project
TA03-2618 SCIF Office Building



LANL Modular Projects
TA03-2618 SCIF Office Building

The modules are six-sided boxes placed over a crawl space. In this project, the crawl space has a vapor barrier instead of a concrete floor.

LANL Modular Project
TA03-2618 SCIF Office Building

Placing the modules after removing the wheels from the module base

LANL Modular Projects
TA03-2618 SCIF Office Building

The modules are six-sided boxes placed over a crawl space. In this project, the crawl space has a vapor barrier instead of a concrete floor.

LANL Modular Project
TA03-2634 Multi-Use Office Building

- SUBCONTRACTOR: Ramtech Building Systems

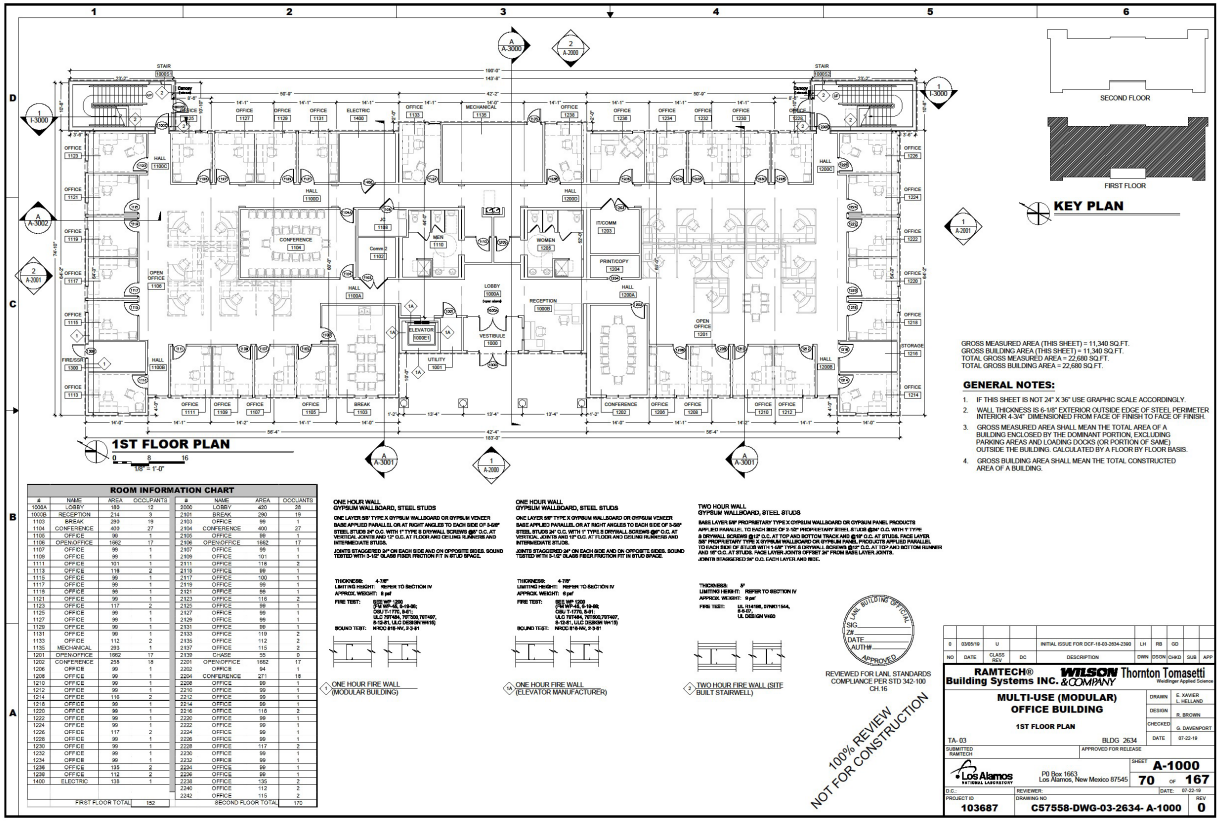
- SUBCONTRACTOR COST
  - TOTAL $13,500,000 / 22,640 gross sq. ft. = $596 per sq. ft. (Not including LANL internal costs)

- SCHEDULE
  - LANL bid the RFP in 2018
  - Design complete in 2019
  - Construction complete in 2022

- PROJECT DESCRIPTION
  - A new two-story office building located within a limited area at LANL

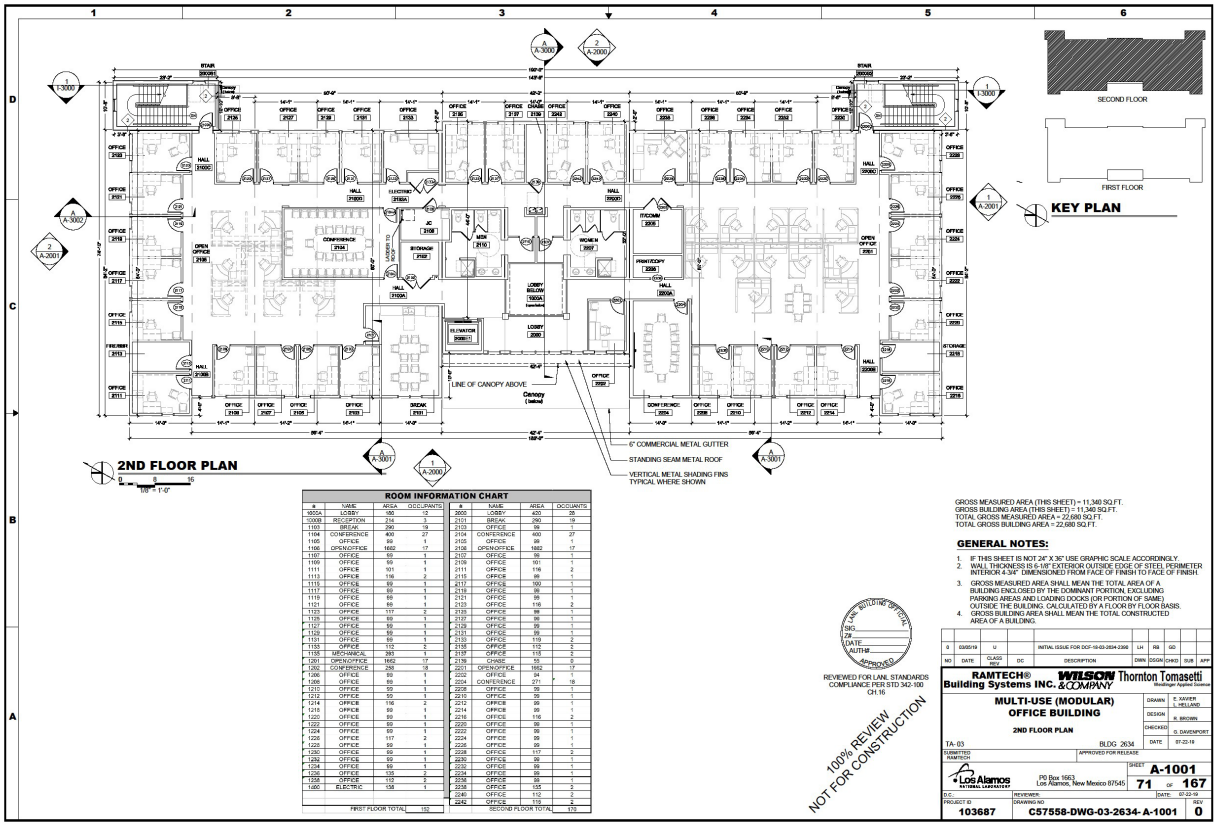
TA03-2634 Multi-Use Office Building

FIRST FLOOR PLAN



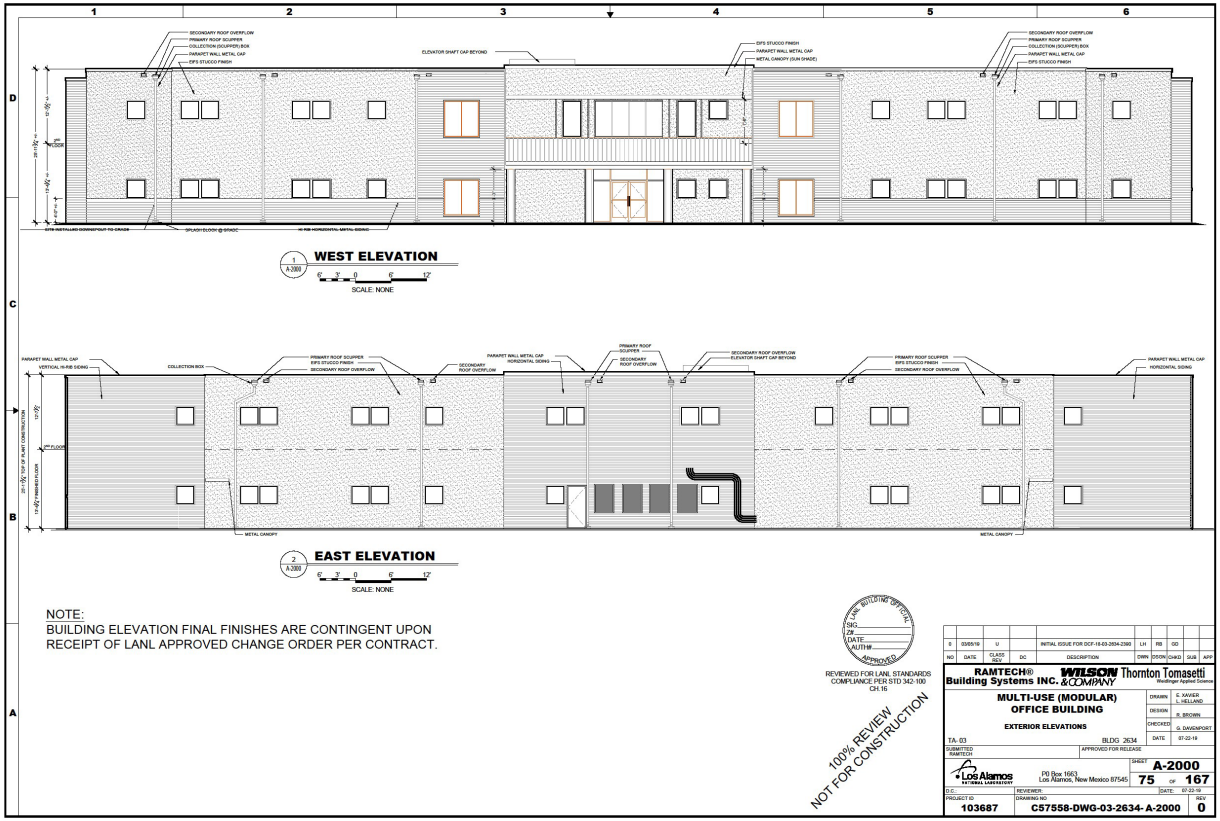
TA03-2634 Multi-Use Office Building

SECOND FLOOR PLAN



TA03-2634 Multi-Use Office Building

EXTERIOR ELEVATIONS



TA03-2634 Multi-Use Office Building

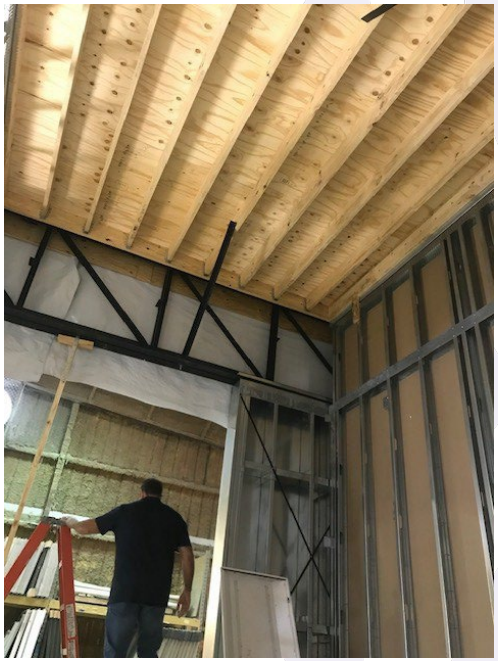
Inside the factory at Ramtech Building Systems where the modules are in fabrication

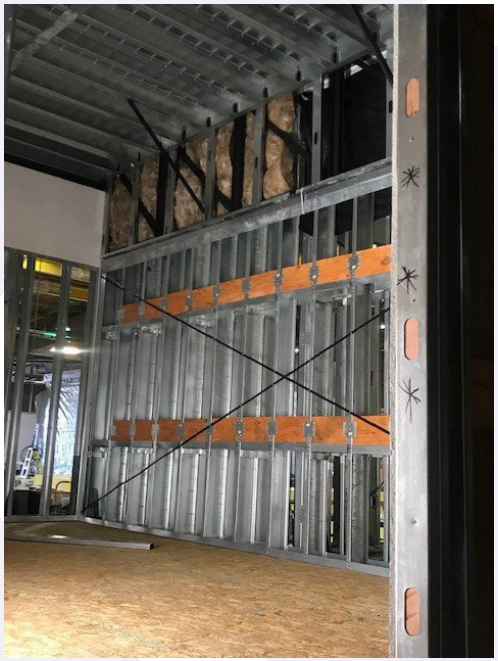
TA03-2634 Multi-Use Office Building

The modules are wrapped inside the factory and ready to be trucked to the project site. Ramtech's yard with modules waiting to ship seen below.

TA03-2634 Multi-Use Office Building

The atrium in construction with temporary wood floor still in place



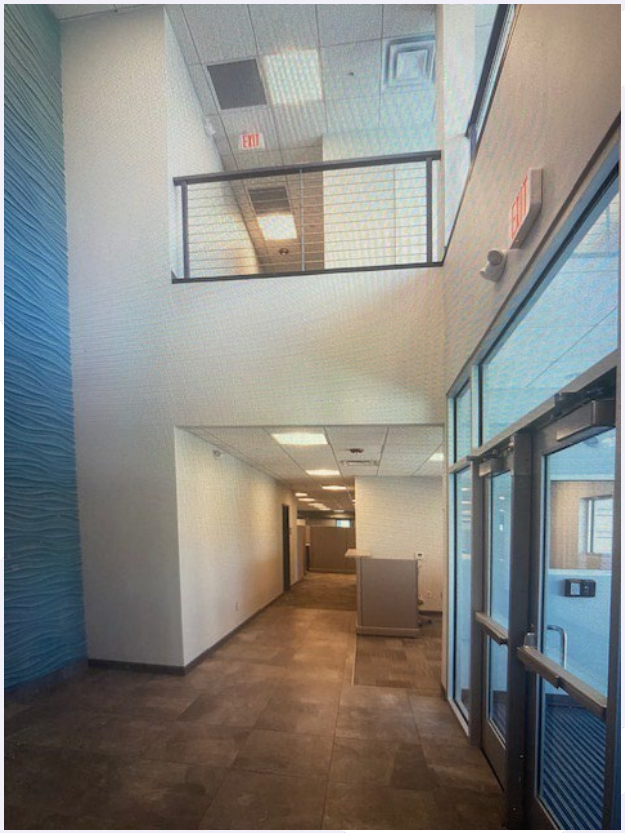


TA03-2634 Multi-Use Office Building

Finished Building Exterior

TA03-2634 Multi-Use Office Building

The Finished Atrium



LANL Modular Projects
TA35-0637 Office Building

- SUBCONTRACTOR: Ramtech Building Systems

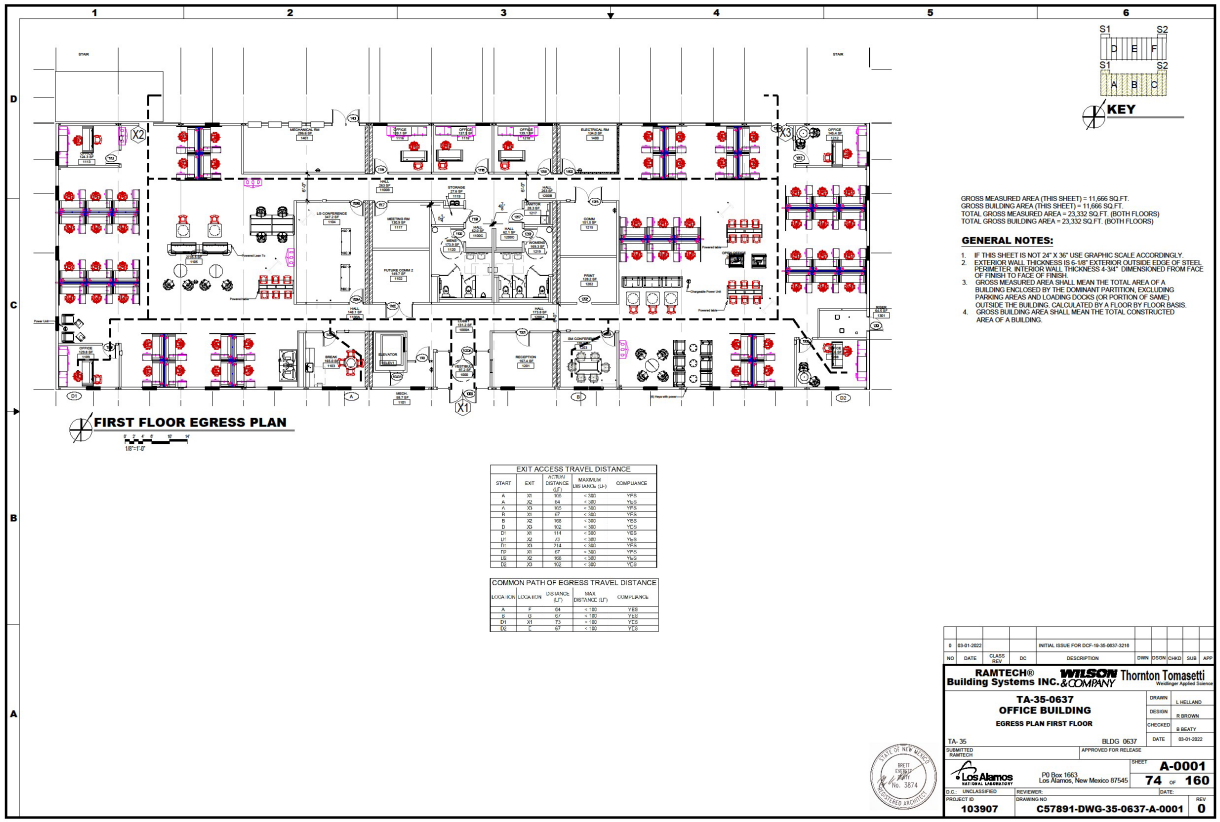
- SUBCONTRACTOR COST:
  - TOTAL $14,900,000 / 23,332 gross sq. ft. = $638 per sq. ft. (Not including LANL internal costs)

- SCHEDULE
  - LANL bid the RFP in 2021
  - Design complete in March of 2022
  - Under construction, scheduled for completion in September of 2023

- PROJECT DESCRIPTION
  - A new two-story office building located within a secure area at LANL

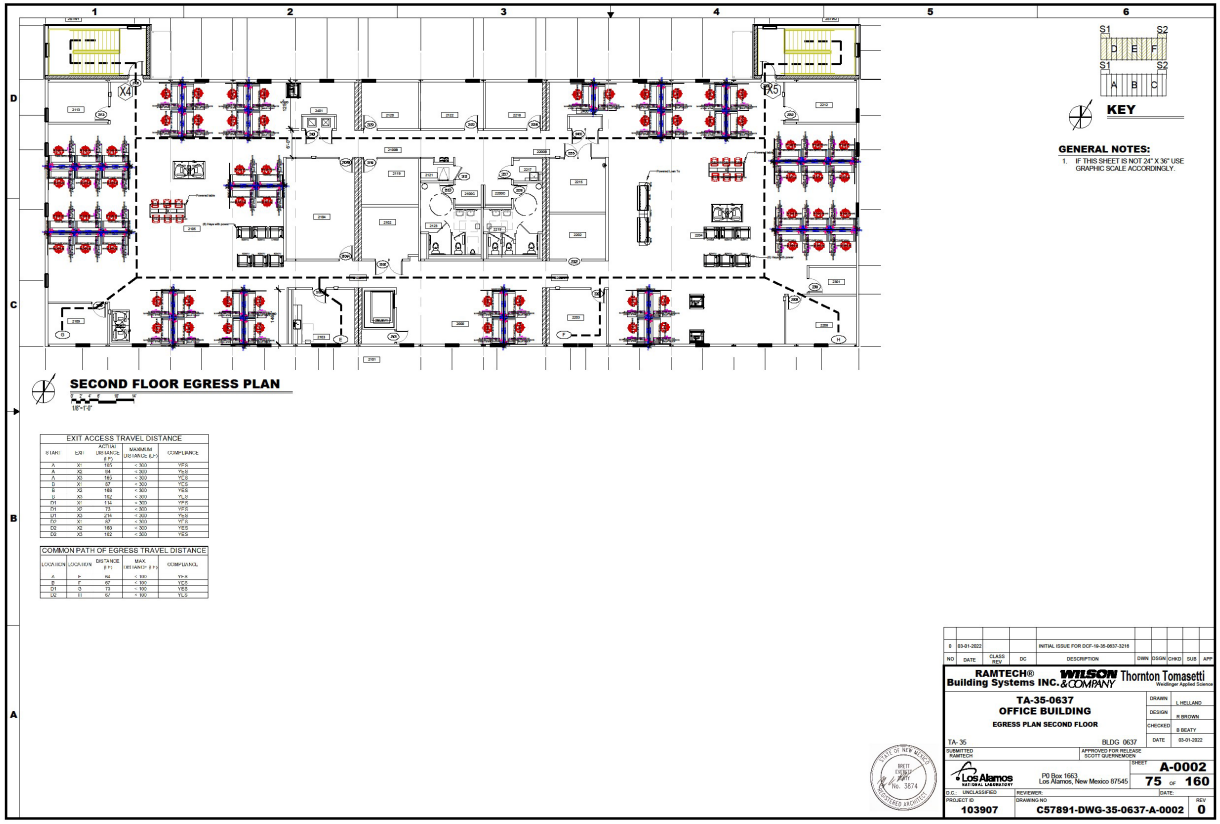
TA35-0637 Office Building

FIRST FLOOR PLAN



TA35-0637 Office Building

SECOND FLOOR PLAN



TA35-0637 Office Building

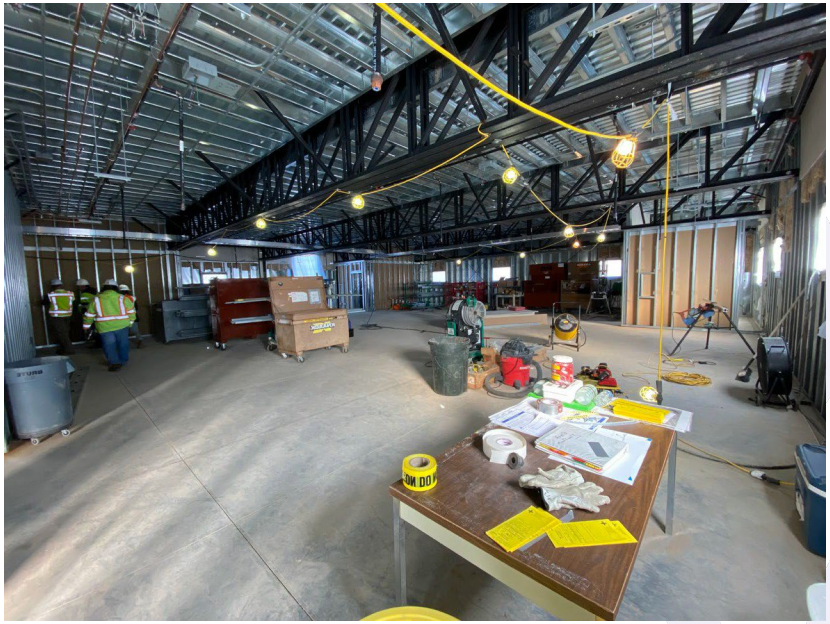
EXTERIOR ELEVATIONS

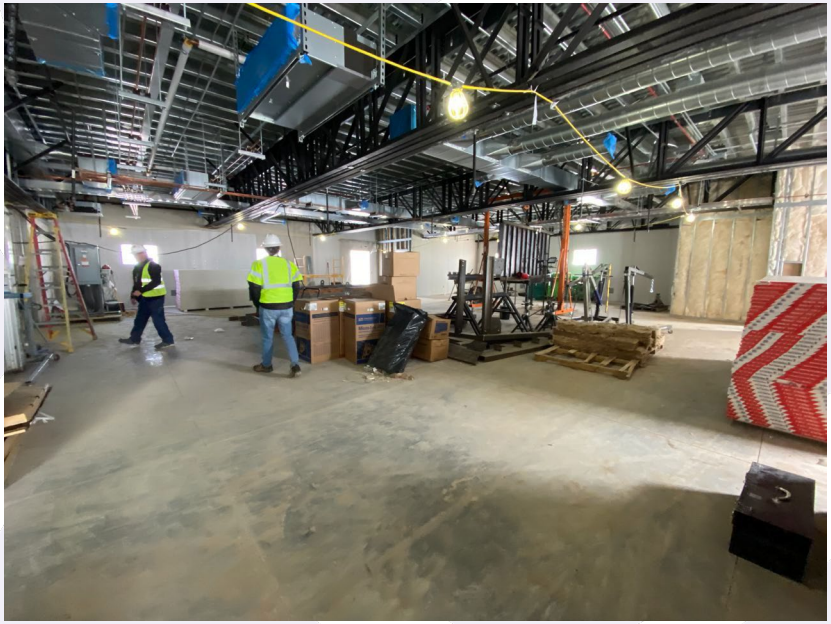
TA-35 Office Building

Drone photo during construction

TA35-0637 Office Building

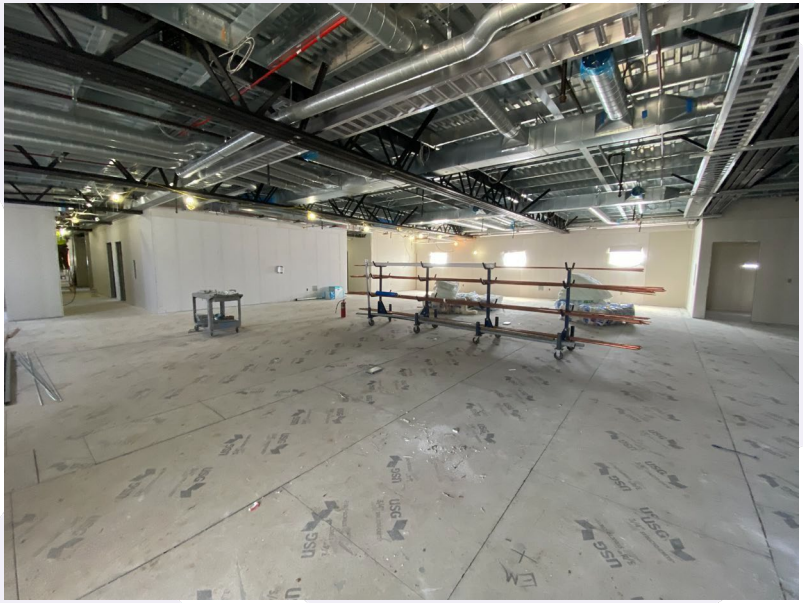
First floor open office area during construction





TA35-0637 Office Building

Second floor open office area in construction



LANL Modular Projects
TA51-0163 Office Building

- SUBCONTRACTOR: Ramtech Building Systems

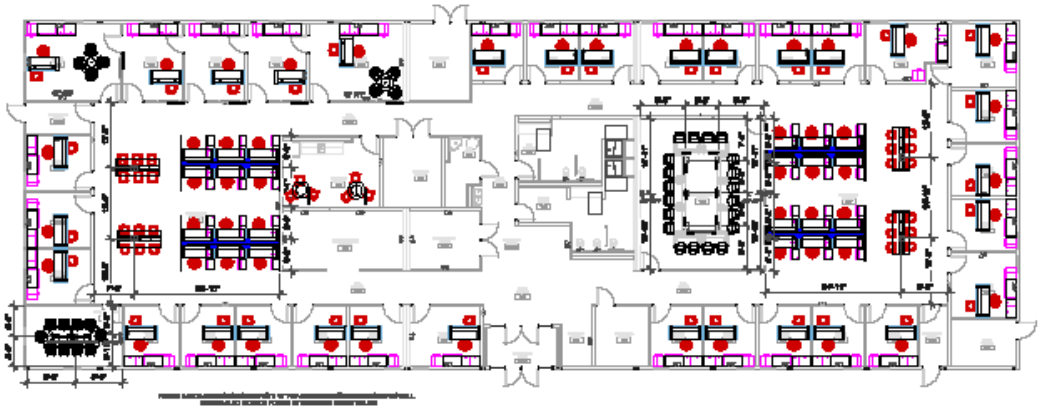
- SUBCONTRACTOR COST
  - TOTAL $11,353,000 / 11,440 gross sq. ft. = $992 per sq. ft. (Not including LANL internal costs)

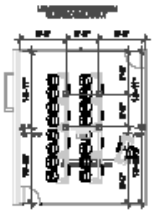
- SCHEDULE
  - LANL bid the RFP in 2021
  - Design complete in 2022
  - Under construction, scheduled for completion in February 2024

- PROJECT DESCRIPTION
  - A new single story office building at LANL

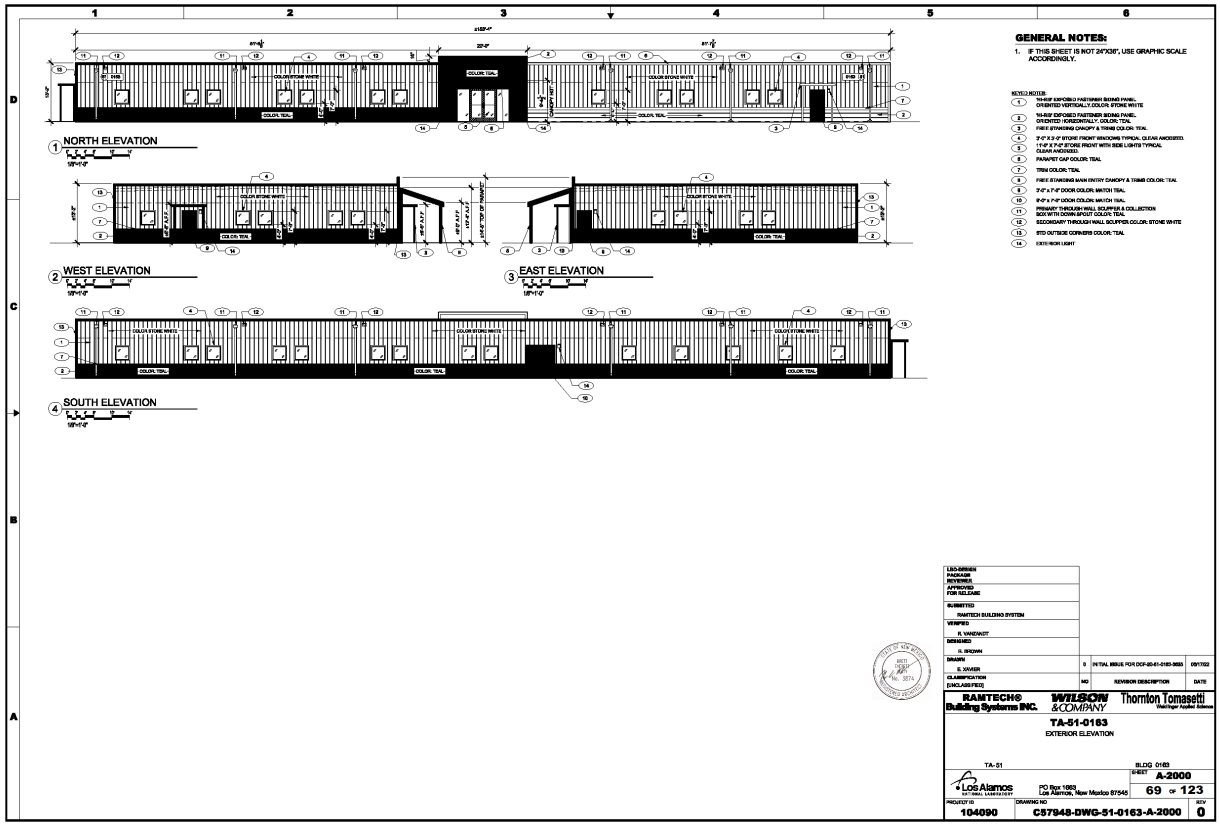
LANL Modular Projects
TA51-0163 Office Building

TA51-0163 FURNITURE ELECTRICAL\DATA PLAN





TA51-0163 Office Building



TA51-0163 Office Building

Drone photo of the foundation execution

Inspection Process and Quality Assurance

- The modular industry is regulated by the state in which the fabrication takes place.

- States that have modular factories, utilize council-approved and ICC certified third-party plan reviewers and inspectors.

Inspection Process and Quality Assurance

A modular company has a Quality Assurance and Control Plan that is followed by their quality control lead. All aspects of compliance to the approved documents are signed off by the factory's quality control lead.

Inspection Process and Quality Assurance

- The third-party inspector visits the factory periodically and performs random inspections.
- It is the responsibility of the third-party inspector to follow up on reinspections.
- The inspector and factory QC lead maintain a working relationship providing a check and balance for quality control.

Inspection Process and Quality Assurance

The State's Responsibility

The State provides periodic audits to ensure that the Quality Control Plan and third-party inspection process is complied with and consistently adhered to.

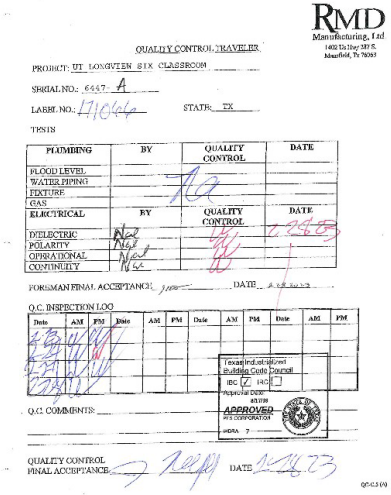
Inspection Process and Quality Assurance

Quality Control Inspection Traveler

In the factory during fabrication, an internal quality control checker performs an informal check and communicates with the workers to correct deficiencies. The worker corrects the deficiencies prior to inspection.

Inspection Process and Quality Assurance

Each factory tracks their QC review with a traveler that moves with each module during the fabrication and inspection process.



RMD Manufacturing, Ltd

QUALITY CONTROL TRAVELER

PROJECT: UT LONGVIEW SIX CLASSROOM

SERIAL NO.: 6447 A

LABEL NO.: 17064 STATE: TX

TESTS

PLUMBING	BY	QUALITY CONTROL	DATE
FLOOD LEVEL			
WATER PIPING			
FIXTURE			
GAS			
ELECTRICAL	**BY**	**QUALITY CONTROL**	**DATE**
DIELECTRIC			
POLARITY			
OPERATIONAL			
CONTINUITY			

FOREMAN FINAL ACCEPTANCE: DATE

Q.C. INSPECTION LOG

Date	AM	PM	Date	AM	PM	Date	AM	PM	Date	AM	PM

Texas Industrialized Building Code Council

IBC ☑ IRC ☐

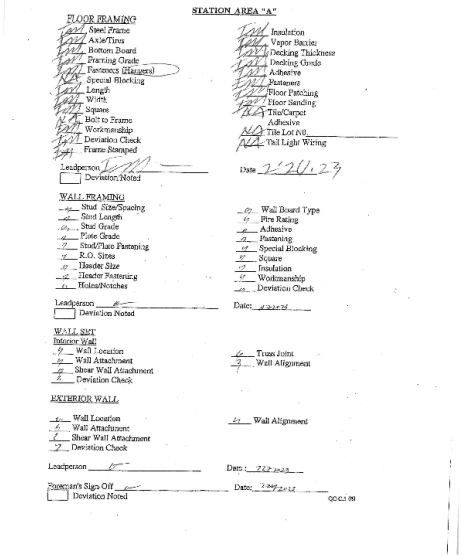
Approval Date: 03/1/99

APPROVED

Q.C. COMMENTS:

QUALITY CONTROL FINAL ACCEPTANCE: DATE

QC-C3 (4)



STATION AREA "A"

FLOOR FRAMING

- Steel Frame
- Axle/Tires
- Bottom Board
- Framing Grade
- Fasteners (Hangers)
- Special Blocking
- Length
- Width
- Square
- Bolt to Frame
- Workmanship
- Deviation Check
- Frame Stamped

Leadperson

☐ Deviation Noted

Date

- Insulation
- Vapor Barrier
- Decking Thickness
- Decking Grade
- Adhesive
- Fasteners
- Floor Patching
- Floor Sanding
- Tile/Carpet Adhesive
- Tile Lot #/Q
- Tail Light Wiring

WALL FRAMING

- Stud Size/Spacing
- Stud Length
- Stud Grade
- Plate Grade
- Stud/Plate Fastening
- R.O. Sizes
- Header Size
- Header Fastening
- Holes/Notches

Leadperson

☐ Deviation Noted

Date:

- Wall Board Type
- Fire Rating
- Adhesive
- Fastening
- Special Blocking
- Square
- Insulation
- Workmanship
- Deviation Check

WALL SET

Interior Wall

- Wall Location
- Wall Attachment
- Shear Wall Attachment
- Deviation Check
- Truss Joint
- Wall Alignment

EXTERIOR WALL

- Wall Location
- Wall Attachment
- Shear Wall Attachment
- Deviation Check
- Wall Alignment

Leadperson

Date:

Foreman's Sign Off

Date:

☐ Deviation Noted

QC-C3 (8)

Inspection Process and Quality Assurance

Quality Control Inspection Report

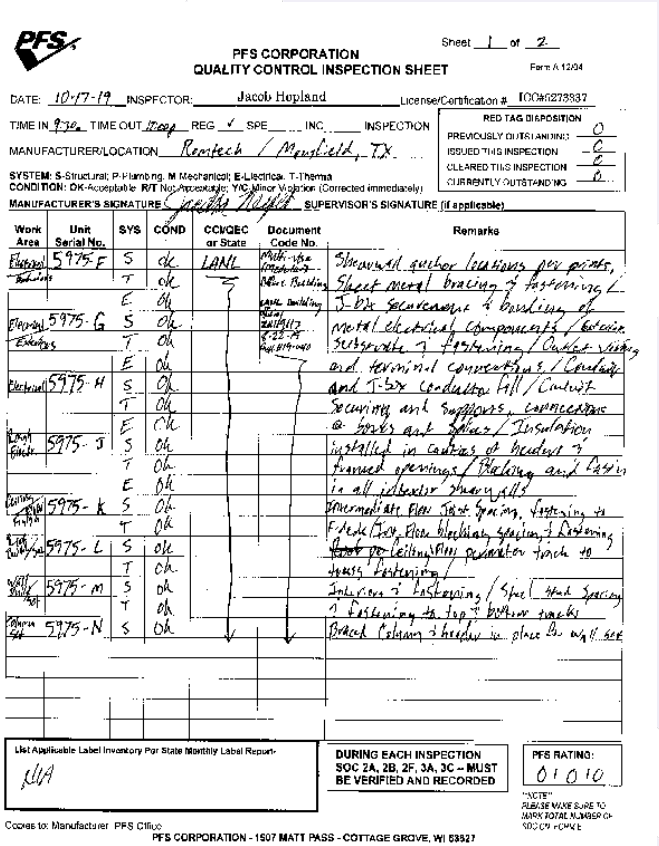
Each factory tracks their inspection records with an Inspection Report.

The Inspection Record contains notes indicating what has been inspected, needs correction, and passes.

The Inspection Record is reviewed by LANL Inspectors for acceptance.

Inspection Process and Quality Assurance

Quality Control Inspection Report



PFS

PFS CORPORATION
QUALITY CONTROL INSPECTION SHEET

Sheet 1 of 2

Form A 12/04

DATE: 10-17-19 INSPECTOR: Jacob Hopland License/Certification # IOO#6273837

TIME IN 9:30a TIME OUT 11:00p REG ✓ SPE ___ INC. ___ INSPECTION

MANUFACTURER/LOCATION Remtech / Mansfield, TX

RED TAG DISPOSITION
PREVIOUSLY OUTSTANDING 0
ISSUED THIS INSPECTION 0
CLEARED THIS INSPECTION 0
CURRENTLY OUTSTANDING 0

SYSTEM: S-Structural; P-Plumbing; M-Mechanical; E-Electrical; T-Thermal
CONDITION: OK-Acceptable R/T Not Acceptable; Y/C Minor Violation (Corrected immediately)

MANUFACTURER'S SIGNATURE [signature] SUPERVISOR'S SIGNATURE (if applicable)

Work Area	Unit Serial No.	SYS	COND	CCI/QEC or State	Document Code No.	Remarks
Electrical Bathrooms	5975-F	S	ok	LANL	Multi-use Inspection Other Building	Sheetrock anchor locations per points,
		T	ok			Sheet metal bracing & fastening /
		E	ok			J-Box securement & bonding of
Electrical Exterior	5975-G	S	ok		LANL Building Metal 2017/2017 8-22-19 Job 819-040	metal electrical components / exterior
		T	ok			surfaces & fastening / Outlet wiring
		E	ok			and terminal connections / Conduit
Electrical	5975-H	S	ok			and J-Box conduit fill / Conduit
		T	ok			securing and supports, connections
		E	ok			@ boxes and fittings / Insulation
Electrical Exterior	5975-J	S	ok			installed in cavities of headers &
		T	ok			framed openings / Blocking and ceiling
		E	ok			in all interior shaftwalls
Ceiling Grid	5975-K	S	ok			Intermediate flex joint spacing, fastening to
		T	ok			Fire deck / Joist, flex blocking spacing & fastening
Ceiling Grid	5975-L	S	ok			~~Joist~~ per ceiling / flex separation track to
		T	ok			studs fastening /
Wall Studs	5975-M	S	ok			Interior & fastening / Stud spacing
		T	ok			& fastening to top & bottom tracks
Interior Wall	5975-N	S	ok			Brace retaining & header in place Dr. will see

List Applicable Label Inventory Per State Monthly Label Report:
N/A

DURING EACH INSPECTION SOC 2A, 2B, 2F, 3A, 3C – MUST BE VERIFIED AND RECORDED

PFS RATING: 0 1 0 1 0

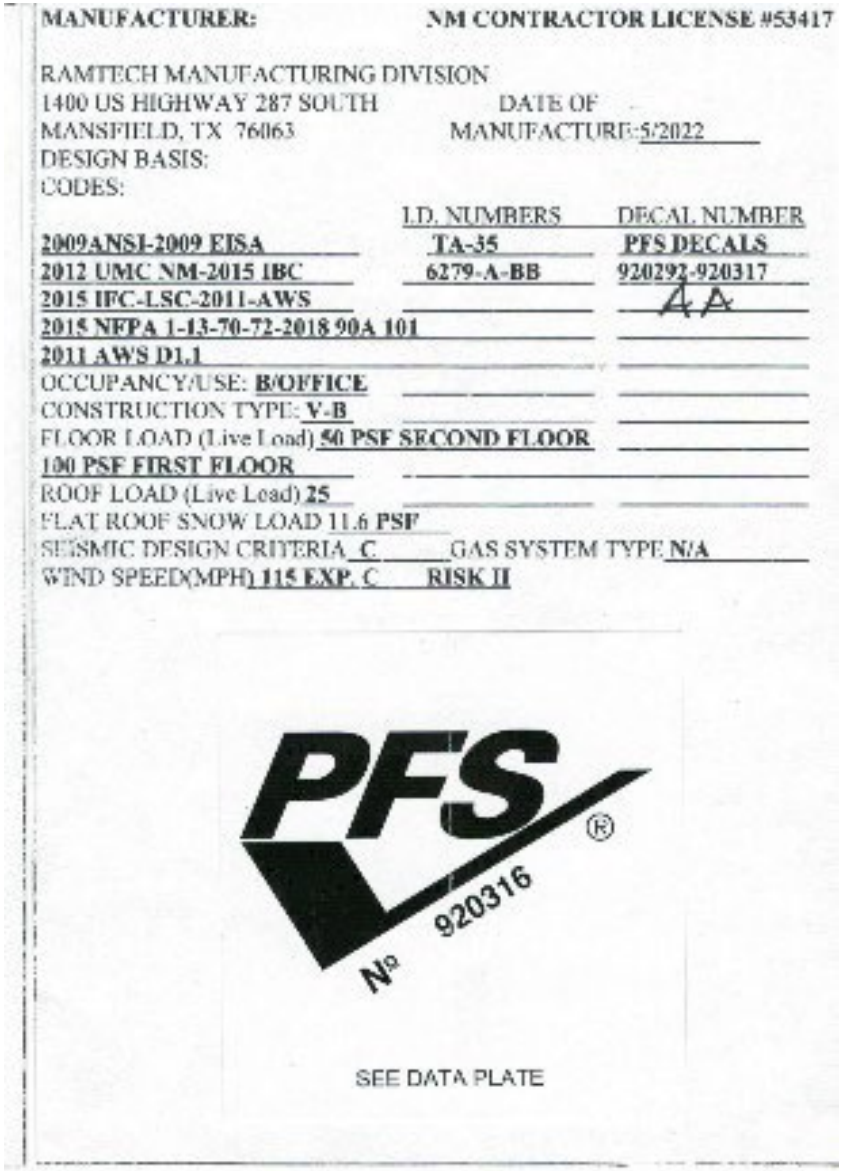
"NOTE" PLEASE MAKE SURE TO MARK TOTAL NUMBER OF SOC ON FORM

Copies to: Manufacturer PFS Office

PFS CORPORATION - 1507 MATT PASS - COTTAGE GROVE, WI 53527

Inspection Process and Quality Assurance

After third-party inspection and the modular construction is finished, compliance is signified by a label that is adhered to each modular unit.



MANUFACTURER: NM CONTRACTOR LICENSE #53417

RAMTECH MANUFACTURING DIVISION
1400 US HIGHWAY 287 SOUTH
MANSFIELD, TX 76063

DATE OF MANUFACTURE: 5/2022

DESIGN BASIS:
CODES:

	I.D. NUMBERS	DECAL NUMBER
2009ANSI-2009 EISA	TA-35	PFS DECALS
2012 UMC NM-2015 IBC	6279-A-BB	920292-920317
2015 IFC-LSC-2011-AWS		AA
2015 NFPA 1-13-70-72-2018 90A 101		
2011 AWS D1.1		

OCCUPANCY/USE: B/OFFICE
CONSTRUCTION TYPE: V-B
FLOOR LOAD (Live Load) 50 PSF SECOND FLOOR
100 PSF FIRST FLOOR
ROOF LOAD (Live Load) 25
FLAT ROOF SNOW LOAD 11.6 PSF
SEISMIC DESIGN CRITERIA C GAS SYSTEM TYPE N/A
WIND SPEED(MPH) 115 EXP. C RISK II

PFS ®
№ 920316

SEE DATA PLATE

Tips for Planning Modular Construction

Know Your Project

- Architectural Program – Provide the modular company with all the specific information needed to meet the needs of the project.
- Project Siting - Is there room for crane placement and delivery of the modules?
- Research Modular Companies – Investigate Quality Control procedures before contracting.
- Do Not Assume Cheap Construction – A new modular building can be just as robust and architecturally interesting as any building. Budget appropriately.

Tips for Planning Modular Construction

Assume Design/Build Execution Strategy

- Not all modular fabricators build the same box.
- The constructor should have a factory in mind to build the modular unit so that the design will reflect the modular execution.
- The designers and constructors must work together with a fabricator in mind.

Tips for Planning Modular Construction

Site Specific Inspectors

The most important step!

Review your execution plan and modular quality control plans with your site inspectors prior to contracting.

Keep your inspectors engaged throughout the process to confirm that site-specific inspection requirements are met.

Modular Construction at LANL

Questions?