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CONFIDENTIAL**

Presentation of Findings

# ALLEN EAGLE STADIUM



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**NELSON**  
FORENSICS

## INTERIM REVIEW DOCUMENT

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# Presentation Outline

- Purpose of Investigation
- Scope of Investigation
- Background
  - Reinforced Concrete Basics
  - Strength and Durability Discussion
- Nelson Forensics' Analysis Approach
- Findings
  - Strength Deficiencies
  - Durability Deficiency
- Remediation Discussion

# Purpose of Investigation

## Assignment #1; August 2013:

Determine the extent and cause of the concrete cracking at the concourse level of the stadium.

## Assignment #2; February 2014:

Evaluate the concourse level of the stadium for structural deficiencies resulting from improper structural design and/or construction.

## Assignment #3; March 2014:

Evaluate the entire stadium facility for structural deficiencies resulting from improper structural design and/or construction.

## Assignment #4; April 2014:

Partner with Datum Engineering for design development of a repair and strengthening plan to rectify identified structural deficiencies.

# Scope of Investigation

## 1. Performed on-site observations of distress and as-built conditions

- Documented observed conditions and distress



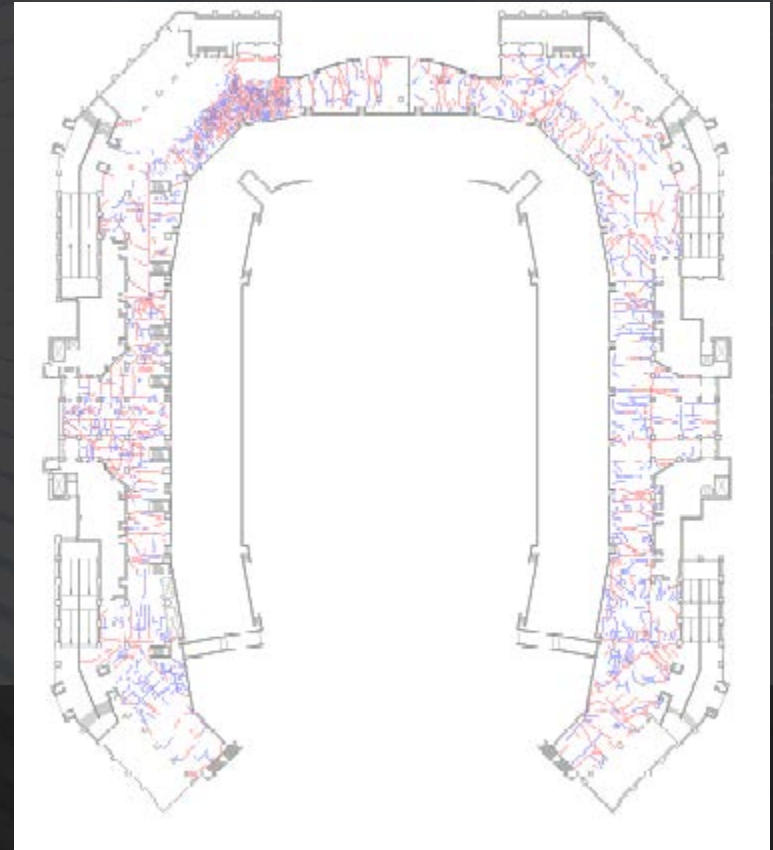
Cracks Emphasized by Author

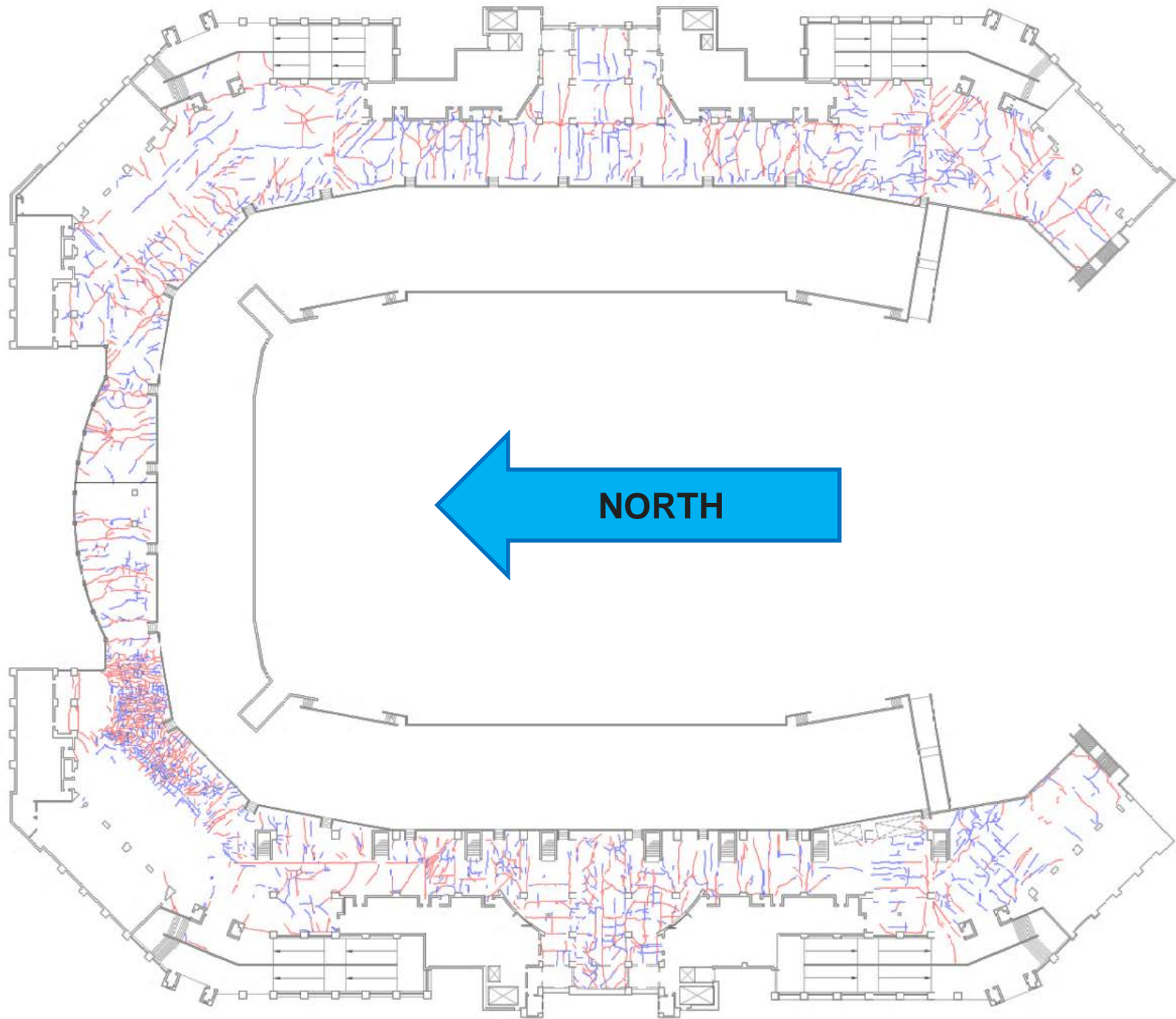


# Scope of Investigation

## 1. Performed on-site observations of distress and as-built conditions

- Photographically and graphically documented observed conditions and distress
- Developed a distress map of the cracking at the concourse





# Scope of Investigation

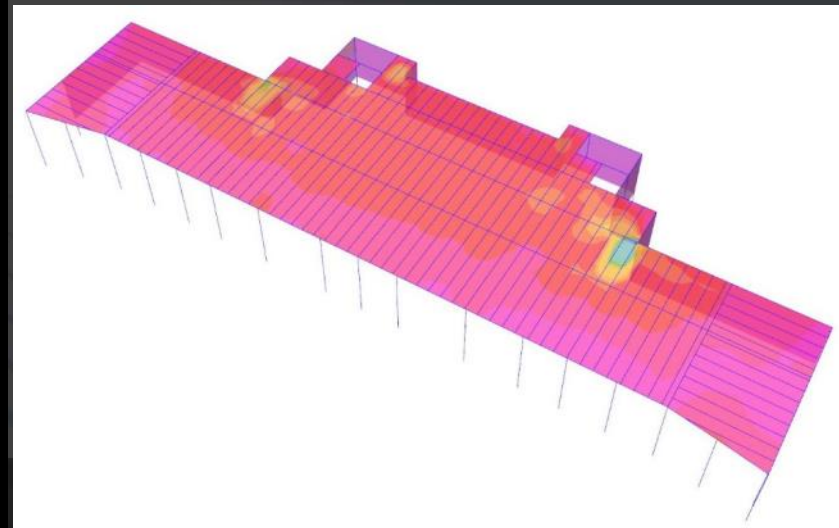
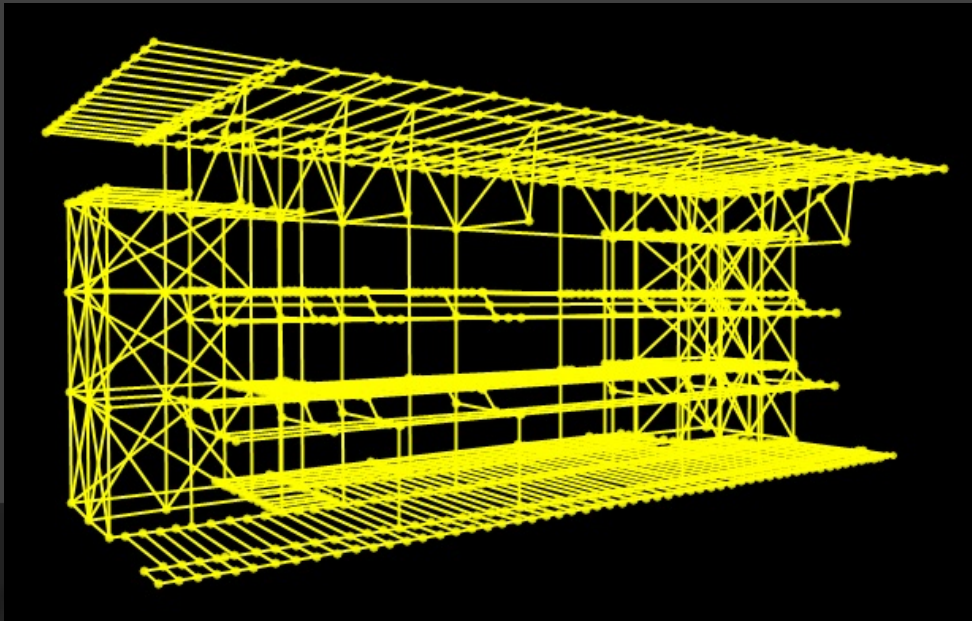
2. Coordinated a limited concrete materials testing regime for the concourse level





# Scope of Investigation

3. Reviewed construction documents; including plans, specifications, shop drawings, design bulletins, and change orders
4. Developed 2- and 3-dimensional analytical models of the stadium structure; performed structural analysis





# Scope of Investigation

5. Identified structurally deficient systems and components
6. Commenced design of repair and strengthening, in concert with Datum Engineering (ongoing)

# Strength vs. Durability

## Strength:

The ability of a structural member or system to support its own weight and superimposed loads with a code-specified factor of safety

## Durability:

The ability of a structural member or system to serve its intended purpose for its required service life

## A bit about concrete... 1 of 2

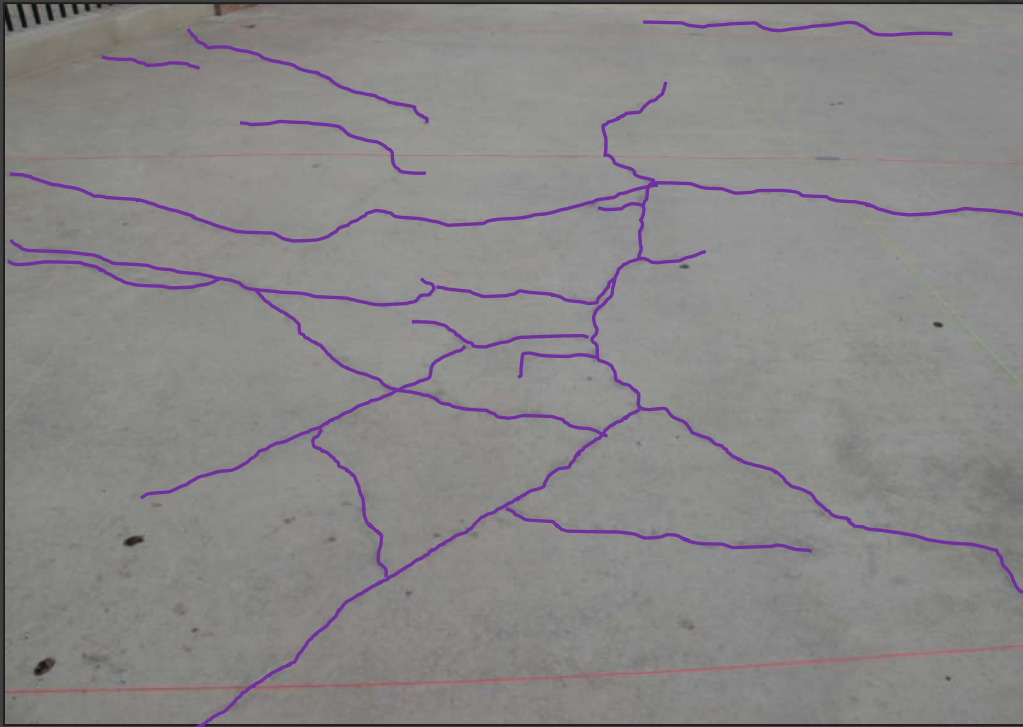
Concrete is much stronger when you push on it than when you pull or bend it...

Thus, reinforcing steel is added to compensate

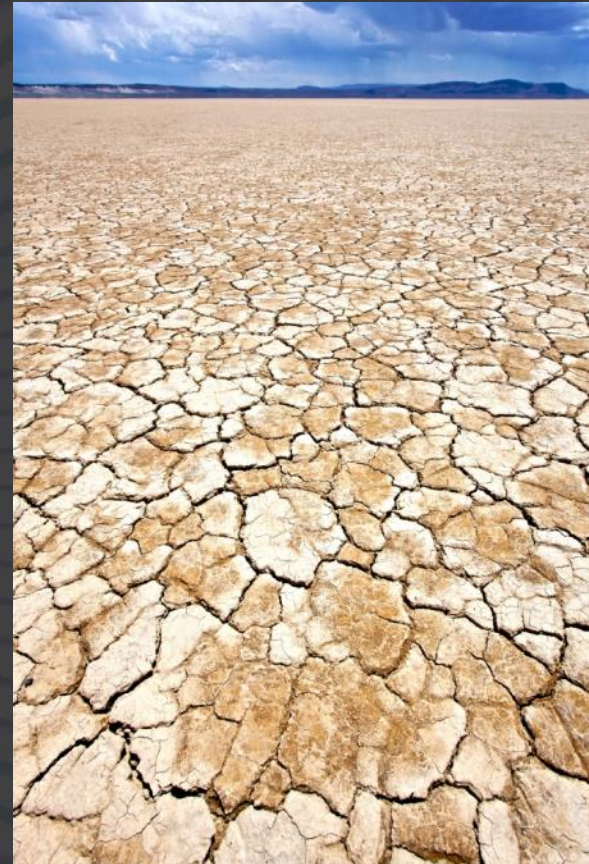


# A bit about concrete... 2 of 2

## Concrete Shrinks!



Cracks Emphasized by Author

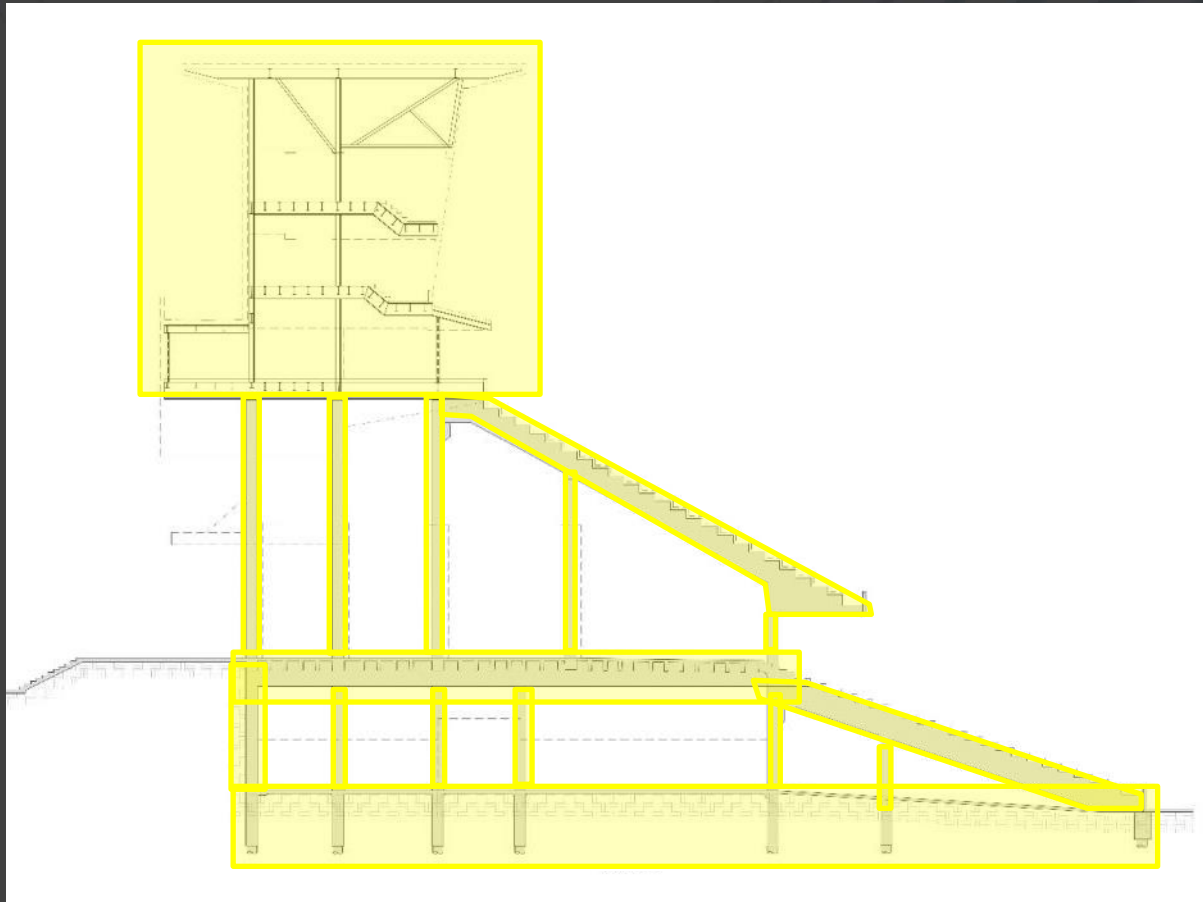


## Remember:

1. Concrete needs properly designed steel reinforcement for strength and durability.
2. Concrete without properly designed reinforcement and/or joints will make its own joints by cracking.

Also: Reinforcing steel corrodes (rusts) when cracks in concrete allow exposure to air and water...

# Structural Systems Analyzed



Concrete Piers

Concrete Retaining  
Walls

Concrete Concourse  
Framing

Concrete Columns

Concrete Seating

Steel Press Box



# Structural Systems Analyzed



Low Steel Buildings

Scoreboards



# Summary of Findings

## Structurally Deficient:

- Retaining walls
- Concourse framing
- Press box support columns
- Press box structure
- Single-story structures
- South scoreboard
- Durability (life cycle)

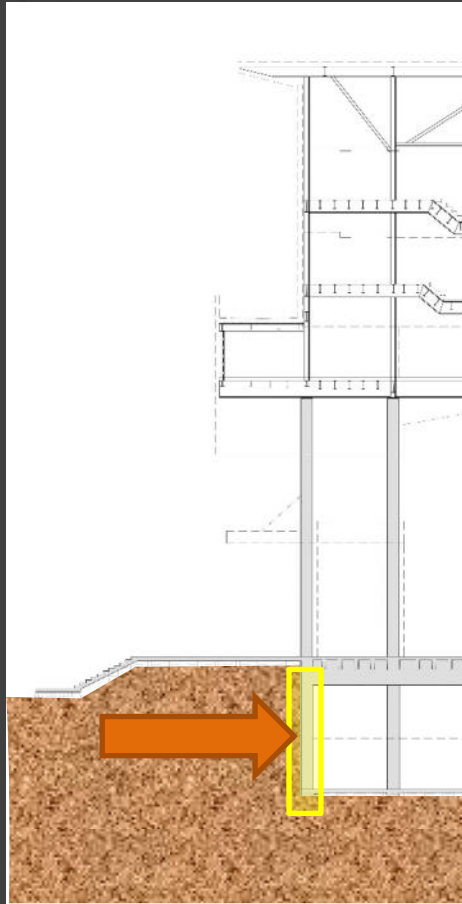
# Strength Deficiencies

## Strength:

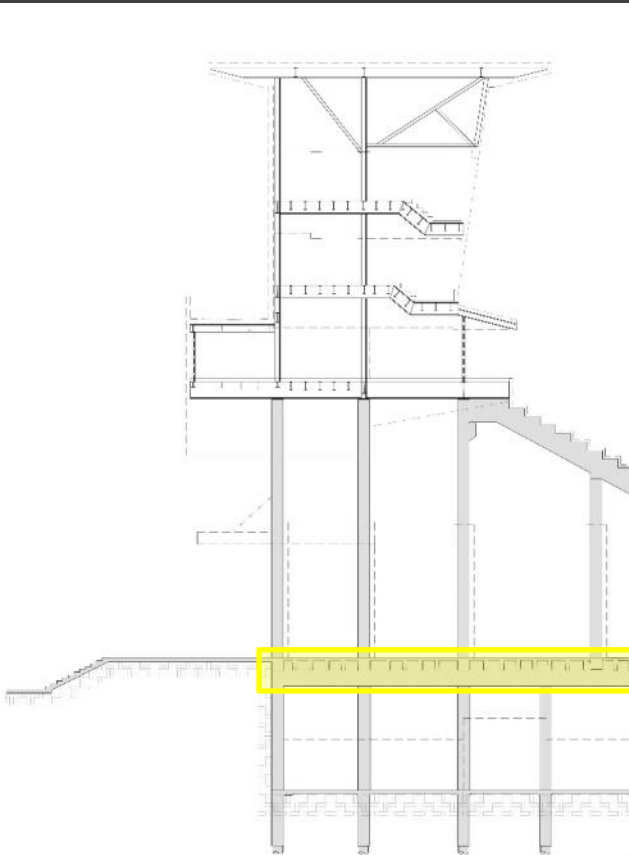
The ability of a structural member or system to support its own weight and superimposed loads with a code-specified factor of safety



# Retaining Walls

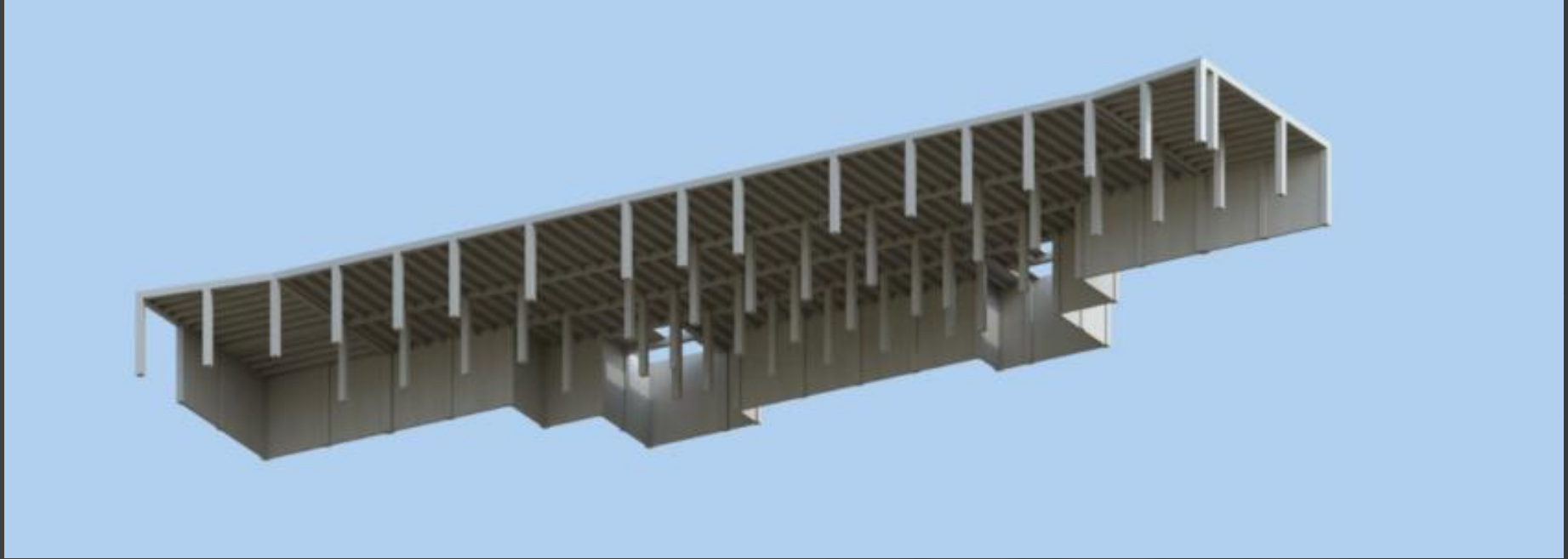


# Concourse Framing

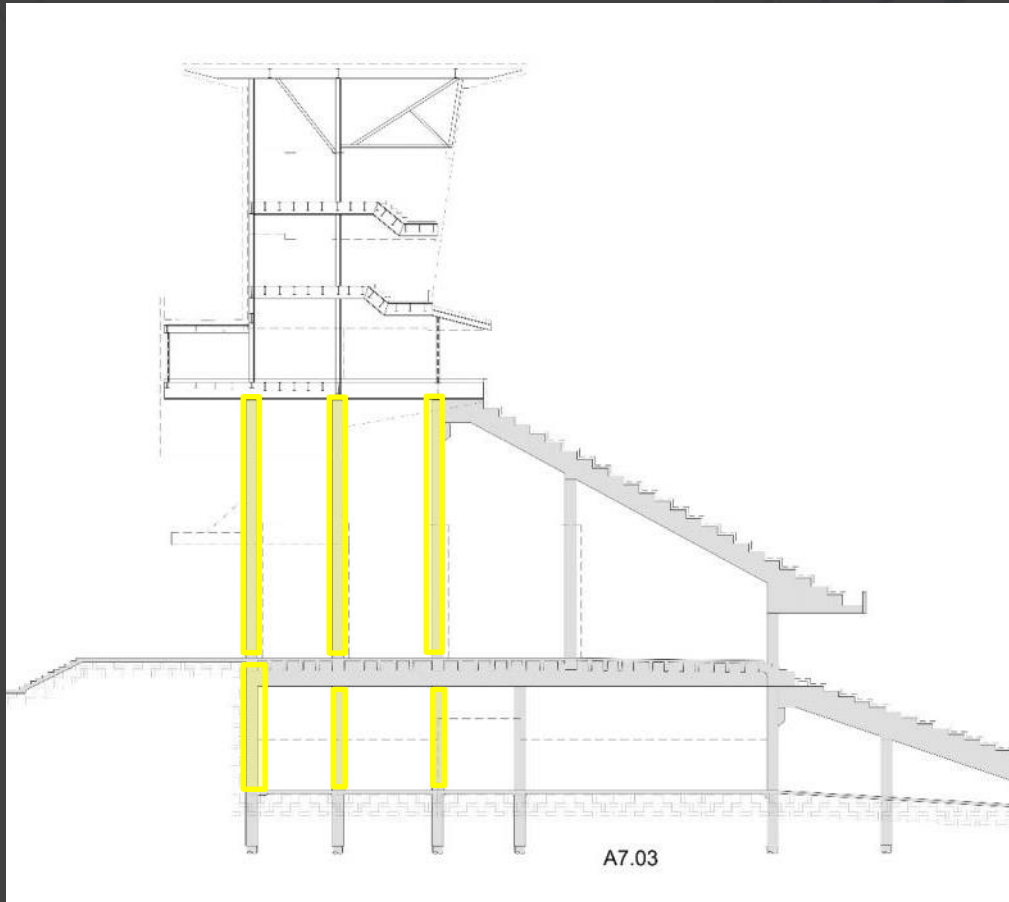


A7.03

# Concourse Framing

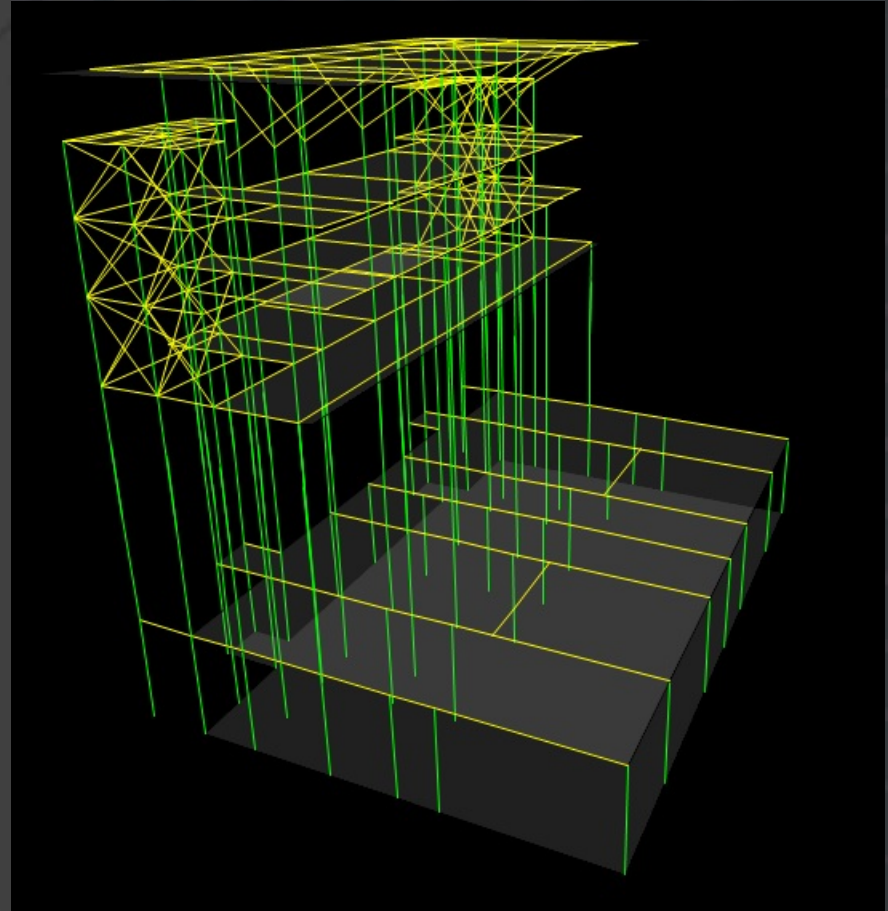


# Press Box Support Columns

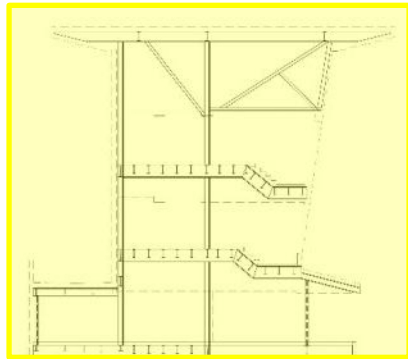




# Press Box Support Columns

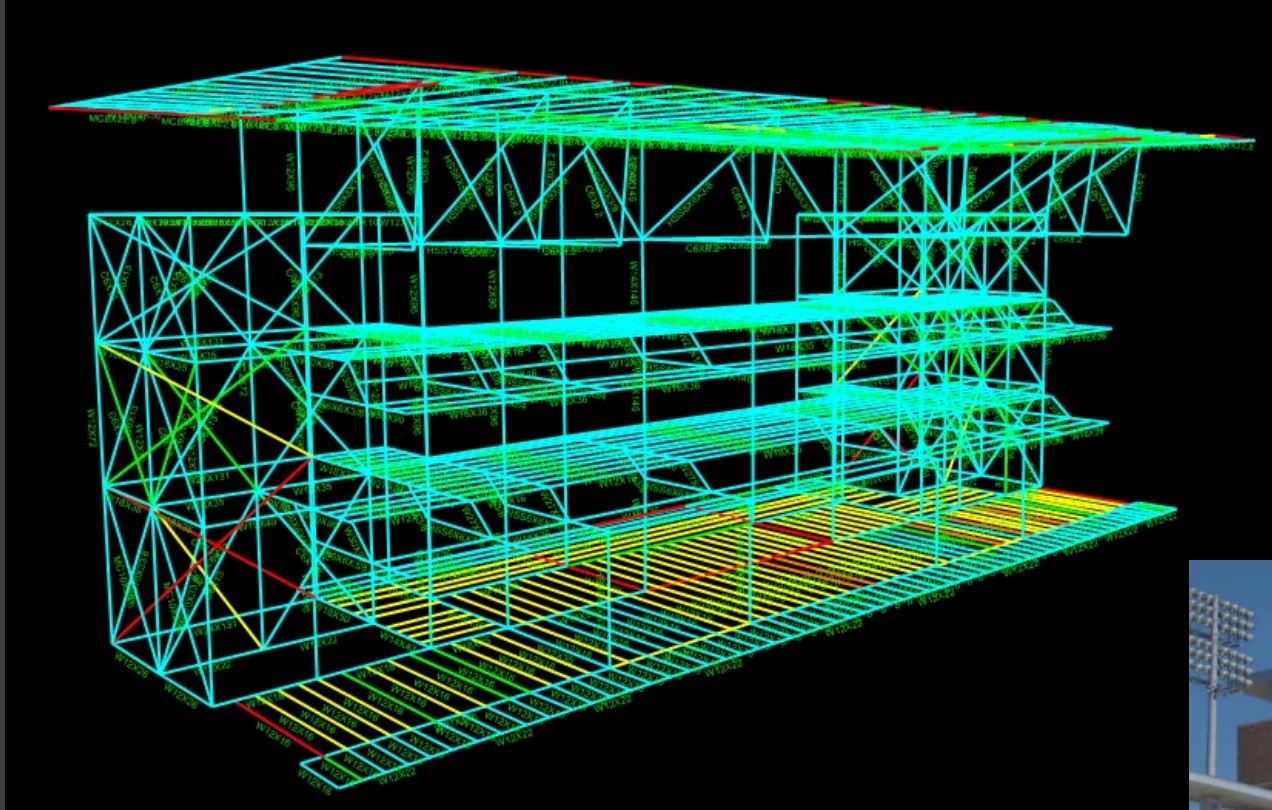


# Press Box Structure



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# Press Box Structure





# Low Steel Buildings and South Scoreboard



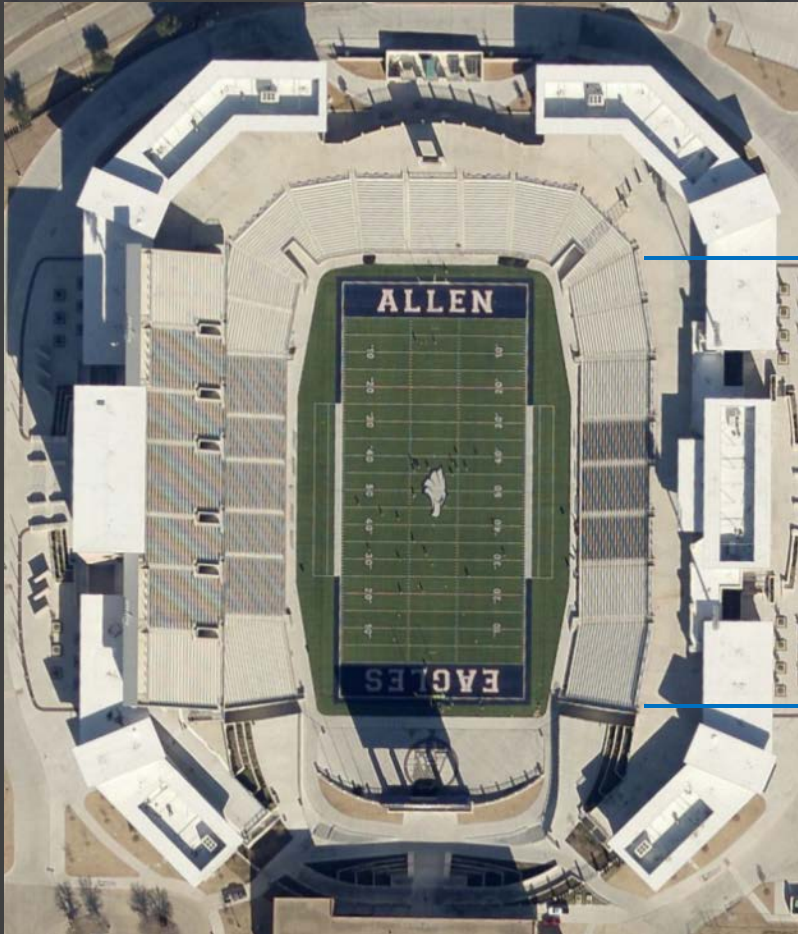


# Durability Deficiency

## Durability:

The ability of a structural member or system to serve its intended purpose for its required service life.

# Durability



# Durability



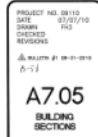


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# Summary of Findings

## Structurally Deficient:

- Retaining walls
- Concourse framing
- Press box support columns
- Press box structure
- Single-story structures
- South scoreboard
- Durability (life cycle)

# Remediation Approaches

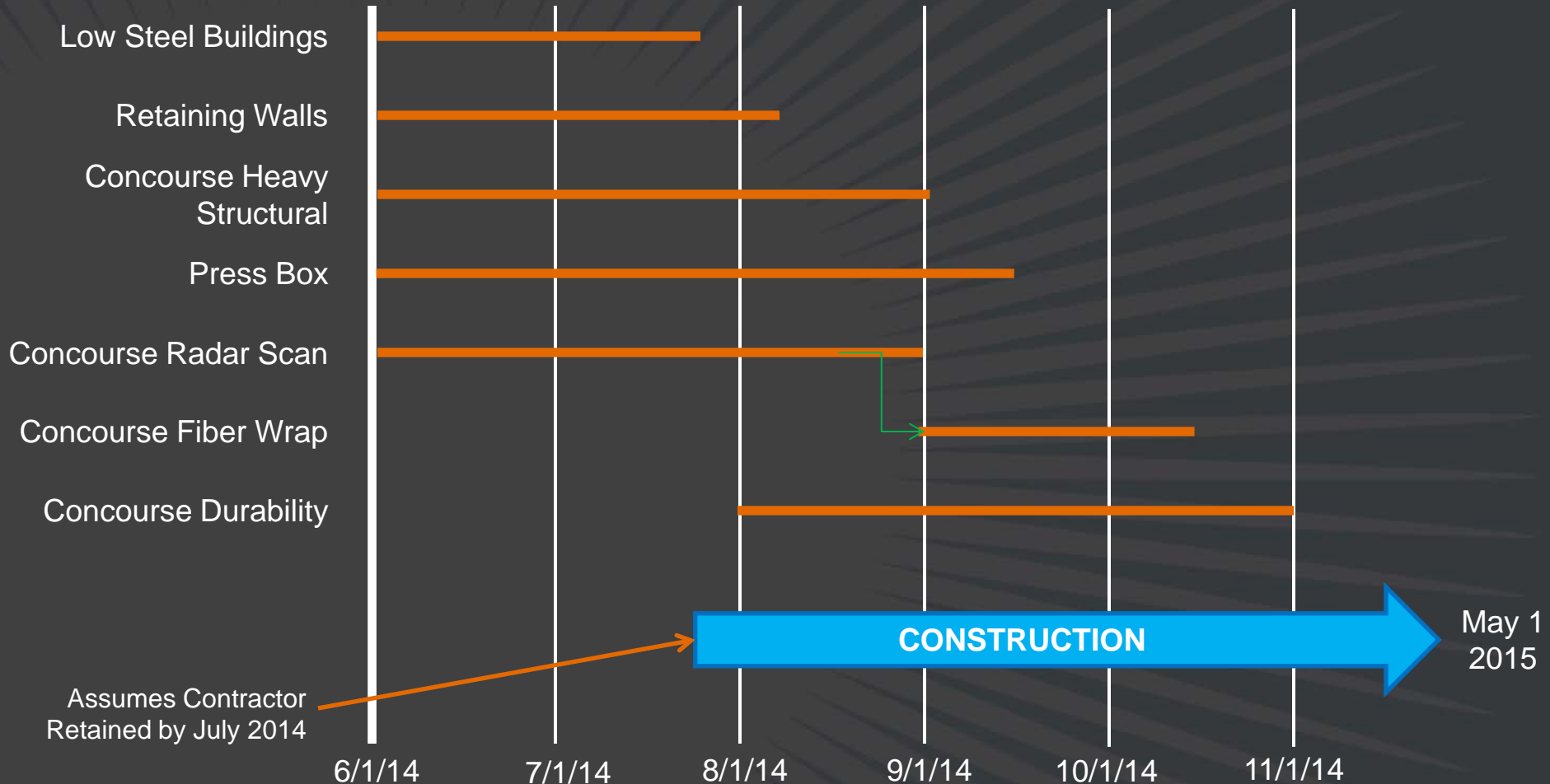
## Design-Bid-Build

- Key Advantage:** Total cost for repair known prior to commencement of construction
- Key Disadvantage:** Construction can not begin until all engineering design is complete (~5 months)

## Staged Design/Construction

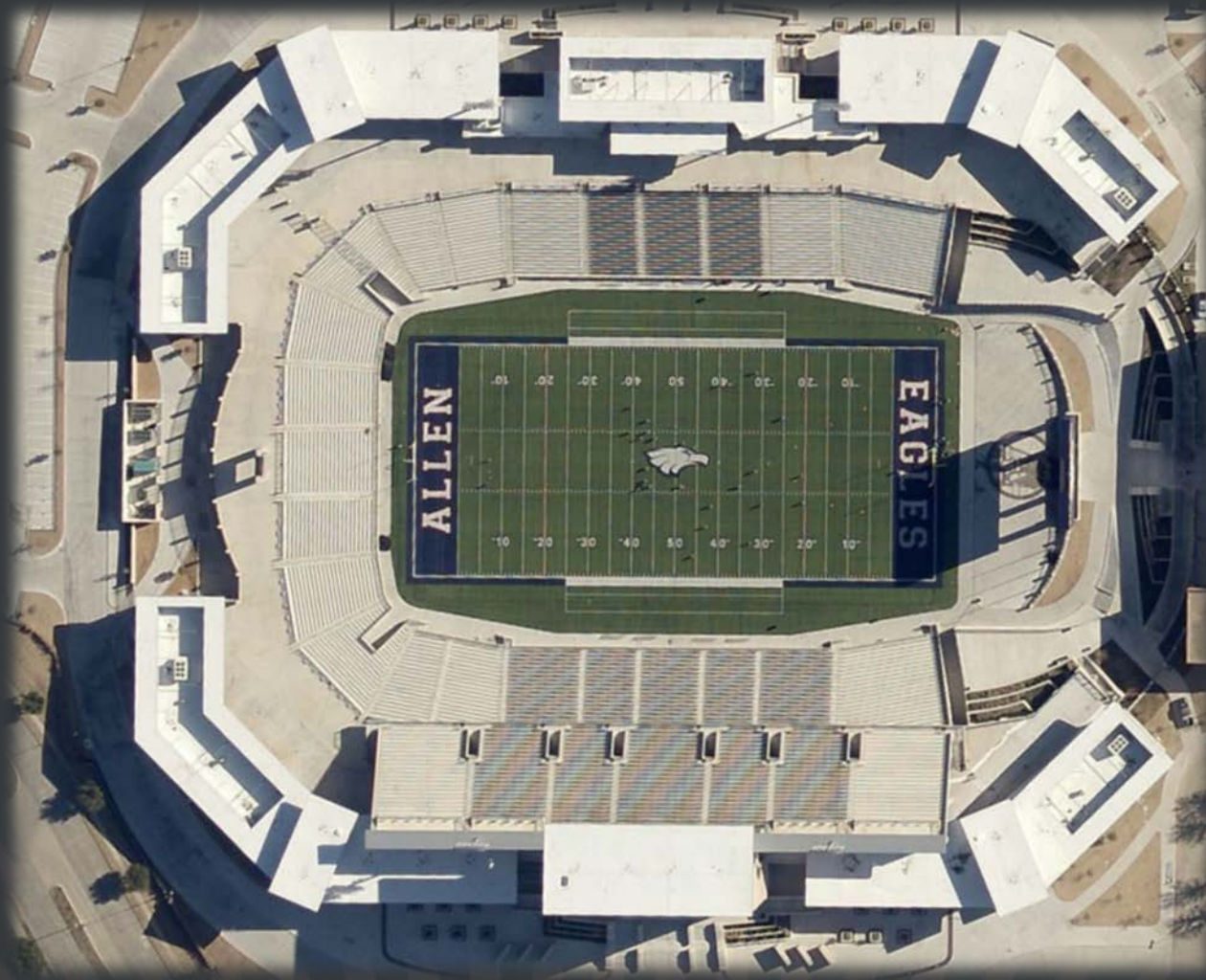
- Key Advantage:** Design is segmented into “packages” such that construction begins as packages are issued
- Key Disadvantage:** Total cost of construction uncertain until later in the repair process

# Staged Design Schedule





# Discussion



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