

TRI - REGIONAL JETS 2025





ACM:

Embracing Construction Acceleration and Innovations





ACM: Embracing Construction Acceleration and Innovations

Moderator:

Michael Jarosz, PE

Assistant VP, Dewberry Engineers

Speaker:

Kurt Wittman, Design Director, NAVFAC SE



MODERATOR

Michael Jarosz_{PE}

Dewberry Engineers

Associate Vice President

Executive Client Manager, Navy



- **Sports Teams: Greenbrier Gators (my kids' teams)**
- **Vacation Spots: The Mountains**
- **Did You Know: You can ski on an erupting volcano, Mt. Etna, in Sicily**
- **Hobbies: Mountain Biking, Skiing**
- **Coollest Project(s): MCAGCC 29 Palms Wastewater Treatment Plant / Establishment of Naval Support Facility Redzikowo, Poland**



SPEAKER

Kurt W. Wittman P.E.

NAVFAC SE

Design Director



- **Sports Teams:** Penn State Football
- **Vacation Spots:** Hiking the Grand Tetons, Gasparilla Island
- **Did You Know:** I played street hockey in Philadelphia growing up and was a big Flyers fan when they won their Stanley Cups. Air Force sent me to Moody A.F.B. in south Georgia after college where hockey is not a sport.
- **Hobbies:** Gym rat, chasing grandkids around
- **Cooler Project(s):** new Pork Processing Plant in Brandon Manitoba, Slimfast Manufacturing Plant – Tucson AZ

Learning Objectives

- Learn how various Alternate Construction Methods (ACM) can provide new facilities **quicker** and **cheaper** than more traditional construction methods
- Learn about the characteristics of various alternate construction methods including **strengths** and **weaknesses** of each type and what type of facilities they have been successfully utilized for in the past
- Review real-world examples of facilities which were constructed using ACM with specifics of the **benefits** reaped by these projects because of these construction methods.



Agenda

- What is ACM?
- Needs Driven Construction– steps towards innovation
- Motivators - ACM for **speed, quality**, and **low cost** of construction
- Modular Construction
- Pre-Engineered Metal Buildings (PEMB) and Tension Fabric Structures (TFS)
- Precast and Tiltup Construction
- Project Case Studies and Examples
- Q&A / Discussion

What is ACM?



Alternate Construction Methods (ACM)

Definition – ACM is innovative building approaches that deviate from traditional, on-site assembly practices to offer more sustainable, efficient, and cost-effective construction solutions.

ACM —————> greater % of building components being **fabricated off-site**.

ACM —————> **delegated structural design** completed by a manufacturer

Some examples of ACM include:

Tension Fabric Structures (TFS)

Modular Construction

Pre-engineered Metal Building

Precast and Tiltup Concrete

Insulated Concrete Forms (ICF)

3-D Printed Construction

Heavy Timber Structures

NEEDS DRIVEN CONSTRUCTION – steps towards innovation



Can anyone give me some very old ACM construction examples?

One example: **Quonset Huts**

- First developed and manufactured during World War II for the U.S. Navy.
- The Navy needed prefabricated, portable structures that could be quickly assembled at military outposts
- Features:
 - light weight,
 - mobile/shippable,
 - easy to assemble,





ACM driven by observed issues or needs:

- **Issue:** *Field welding is costly and maintaining quality is often difficult.*
- **Solution:** Design a building that completely bolts and screws together – PEMB
- **Issue:** Remote project site has limited resources (personnel and materials) to support new facility construction:
- **Solution:**
 - Manufacture components or units offsite ship to site for final erection
 - Modular Construction, Quonset Hut, PEMB, TFS, Precast, etc.

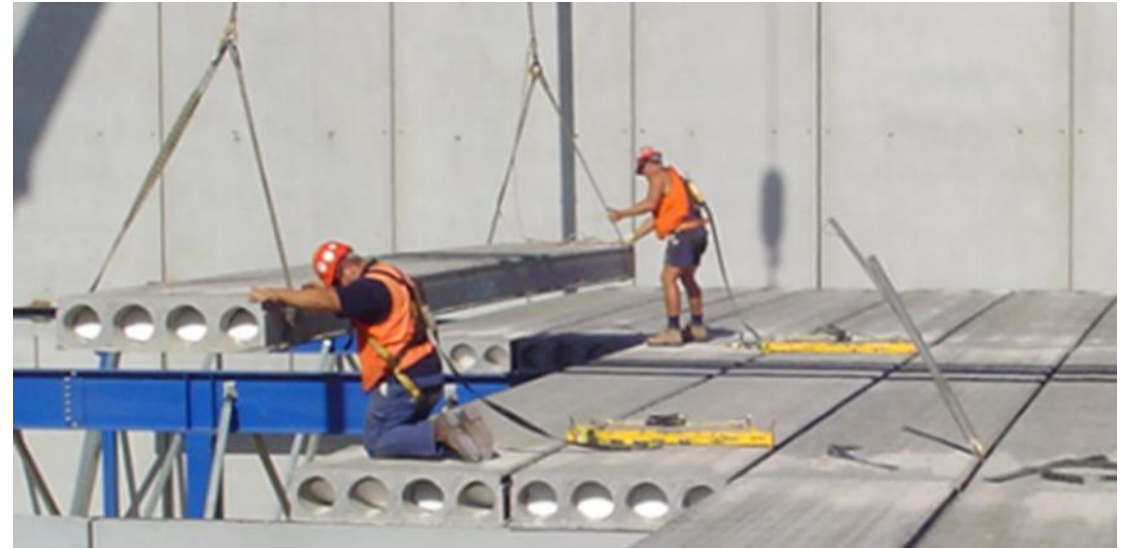
ACM driven by observed issues or limitations:

- **Issue: Formwork, scaffolding, shoring, bracing for concrete construction is expensive and time consuming to install and remove.**
- **Solution:**
 - Precast concrete components shipped to the jobsite for erection
 - Forms left in place as permanent construction – ICF, Precast
- **Issue: lack of skilled labor available at jobsite to support facility construction**
- **Solution:** Almost ALL ACM reduces the demand for skilled labor at jobsite
- **Issue: Limited finances and time to procure required facility**
- **Solution:** Purchase facility as “temporary equipment” with bare bones requirements – Modular construction, PEMB, TFS, etc.

SPEED OF CONSTRUCTION



Cast-in-place slab construction often requires extensive formwork and shoring - **expensive** and **time consuming**.



Precast floor or roof planks:

- **quickly** and **efficiently** erected with a small crew
- Can also serve as the formwork for a topping slab (when required)

SPEED OF CONSTRUCTION



Cast-in-place walls - extensive formwork and bracing



Precast or **tiltup** concrete wall components often lead to **quick, efficient** and **economical** construction

SPEED OF CONSTRUCTION

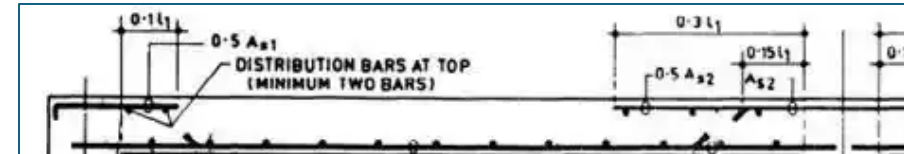
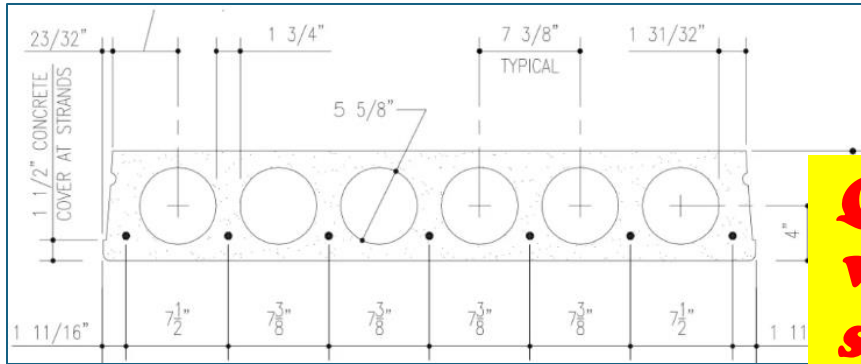


Scaffolding and **skilled masons** are required for masonry wall construction



With proper planning and equipment, erection of tiltup or precast walls typically leads to **very rapid wall construction**.

QUALITY OF CONSTRUCTION



QUESTION: Not this picture, but where does welded-wire mesh almost always end up in a slab pour?



Plant conditions lead to tighter control of reinforcement in precast components

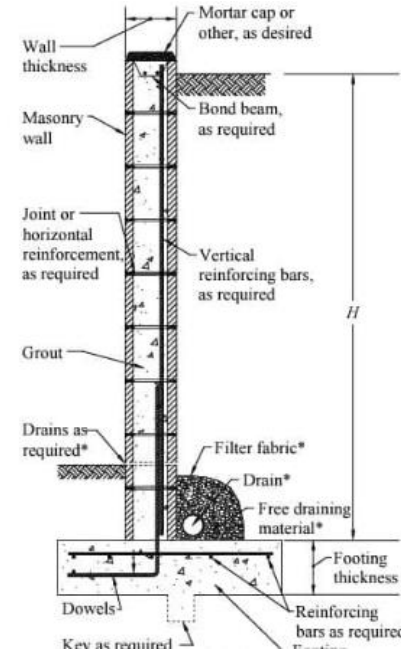


Difficulties arise in ensuring reinforcing is properly placed in the field.

QUALITY OF CONSTRUCTION



Manufacturing plant conditions lead to tighter control of reinforcement in precast components



Proper placement of masonry reinforcement is often an issue.

PM quote "Just be glad the rebar is in the block cell at all"

Modular Construction



MODULAR CONSTRUCTION

- Modular buildings are structures that are constructed in a **factory setting** away from the construction site before being transported for assembly on site
- 60-90+ % of the work is completed in a factory-controlled environment, either as a complete structure or as modular subassemblies for a larger project
- The modular construction process is completed onsite using inter-module connections (or inter-connections) to tie the units together.
- Lower costs for multiple builds of standard design (typ. 5 or more builds of same team/design)
- Projects can be completed 30 to 50% faster than when using conventional construction
- Configurations range from framing-only to fully wired, plumbed, drywalled, and windowed units



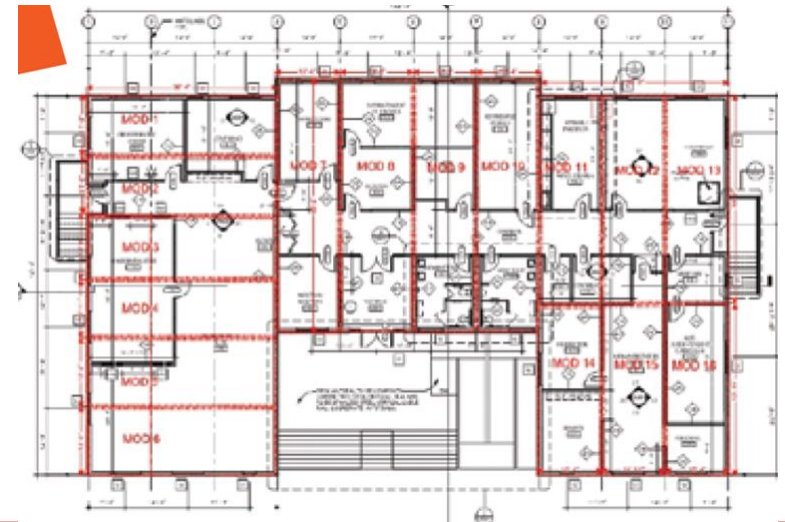
ADVANTAGES OF MODULAR CONSTRUCTION

- **Quality Control** – controlled manufacturing environment.
- **Speed** – quick erection at site
- **Transportable** to remote locations – ideal where onsite building could prove difficult or expensive
- **Weather immunity** - Construction delays due to adverse weather minimized
- **Environmentally friendly** - Material supplies are easier to control in a factory setting, reducing wastage
- **Minimal Site Disruption** – dramatically smaller laydown yard and impact area at site.



DISADVANTAGES OF MODULAR CONSTRUCTION

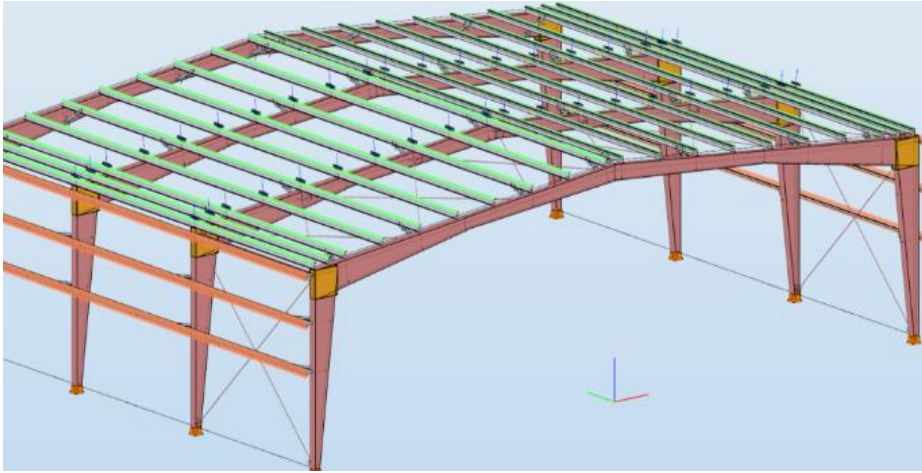
- Can cause floor plan constraints due to transportation limitations
- Limited ability to modify floor plan for future mission changes
- Increased quantities of building joints leading to potential for leakage, intrusion, etc. and increased maintenance costs
- No owner/government QA/QC oversight at manufacturing location – potential quality control issues



Pre-Engineered Buildings and Tension Fabric Structure

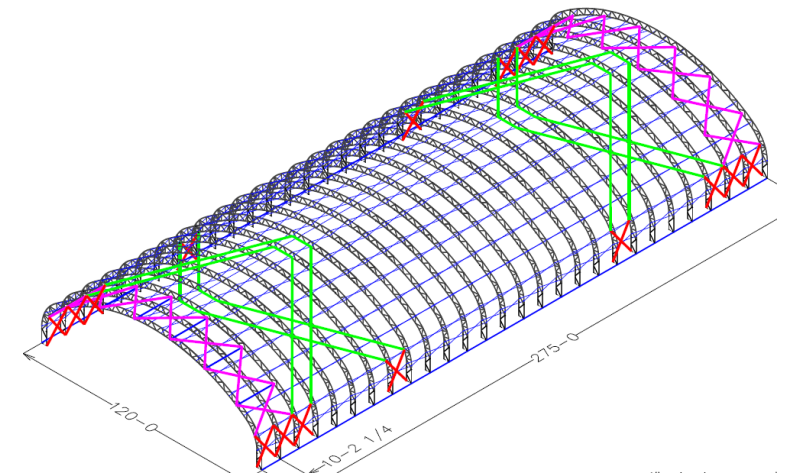


PEMB



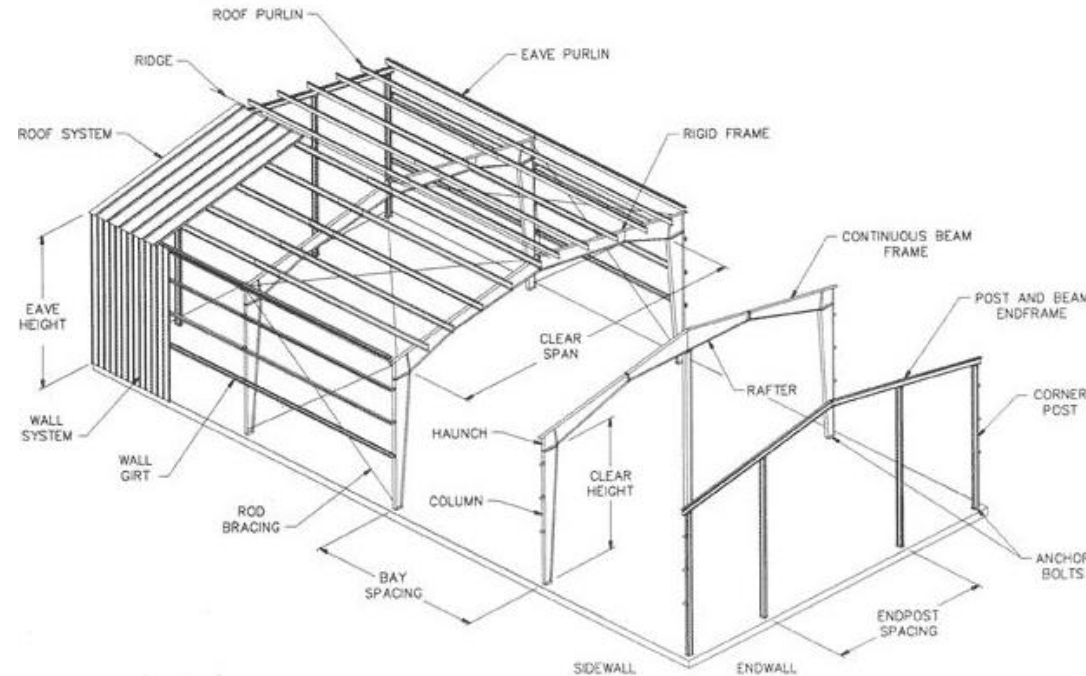
and

TFS



- PEMB and TFS are similar in their steel framed structural systems, with light gauge metal cladding for PEMB and polyester (typ.) fabric cladding for TFS
- PEMB and TFS best accommodate simple rectangular floor plans ➡ **economical** ➡ **speedy**
- PEMB and TFS both **delegated designs** of the structure and building envelope to the manuf.
- Manufacturer's typically do NOT provide a foundation and floor slab design for the facility.
- Separate engineers must be employed to design the foundations/slabs/utilities, etc.
- Must establish who is the overall Designer of Record (DOR) for structural components.

PRE-ENGINEERED METAL BUILDINGS (PEMB)



- PEMB typically utilize tapered I-shaped steel moment frames in the short direction of the building and cable or rod cross-bracing in the long direction of the building and in the roof planes to provide lateral stability for the structure.
- Wall and roof cladding is typically light gauge corrugated metal panels supported from light gauge purlins/girts spanning between structural framing members

PRE-ENGINEERED METAL BUILDINGS

ADVANTAGES OF PEMB

- One of the **quickest** and most **economical** means of providing an enclosed building
- Can be strengthened to support large loadings such as from bridge cranes, monorails, rooftop equipment
- Bolt-together, screw together components requiring minimal technical expertise for the erection crew
- Can be made (more) aesthetically pleasing with masonry veneers and standing seam metal roofs, etc.

DISADVANTAGES OF PEMB

- Recently - **long lead times** for delivering building components to the jobsite.
- Facilities are very **light in nature** and do not provide the equivalent sheltering protection during extreme weather as heavier components
- May not efficiently accommodate floor plan insets, offsets, etc. that require a more tailored design.

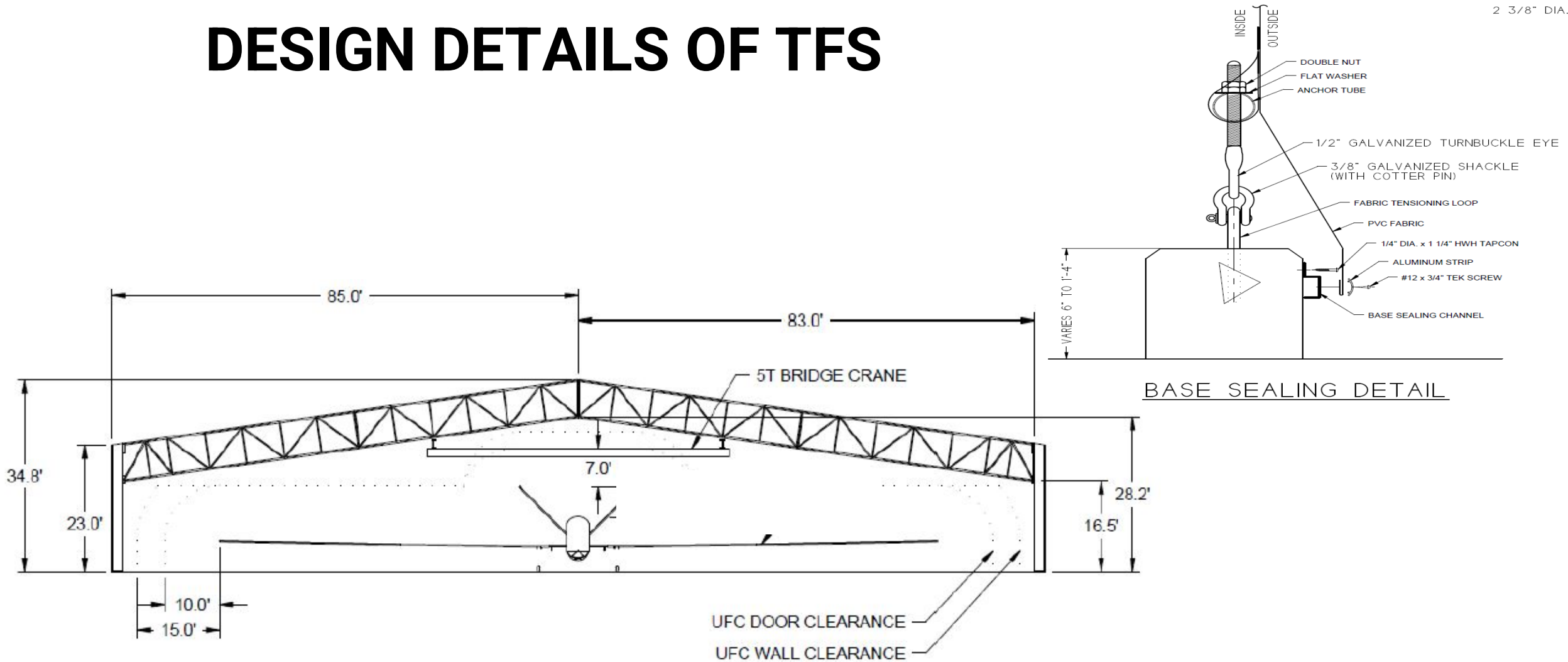
TENSION FABRIC STRUCTURES (TFS)



AHTS TEMPORARY MAINTENANCE HANGAR NAS WHITING FIELD (P288)

TFS Fabric – 15 Year Lifespan
156 MPH Wind Speed

DESIGN DETAILS OF TFS





Advantages of TFS

- Can be constructed **quicker** than conventional construction
- **Cheaper** than conventional construction (building costs are comparable to Pre-Engineered Metal Buildings)
- Can be purchased as **temporary or relocatable “equipment”** which potentially has some funding or “permitting” advantages for government facility construction.

Disadvantages/Constraints of TFS

- The fabric cladding degrades and must be replaced at approximately **15-year** intervals.
 - One TFS manufacturer indicates that their fabrics will retain not less than 70% of the published tensile strength ... for the life of the warranty.”
- Challenges for providing hard walls and industrial shop spaces within the TFS envelope
- Limits on roof penetrations, roof-top equipment , roof access
- Concerns/limitations in windborne-debris regions

Edwards Air Force Base - 10 projects in the span of 8 years

2017

2025



B-52 Hangar

220' x 200'
Fabric & Metal



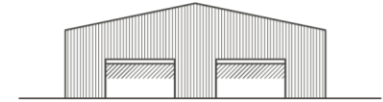
B-52 Hangar

220' x 200'
Fabric & Metal



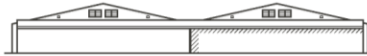
Munitions Storage Facility

50' x 100'
All fabric



Building Extension

70' x 100'
All metal



RQ-4 Hangar

170' x 83' x 2 (linked)
All fabric



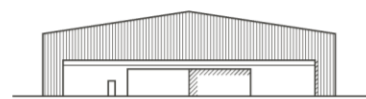
SAPF Hangar

196' x 144'
All metal



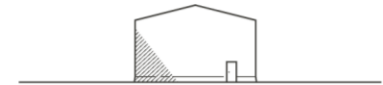
SAPF Hangar-Main Base

245' x 155'
All metal



SAPF Training Facility

140' x 250'
All metal



Mass Prop Facility

40' x 75'
All fabric

Breaking the Code on Military Construction:
Edwards AFB's Response to Emerging Facility Reqmts
Masters Degree Thesis Paper- Michelle Perry

Precast and Tiltup Concrete Construction



Precast and Tiltup Concrete Construction

- Components cast in **controlled manufacturing environment** and
- **transported** to the jobsite for final erection
- Typical precast components are wall, floor, roof and other structural members
- Tiltup wall panels are formed and placed horizontally **at the jobsite** and then lifted into final vertical position



Advantages of Precast and Tiltup Concrete Construction

- Site erection time dramatically quicker than CIP concrete or masonry
- QC of component dimensions and steel reinforcement better than site placed concrete
- Better QC of fluid concrete being placed - no transport
- Advantageous for very **tight project sites** with little lay-down area
- Form liners and paver templates can simulate masonry appearance
- Long clear spans (like double-tees) can be provided with some components (like double-tees) minimizing columns and walls
- Smooth concrete surfaces without ledges can provide for a “clean environment” as required by many food manufacturing plants



Disadvantages of Precast and Tiltup Concrete Construction

- Component **sizes are limited** by shipping and/or lifting constraints
- Size limitations typically results in more wall joints which must be caulked/sealed and **maintained**.
- Potential for **damage** in shipping and erecting them.
- Jobsite layout errors or adjacent component or foundation anomalies can be extremely difficult to remediate.



Case Studies & Examples



Precast Concrete Construction

ACQUILUS I – JACKSONVILLE BEACH, FL

- Masonry Block, Hollow Core, and Solid Slabs
- Erected at rate of one floor per month (13-stories)
- Erection speed decreased as building height increased due to the high coastal winds



ACQUILUS II – JACKSONVILLE BEACH, FL

- Identical to Phase I
- Converted masonry to precast walls
- Other precast components: columns, beams, spandrels, and stairs
- Erected in **six months**, **50% less time than Phase I**



Precast Concrete Construction

ASCENSION ST. VINCENT'S FOUNDATION DELORES BARR WEAVER HEART AND VASCULAR PAVILION JACKSONVILLE, FL

Challenges

- Extremely tight site
- Existing operational hospital on 2 adjacent elevations
- Very little laydown area
- Designed required future vertical expansion
- Utilized a combination of columns and load-bearing walls with flooring consisting of double tees, flat slabs, and hollow core





Marine Forces Storage Command - TFS Warehouse



Awarded:
August 2020

Location:
Albany, GA

Dimensions:
200'(W) (Linked 2-Bay
x 500'(L) x 16'(H)

Features:
Dehumidification System,
Light & Power Package,
[R-19 Fabric Insulation](#), Fire
Suppression System

Includes:
Shipping & Assembly



**Utilizes Insulated Fabric
Technology to facilitate
humidity-controlled storage**

Approx. Price
~\$13.5M

Contract Date
2020

Other ACM Example Project



NEWPORT NEWS SHIPYARD – Modular



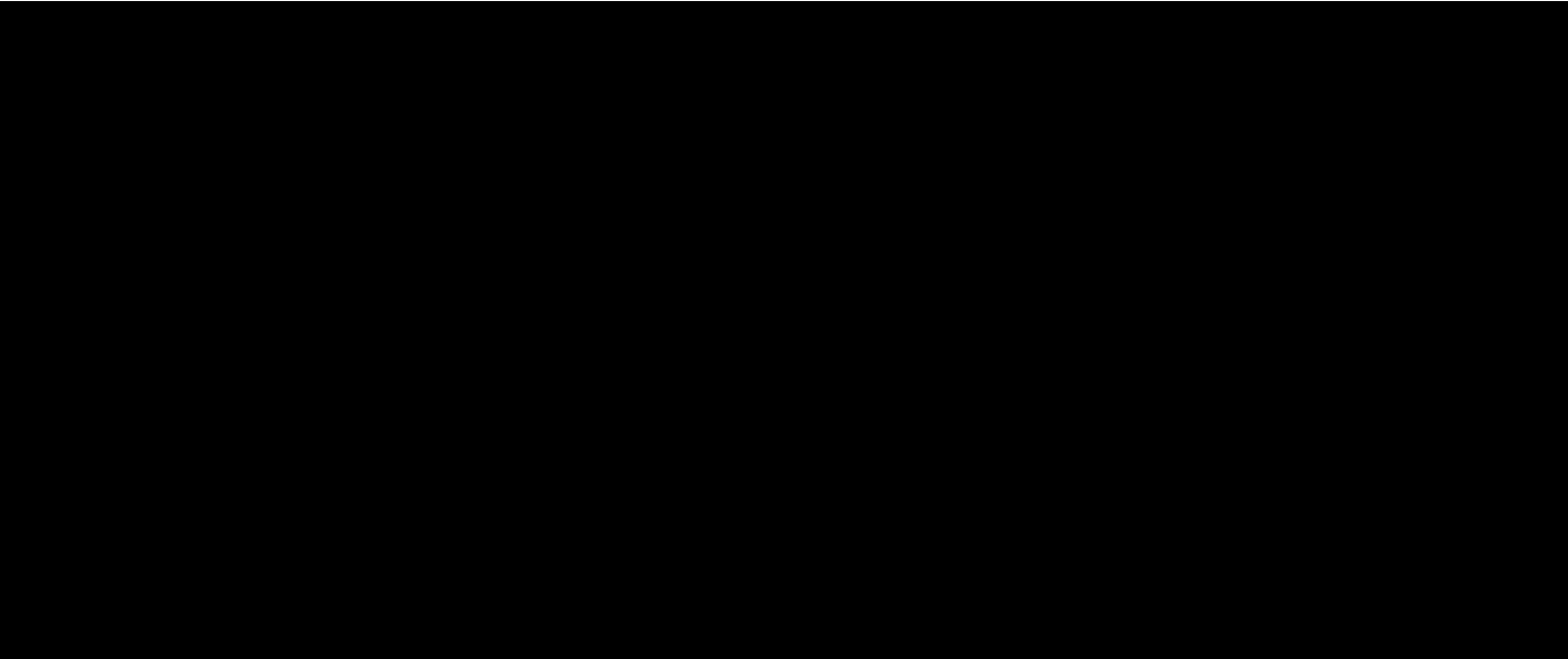
**C-27J Hangar– TFS
Yuma, AZ**



**Africa Hangars – TFS
819th Expeditionary RED Horse**

TRI - REGIONAL
JETS 2025

Society of
SAME
American Military Engineers



Wrap Up



Summary

- Alternative Construction Methods are critical part of meeting the military's infrastructure needs
- They can save significant time and money compared to traditional construction
- They have proven effective in various uses, climates, and conditions
- Capable of meeting UFC and building code requirements
- They utilize a wide range of materials and are adaptable to project needs and constraints
- They are well-suited to design/build and Minimum Viable Project requirements



Contact Info



Kurt Wittman

kurt.w.wittman.civ@us.navy.mil

Q&A / Discussion



TRI - REGIONAL JETS 2025

