SCHEMATIC DESIGN PLANNING

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Mission Statement:

To deliver innovative designs, with an integrated, streamlined approach to building systems and construction management

Agenda

Goals
Site Investigation
Roof Structure and Materials
Coordinated Design Items
LEED Considerations
Conclusion

Project Goals

Deliver a NCAA *Championship* level hockey facility

Produce an *iconic* design that represents Penn State athletics and the University's dedication to a *sustainable* future

Provide a multipurpose facility that can *unite* the University and local community

BIM Thesis Goals

To develop a greater understanding of the wants and needs of each discipline

To recognize design conflicts before they reach construction

To design with constructability in mind

Decision Making Process

Vote on all decisions with Majority Ruling

In the case of a tie:

1. Step Back & Reanalyze from Different Viewpoints
2. Consult Faculty
3. Discuss Faculty Thoughts
4. Discipline Most Affected Decides

Geotechnical Report

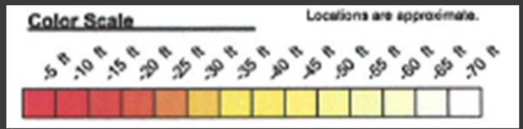
Pinnacle Rock Formations

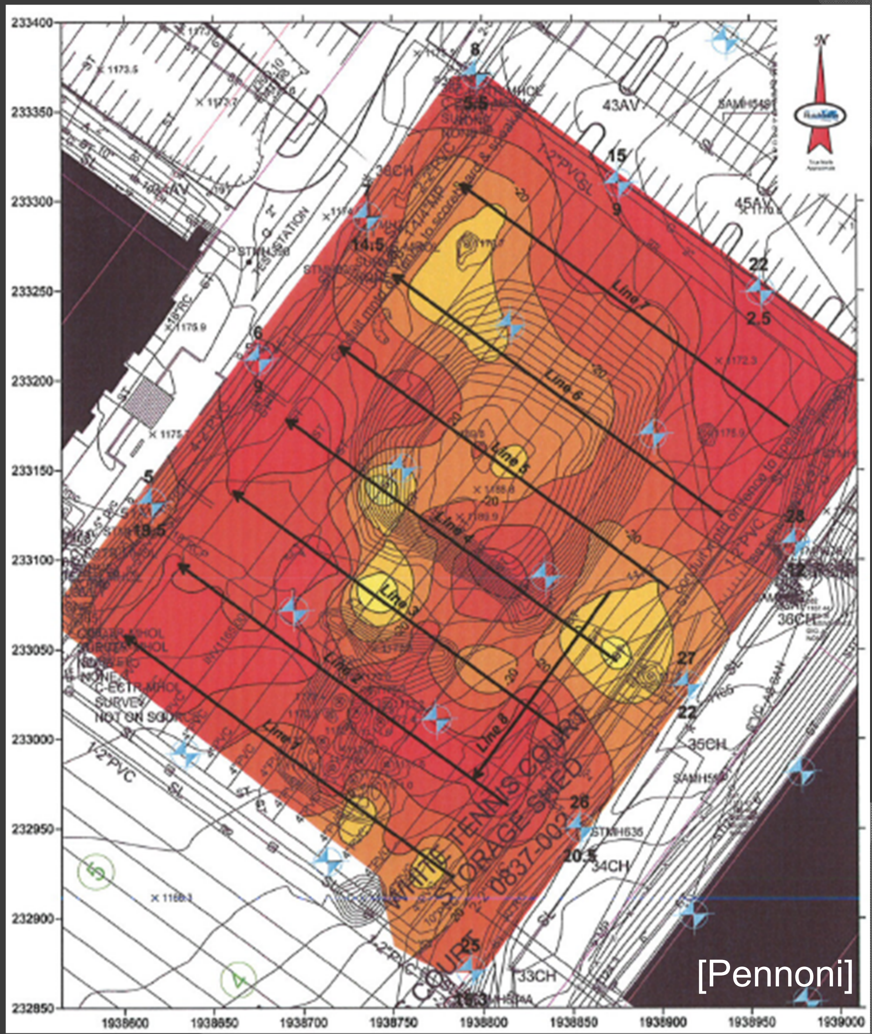
Shallow and Deep Foundation

Net Allowable Rock Bearing Capacity= 15,000 psf

Net Allowable Bearing Capacity on Stiff Clay= 3,000 psf

Excavation Issues





Excavation Concerns

"Excavations in trenches will be extremely difficult if not impossible"

- Pennoni

Blasting allowable

Minimize Vibrations

Site Logistics

Laydown/staging area

Parking

Deliveries

Pedestrian Walkways

[rlccampus.wordpress.com]

Dewatering

Water must be kept out of site

Sinkhole mitigation

Prevent erosion and rainwater from running off site

Excavation

Topsoil saved

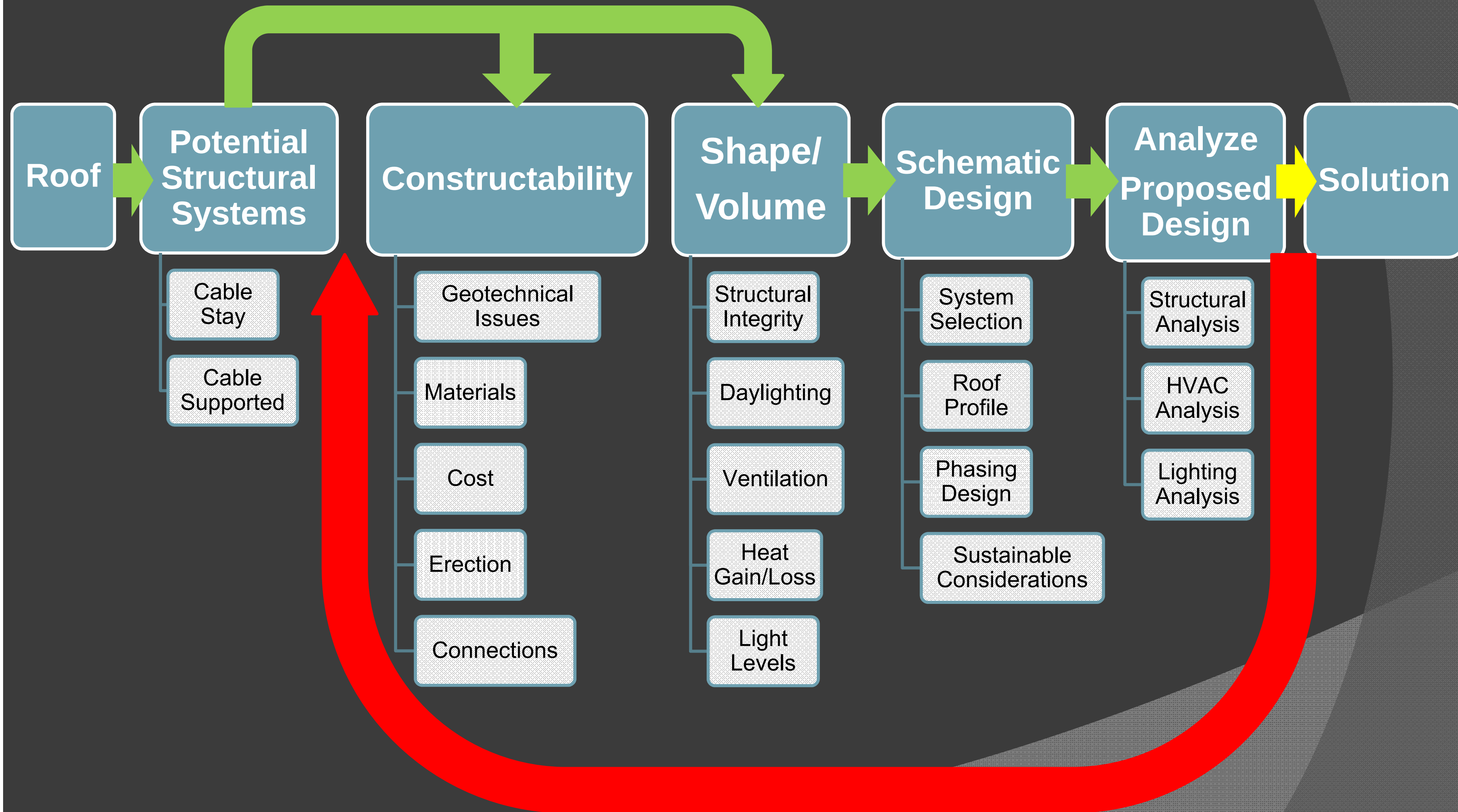
May reuse excavated soil and stone for filler

Blasting

Prevent runoff and erosion

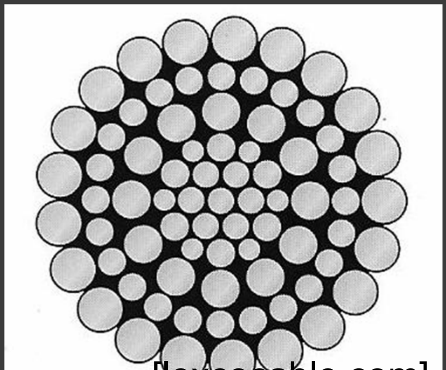
Avoid existing utilities

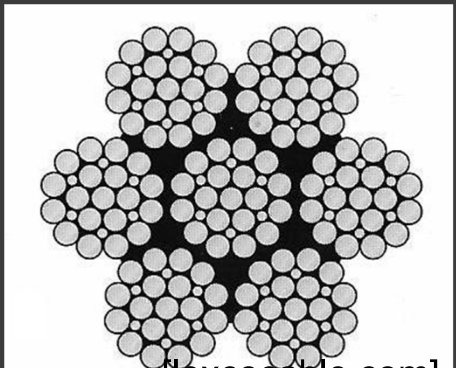
Roof Selection Process



Cable Structure Basics

Strands vs Ropes


[lexcocable.com]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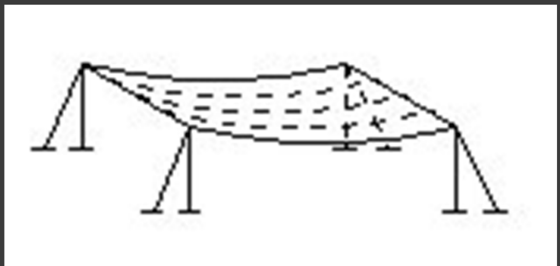
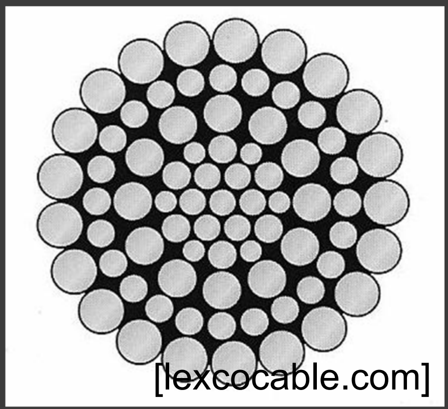
Basic Categories

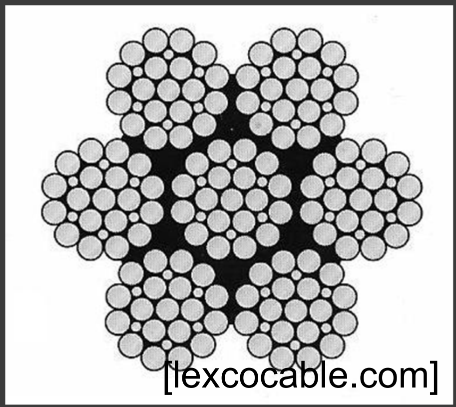

[fgg.uni-lj.si]

Single Curvature

Cable Structure Basics

Strands vs Ropes





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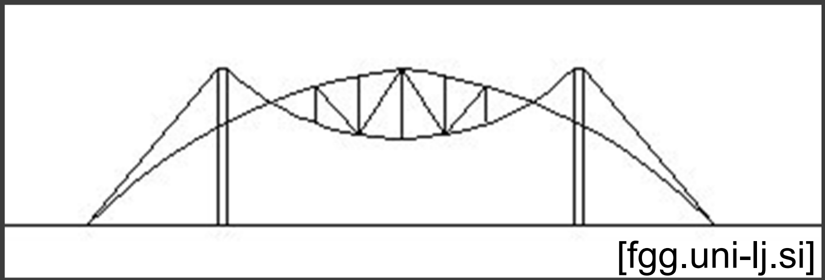

Double Curvature

Cable Structure Basics

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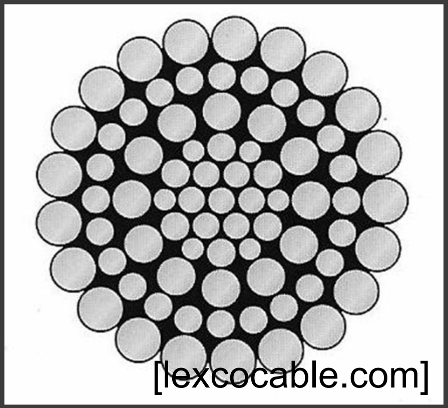

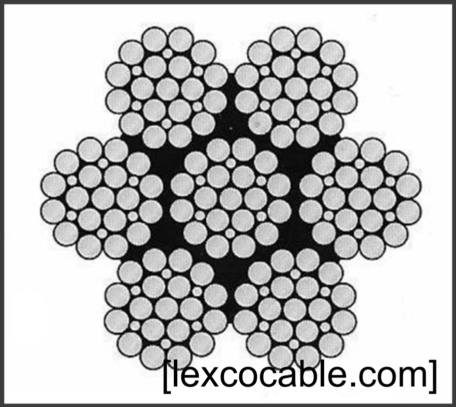

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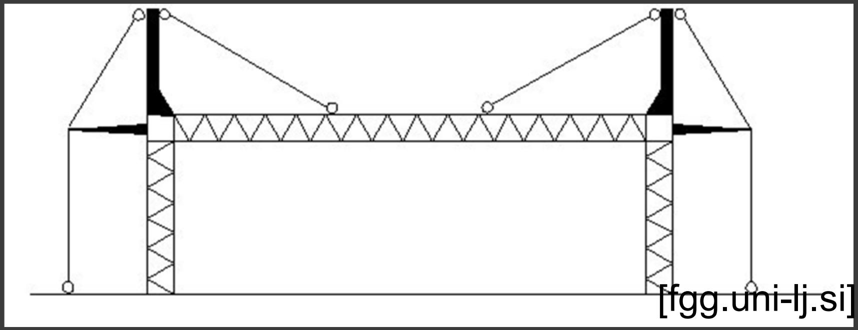
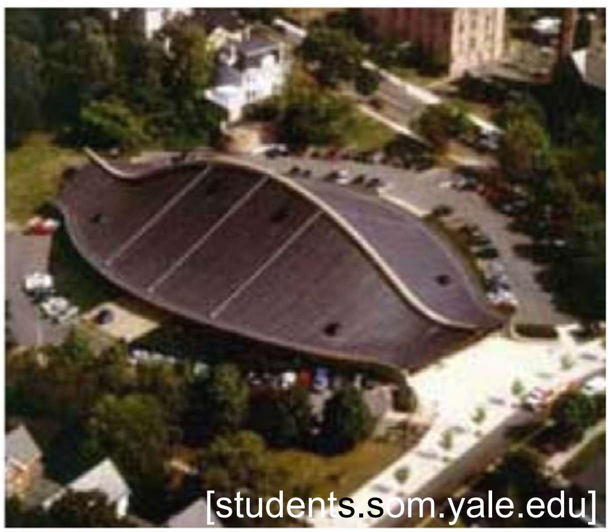


Cable Stay

Case Studies

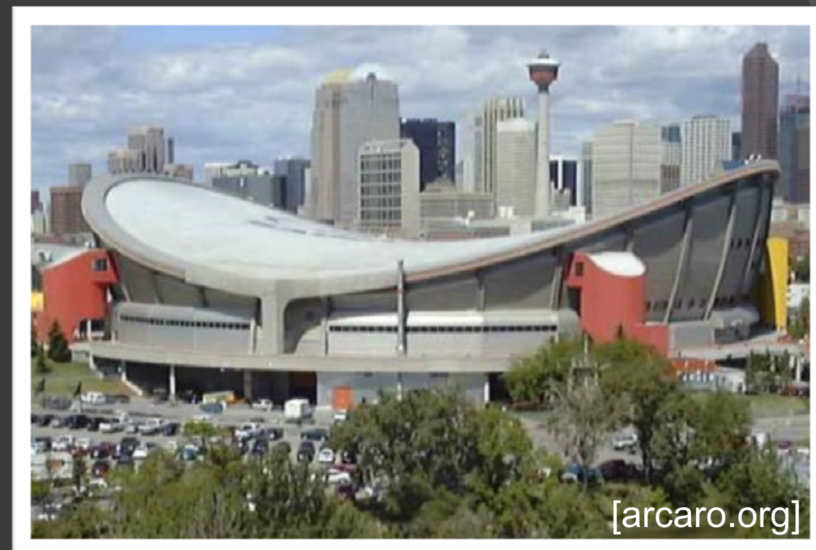

[giving.yale.edu]


[students.som.yale.edu]


[buildershdwe.com]

Ingalls Rink- 1959
Yale University
New Haven, Connecticut
Architect: Eero Saarinen
300 foot Concrete Backbone

Case Studies



Scotiabank Saddledome- 1983
Calgary, Alberta, Canada
Hyperbolic Parabaloid Concrete Shell
400 foot span covering ~3 acres

Case Studies

Dulles International Airport- 1962
Washington, DC
Architect: Eero Saarinen
141 foot Span Single Curvature

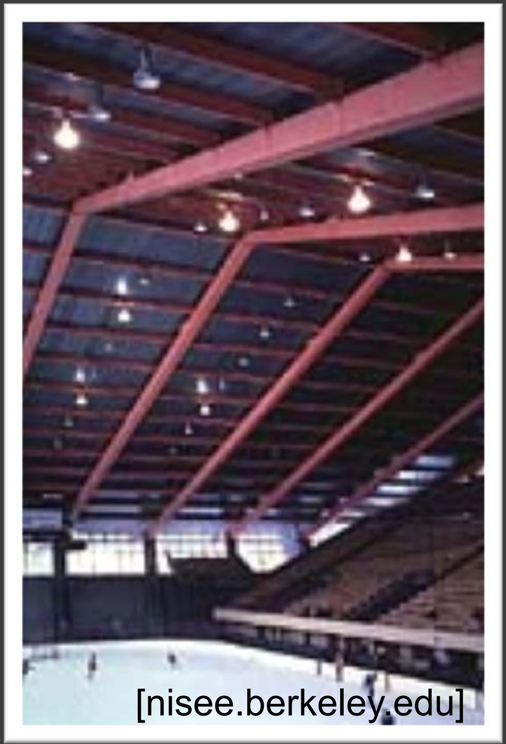
Case Studies


[aedesign.wordpress.com]


[en.wikipedia.org]

Oxford Ice Rink- 1984
Oxford, England
Structural Engineer: Ove Arup
2-Mast (98 feet) Cable Stay
236 feet by 125 feet

Case Studies



Blyth Arena- 1959
Squaw Valley, California
16-Mast Cable Stay
300 feet by 232 feet

Cable Suspended Roof

Plusses

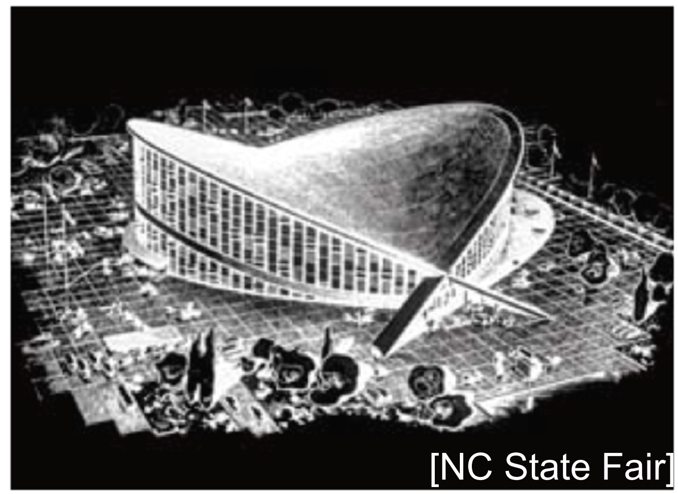
- Economy
- Reduce Roof Weight
- Open Plan
- No Local Buckling
- Resists Settlement
- Fire Safety
- Acoustics
- Ventilation


[london2012.com]

Cable Suspended Roof

Minuses
- Flutter
- Temperature Effects
- Deflection

Other Considerations
- Watertightness
- Drainage


[NC State Fair]

Cable Stayed Roof

Plusses

- Open Plan
- Regularity
- Concentrated Found.
- ↓ Building Volume
- Free Roof Clutter
- Strong Visual Identity

Cable Stayed Roof

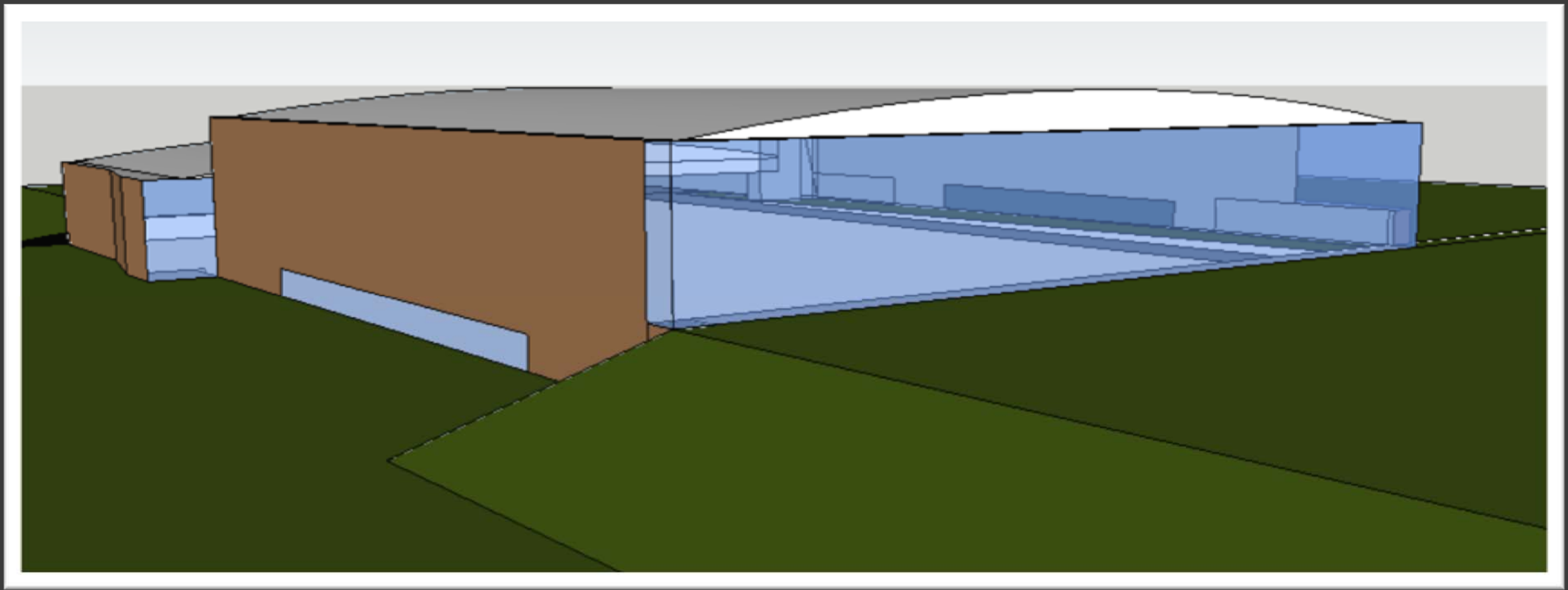
Minuses

- Higher Design Costs
- Thermal Movement
- Corrosion Protection
- Roof System
- Erection

Construction Considerations

- Cable Anchorage
- Erection
  - Sequencing
  - Prestressing
- Cable Supports
  - Buttress
  - Masts
- Foundations

Possible Roof Shapes



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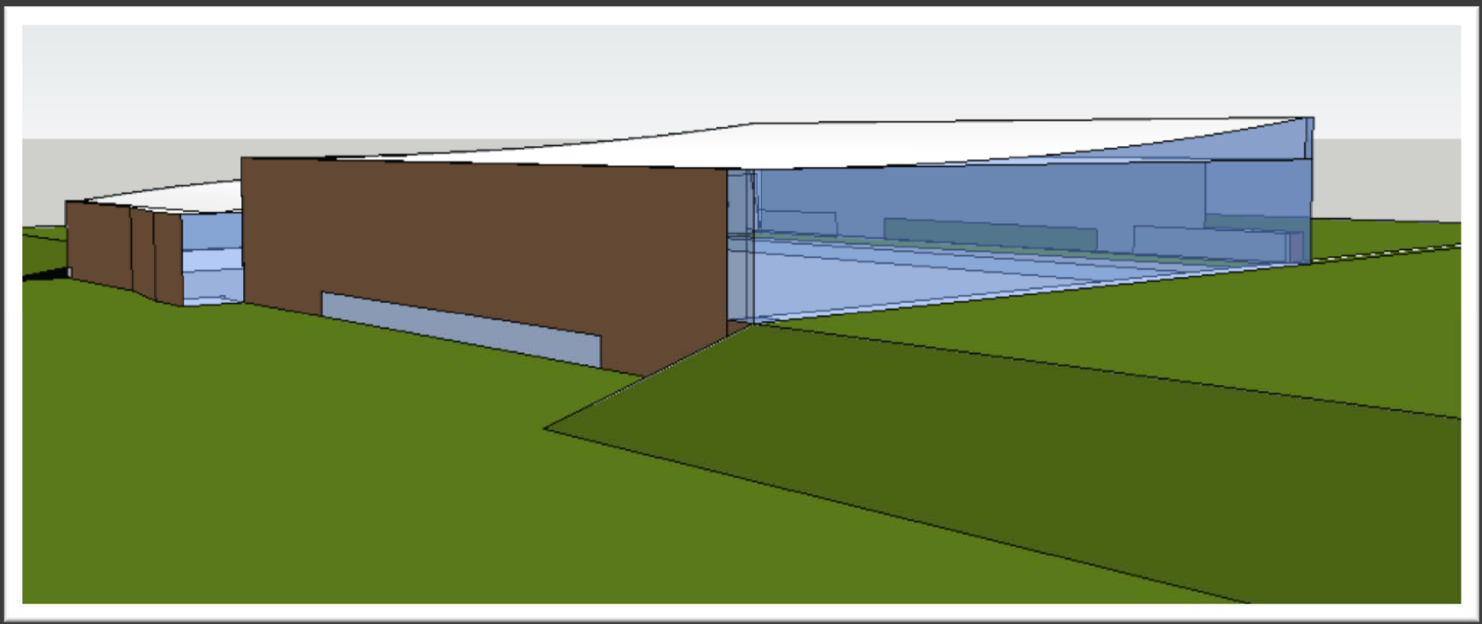

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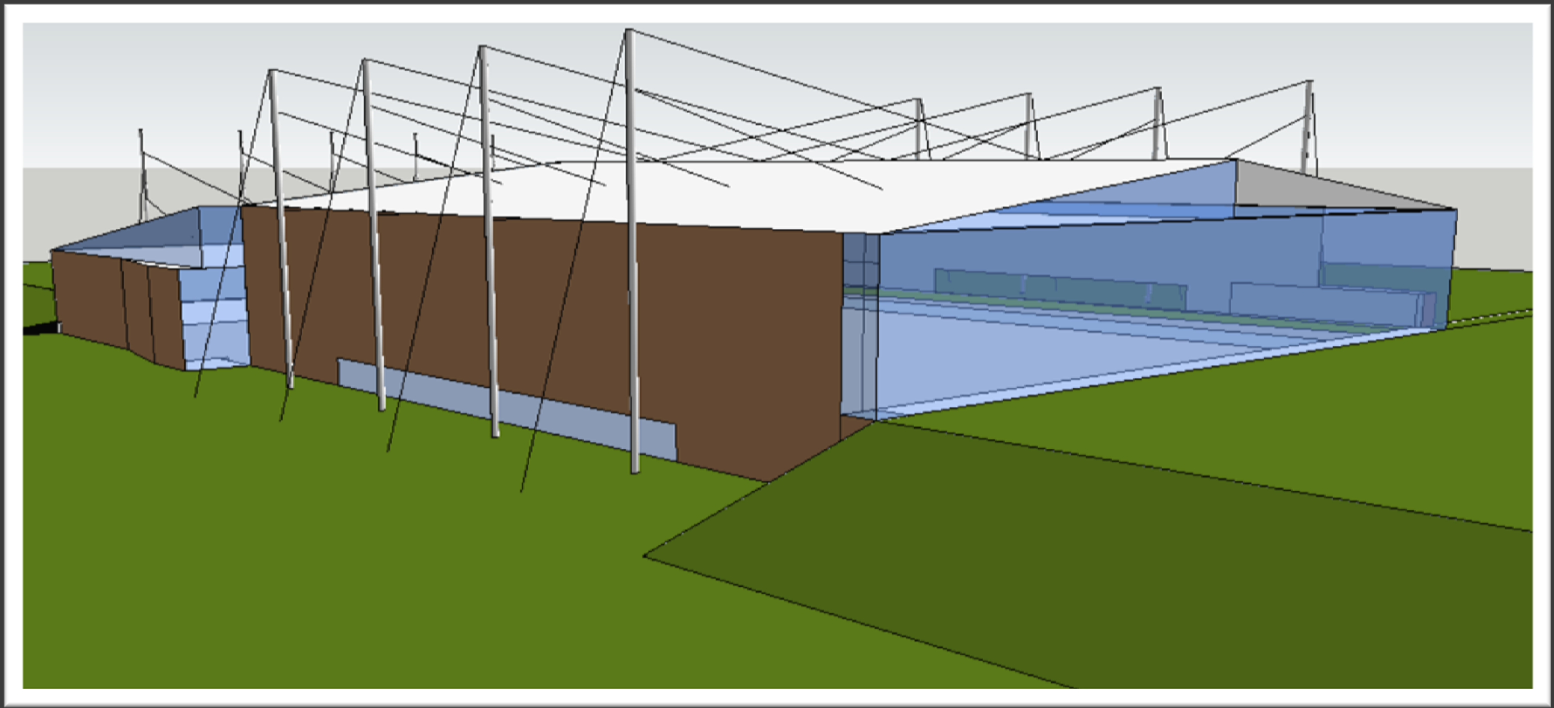


Radiant Floors

For Lobby and Concourse Spaces

Thermal Comfort Quality

Indoor Air Quality

Energy Efficient

Dedicated Outdoor Air System

Dedicated Outdoor Air System

Heat Recovery

Filtration

Deodorization

Decontamination

Dehumidification

Minimize Ductwork

[commercial.carrier.com]

Chilled Beams

- High COP
- Quiet
- Low Maintenance
- Lower Carbon Emissions
- Prefabrication
- Multi-service


[energydesignresources.com]

Heat Rejection

Radiant Floors

Hot Water

Snow Melt

Heated Seats

Under Ice Heating

Lighting: Considerations

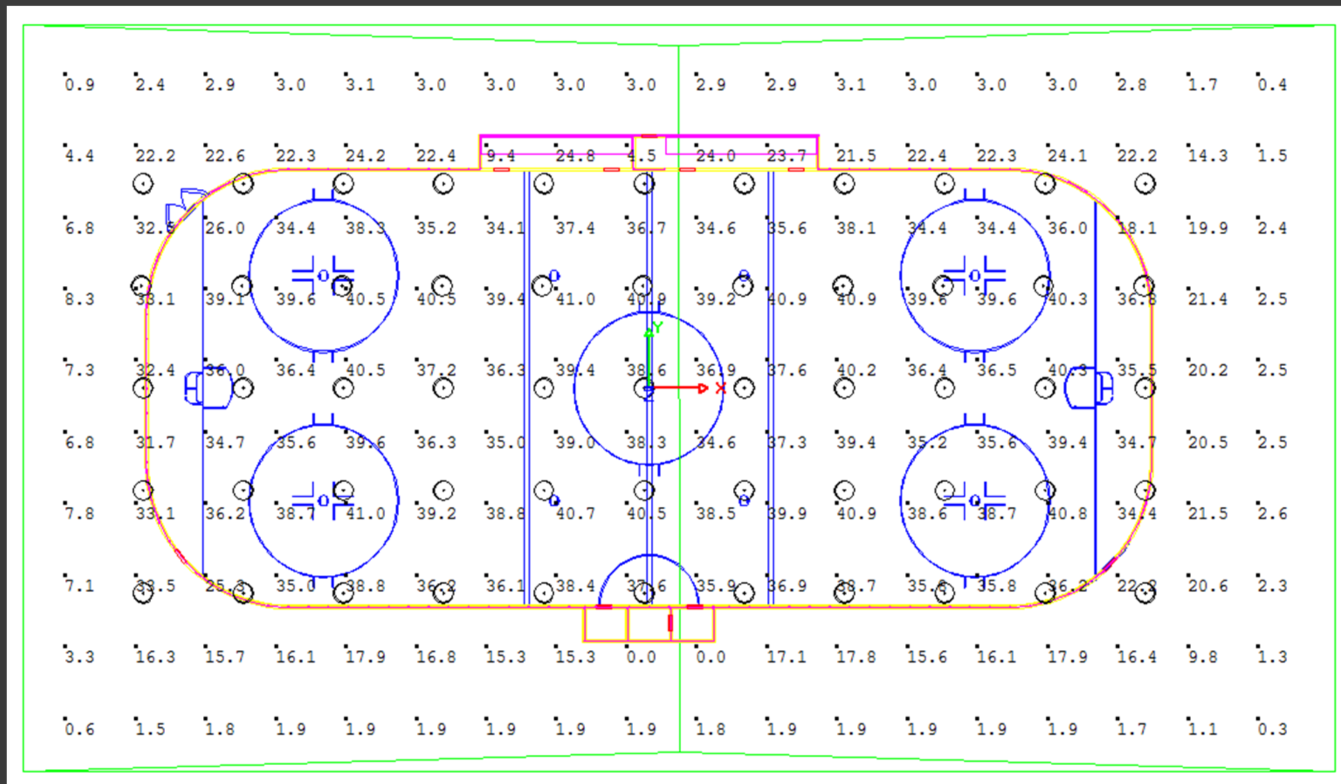
NCAA Recommendations

- Main Rink (Broadcasting)
  - E_h = 125 fc \ E_v = 125 fc
  - Uniformity Ratio = 1.5:1
- Community Rink
  - E_h = 100 fc
  - Uniformity Ratio = 2.5:1
- Multi-directional ground level sport
  - Uniform/adequate illuminance
  - Minimize glare/shadows

Lighting: Considerations

- IES Recommendations
  - Administrative Areas
    - Circulation: 10 fc
    - Offices: 30 fc
    - Conference Rooms: 30 fc
  - Lockers/Restrooms
    - General: 5 fc
    - Showers: 10 fc

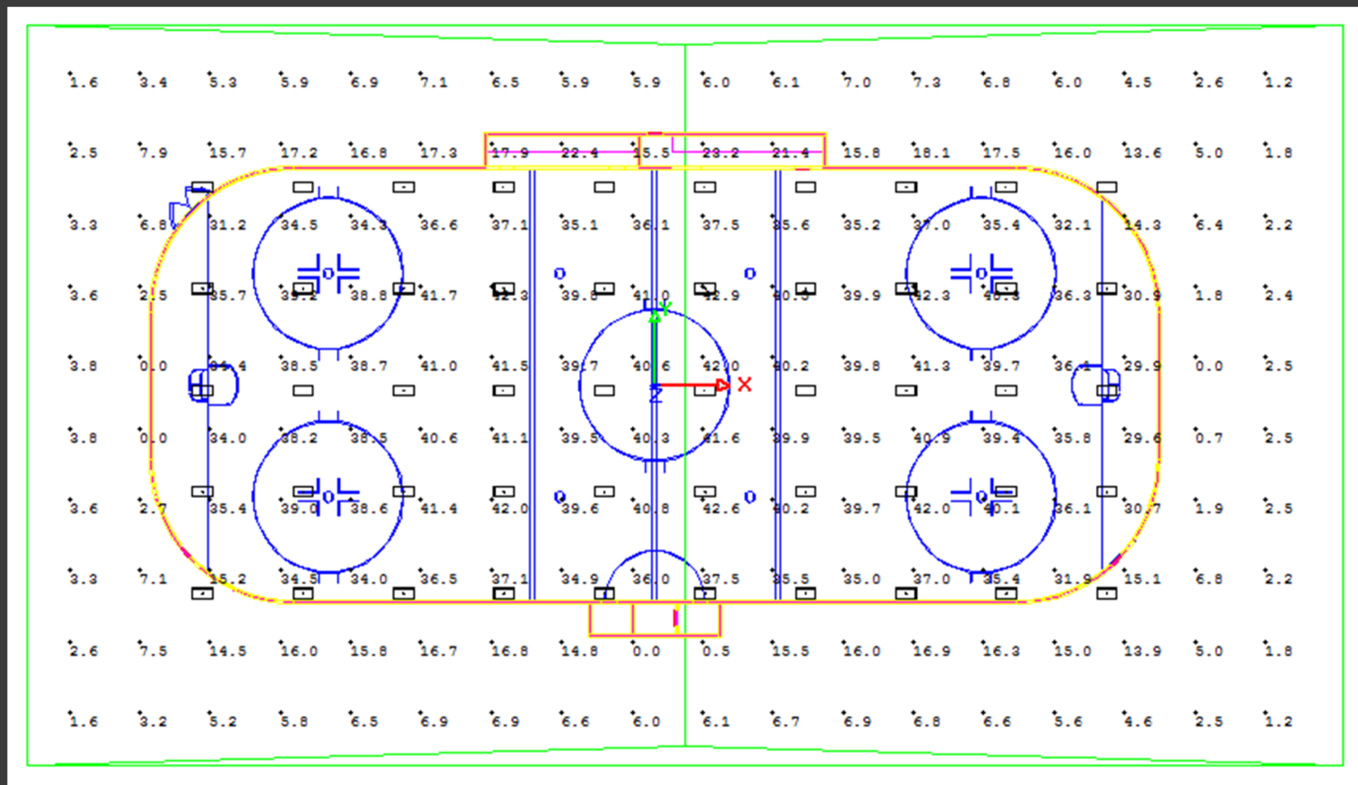
Lighting: Source Analysis (MH)



55 - 400W metal-halide luminaires @ 438W = 24,090W

Average illuminance = 41 fc

Lighting: Source Analysis (FL)



50 - (4)T8HO 65W fluorescent luminaires @ 280W = 14,000W

Average illuminance = 43 fc

Lighting: Source Analysis

Metal-Halide

- 400W/lamp (438W)
- 55 luminaires
- 24,090 watts
- Average 41 fc
- 31,000 lumens
- 77 lumens/watt

Fluorescent

- 65W/lamp (280W)
- 50 luminaires
- 14,000 watts
- Average 43 fc
- 5490 lumens/lamp
- 21,960 lumens/luminaire
- 84 lumens/watt

10000 watt reduction in fluorescent compared to MH

10000 watts = 42% energy reduction

Daylighting

Main Arena

- Enclosed/surrounded by rooms
- Cable roof system… utilize roof

Need to:

- Correctly model
- Analyze loads and performance

Georgia Dome, Atlanta

Daylighting

Community Rink

- Virtually no integration
- Aerogels
  - Translucent solid
  - Good insulating properties
  - Diffuses light/reduces glare
- Need to
  - Correctly model
  - Analyze impacts and performance


Port Hawkesbury Civic Center, NS


Killarney Community Centre, Vancouver

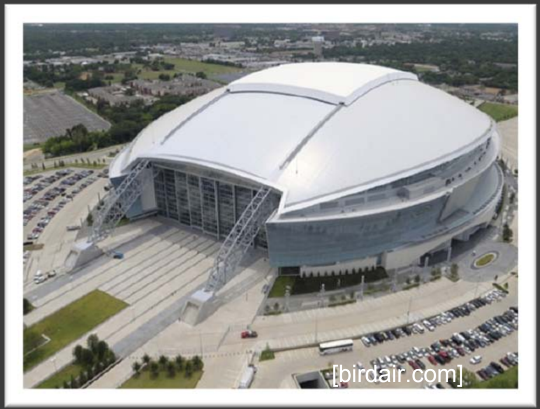
Birdair

- Daylighting
- Increased Insulated Value
- Thermal Efficiency
- Steel Cable Assembly
- Reduced Material Usage
- LEED
- Acoustics

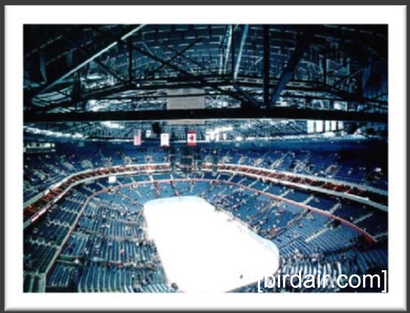
Aspen Music Festival

Birdair

1200 Major Installations Worldwide



Cowboys Stadium



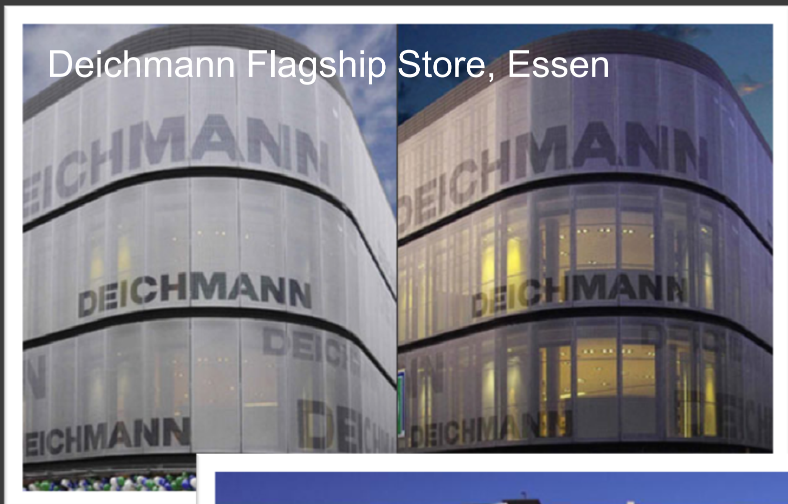
HSBC Arena

Red Bull Arena

Nelson Mandela Bay Stadium

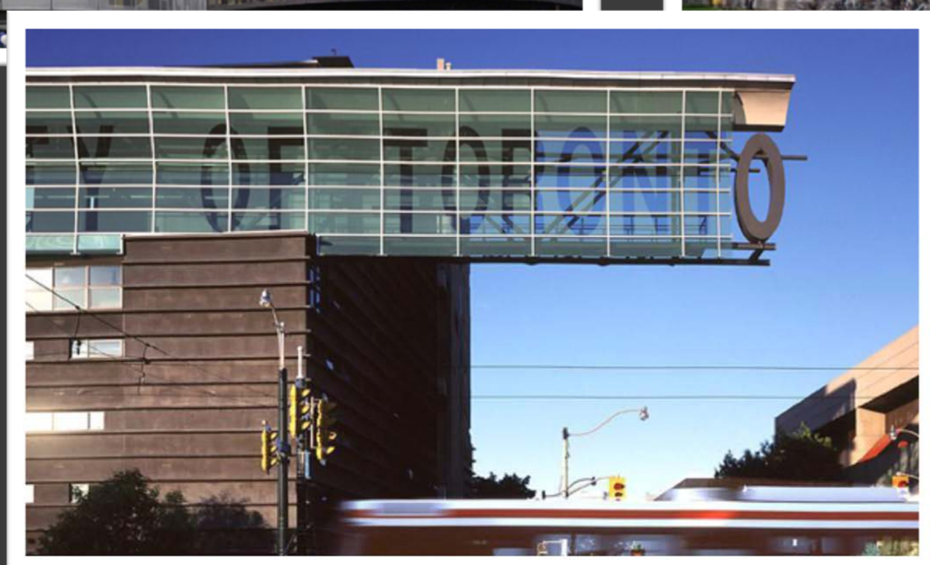
Talisman Centre

Architectural Branding



Deichmann Flagship Store, Essen

Minnaert Center, Washington



University of Toronto

Sustainability

- OPP/University Guidelines
- Energy Efficient Chillers
- Local Materials/Manufacturers
- Extensive Daylighting
- Recycled Materials
- Advanced Control Systems
- Rainwater Collection
- Sustainable Landscape
- Efficient Lighting

Cable Manufacturers

Sustainability

OPP/University Guidelines

Energy Efficient Chillers

Local Materials/Manufacturers

Extensive Daylighting

Recycled Materials

Advanced Control Systems

Rainwater Collection

Sustainable Landscape

Efficient Lighting

U.S. GREEN BUILDING COUNCIL USGBC ®

Moving Forward