Expansion of Spectator Seating to a Total of 3,000

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Mechanical Option
The Pennsylvania State University
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INDOOR MULTI-SPORT FACILITY
Pennsylvania State University

Outline

• Project Team
• Existing Conditions
• Parameters
• Architectural Design
• Structural Design
• Electrical Design

• Mechanical Design
• Cost Estimates
• Summary
• Acknowledgements
• Questions?
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Project Team

• **Owner:** The Pennsylvania State University
• **Architect:** NBBJ
• **Associate/Landscape Architect:** Hoffman Popovich
• **MEP Engineer:** Parfitt/Ling
• **Structural Engineer:** Korda/Nemeth Engineering, Inc
• **Civil Engineer:** Gannett Fleming, Inc
• **Sports Facility Consultant:** International Sports Management
• **Construction Management:** Barclay White, Inc
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Existing Conditions

- **Structural System**
  - Custom structural steel system
  - Roof system uses a truss system that spans over the entire track

- **Electrical/Lighting System**
  - Infinitely dimmable metal-halide luminaries (400W – 1000W) over the track
  - Regular power enters at 4160V; stepped down to 480V/277V 3Ø 1200A
  - Emergency power enters at 2400V; stepped down to 120V/240V 1Ø 150A
Existing Conditions

• Mechanical System
  – (19) 15,000cfm sidewall propeller fans
  – Gas-fired infrared radiant heating system at ceiling height
  – 18,000cfm AHU for spectator ventilation

• Special Features
  – The roof uses a stainless steel sheets that stretch the entire 200ft
  – The track has a 65ft radius hydraulic lift system to bank the turns
Parameters of the Addition

• General
  – Match addition architecture to existing
  – Place minimum 2,200 seats at south end of track
  – Minimize spectator traffic flow back to the program space
  – Place concession stand at new section

• Mechanical
  – Avoid changes to existing Mechanical system
  – Apply same principals to new section as with existing
Architectural Design

- Corridor to the New Section.
  - Height extends to the top of the addition (31’)
  - Open to track with railing to divide the spaces
  - Extra wide to allow watching the meets from the foot of the track, if desired
  - Possibility to add Big Ten banners along the walls or center of ceiling
  - Windows line the entire length of the corridor
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Architectural Design

• Spectator Seating Area
  – Seating to accommodate 2,200 screaming fans
  – Space for physically handicapped people
  – Concession and Restroom Area
Architectural Design

• Track Level
  – Added extra showering facilities for visitor teams
  – Extra space for miscellaneous use. (possible visitor team area)
  – Area in front of stands (behind a barrier) for spectator traffic
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Flow Pattern

[Diagram of flow pattern inside the facility]
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Structural Design

- Roof Framing Plan
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Structural Design

- Second Floor Framing Plan

![Second Floor Framing Plan Diagram]
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Electrical Design

• Representative Lighting Layout (First Floor)
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Electrical Design

- Representative Lighting Layout (Second Floor)
Electrical Design

### Mechanical Equipment

<table>
<thead>
<tr>
<th>Type</th>
<th>BHP</th>
<th>FLA</th>
<th>Breaker</th>
<th>Ckt. Bkr.</th>
<th>Feeder (75ºC)</th>
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</thead>
<tbody>
<tr>
<td>AHU (3Ø 208V)</td>
<td>-</td>
<td>72</td>
<td>180</td>
<td>200</td>
<td>(4) 3 AWG, 1.25&quot; C</td>
</tr>
<tr>
<td>Fans (3Ø 208V) (90% Efficient)</td>
<td>1.72</td>
<td>3.96</td>
<td>9.90</td>
<td>15</td>
<td>(4) 12 AWG, 0.5&quot; C</td>
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<tr>
<td>Total Current (A) (1AHU, 9Fans):</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>269</td>
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</table>

- Use inverse time delay breaker: 250% FLA (NEC 430-52)
- Feeder Sizing: 125% FLA (NEC 430-22)

### Required Service

<table>
<thead>
<tr>
<th>Type</th>
<th>A</th>
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<tbody>
<tr>
<td>Lighting</td>
<td>36</td>
</tr>
<tr>
<td>Mechanical</td>
<td>269</td>
</tr>
<tr>
<td>Recept (50)</td>
<td>25</td>
</tr>
<tr>
<td>Total (10% Exp):</td>
<td>363</td>
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<tr>
<td>Actual Service:</td>
<td>400A 120V/208Y</td>
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</table>
Mechanical Design

- Winter Heating
  - Roberts Gordon, CoRayVac Gas-fire radiant heating
  - Spaced at recommended distances (30’ – 60’)
    - Same system used in existing building

- Ventilation
  - 35,650cfm total outdoor air (ASHRAE 62-2001)
    - 33,000cfm for spectators
    - 1,650cfm for restrooms
    - 1,000cfm for locker rooms
  - Trane direct gas-fired air handling unit
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Mechanical Design

- Concept Used for Summer Cooling

Diagram:
- Air Flow up to Existing Fans
- Air from Supply Vents
- Vents at Risers
- Open Area Beneath Stands
- Louvers to Outside
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Mechanical Design

- Air Flow Ducting Cross-Section
Mechanical Design

• Air Flow Requirements
  – 50fpm over spectators (ASHRAE 55-1992)
  – 3,770 square feet of vent area
  – 188,500 total cfm

• Fan Design
  – (9) Greenheck sidewall propeller fans
    • 23,000cfm each fan = 207,000cfm total
  – Fans located at the end of addition
Mechanical Design

- Controls
  - AHU controlled with existing ventilation system
  - Fans controlled in thirds to allow less air flow during the early spring and late fall
    - Fans can be fully integrated with existing cross-ventilation system
Mechanical Design

- First Floor Mechanical Plan
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Mechanical Design

- Second Floor Mechanical Plan
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Cost Estimates

- Using RS Means 2001 (Time shifted to 2003)
  - Component costs include materials, labor, equipment and profit
  - State College used for location
  - Radiant heating units, piping, AHU, fans, and ductwork are included within the mechanical cost
  - Concrete Floor, Grandstands, steel roof, roof insulation, wall brick, windows, louvers, lavs, water closets and showers are included within the miscellaneous
  - Other covers everything else like: lighting, foundation, electrical, etc.

<table>
<thead>
<tr>
<th>Total Cost</th>
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<tbody>
<tr>
<td>Mechanical</td>
<td>$ 139,061</td>
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<tr>
<td>Steel</td>
<td>$ 255,054</td>
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<tr>
<td>Miscellaneous</td>
<td>$ 2,045,320</td>
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<td>Other (25%)</td>
<td>$ 609,858</td>
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<tr>
<td>Total</td>
<td>$ 3,049,294</td>
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<tr>
<td>Loc. Factor</td>
<td>97</td>
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<tr>
<td>Time Factor</td>
<td>1.04</td>
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<td><strong>Final Cost</strong></td>
<td><strong>$ 3,077,851</strong></td>
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Summary

• Reasons to Build
  – Increase revenue due to increase in seating capacity
  – “Show Piece” – more coverage on Television from NCAA Big Ten Championship Indoor Track Meet
  – Help Indoor Track teams gain prestige
  – Very little interruption to building use

• Reason not to Build
  – $3 million is a lot of money
  – Takes up adjacent “Green Space”

• Recommendation
  – As Nike says… “Just Do It!”
  – If the money can be raised
Acknowledgements

- Moses D.F. Ling, PE, RA
  - Ling Partnership (formally Parfitt/Ling)
- Marv Bevan, Jr., PE, RA
  - Office of Physical Plant (Penn State)
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- James Freihaut, Ph.D.
  - Associate Professor AE (Penn State) (AE Consultant)
- Jonathan Dougherty
  - Grad. Student (Penn State)
- AE Buddies
Questions?