American Concrete Institute®
Advancing concrete knowledge

Advancements in the Use of Building Information Modeling (BIM) Systems

ACI Fall 2012 Convention
October 21 – 24, Toronto, ON

ACI
WEB SESSIONS

Dr. Kishek is a seasoned Professional Engineer with extensive experience in leading Structural teams on high profile educational, healthcare, commercial, municipal, governmental, industrial, recreational, and residential projects. He has over 20 years of successes as a Senior Engineer and Senior Project Manager working with top calibre Canadian and American firms. Well acknowledged by clients and stakeholders alike as an invaluable resource and a key player in the successful completion of dozens of signature quality projects, including the Greektown Casino 31-storey Hotel in downtown Detroit, Michigan, State of Michigan House of Representatives Building in Lansing, Michigan, the SickKids 25-storey Research Tower in Toronto; and The WindEEE Dome, UWO, London, Ontario. Dr. Kishek has a wealth of practical experience built on a firm theoretical foundation. Since earning his Doctoral degree in Structural Engineering from the University Of Cambridge, England, U.K., in 1984, Dr. Kishek was involved in academia first as a full time Professor at Birzeit University, Palestine, and later as an Adjunct Professor, University of Windsor, Windsor, Ontario, and as an Adjunct Professor at Lawrence Technological University, Southfield, Michigan.

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Toronto

The Windeee Dome - The Demonstration of the Successful Implementation

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NORR Ltd.

NORR ARCHITECTS ENGINEERS PLANNERS

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- Objectives of the Design Team
- Benefits of BIM in the Design Phase
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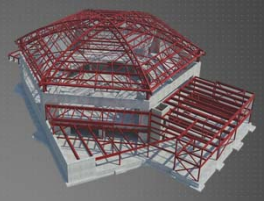

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INTRODUCTION

- The presentation will showcase the WindEEE Dome facility
- WindEEE = Wind Engineering, Energy and Environment
- Implementing BIM in a multidisciplinary environment
- NORR provided the Architectural, Structural, Mechanical & Electrical teams

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THE WINDEEE DOME FACILITY

- The first research facility of its kind in the world
- Capable of physically simulating high intensity wind systems
- Will study effect of local wind systems on the natural and built environmental under one roof
- Will improve positioning and design of wind farms

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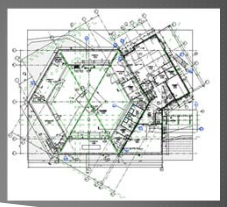
THE WINDEEE DOME FACILITY … CONT.

- Features a complex array of fans to simulate wind systems
- A total of 106 fans arranged around a hexagonal shaped test chamber
- Each fan can be manipulated individually



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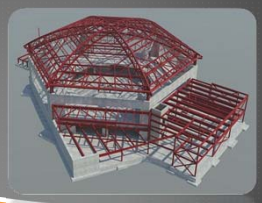
THE WINDEEE DOME - BUILDING

- Hexagonal test chamber attached to a research building
- Outer shell is 40 metres in diameter
- Inner Chamber is 25 metres in diameter
- Space between the outer shell & inner chamber is used to recirculate air



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OBJECTIVES OF DESIGN TEAMS

- To provide innovative and cost effective and design
- To provide a 3D, real time dynamic model
- BIM greatly enhanced collaboration between team members
- BIM ensured best fit at interface between equipment and the concrete and steel structures

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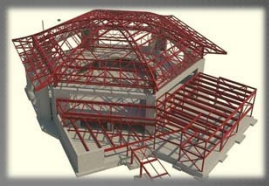
BIM – BUILDING INFORMATION MODELING

- A new approach to design, construction, & management of buildings
- BIM in a nutshell
- How does BIM work



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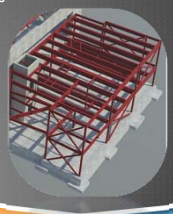
BENEFITS OF BIM IN THE DESIGN PHASE

- Sharing a central BIM model by multidisciplinary teams
- Teams can make better informed decisions earlier on in the planning
- Better coordination and clash detection
- Automatic capture and coordination of changes
- Easier and faster design revisions



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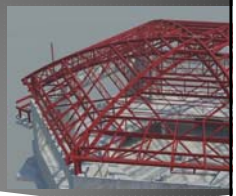
BENEFITS OF BIM IN THE DESIGN PHASE

- Generates schedules, costing and other attributes
- Calculates program areas, spatial relations and quantities
- Clients are requesting BIM as the sole delivery system



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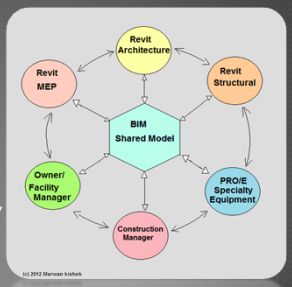
BIM MODELING SOFTWARE USED FOR WINDEEE

- REVIT used by A/E teams
  - Revit Structure
  - Revit Architecture
  - Revit Mechanical
  - Revit Electrical
- PRO E used by the specialty consultant
- Sharing a central BIM model by multidisciplinary project teams



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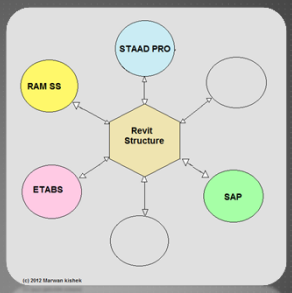
BIM MODEL – REVIT STRUCTURE

Revit Structure can interface with Structural design software



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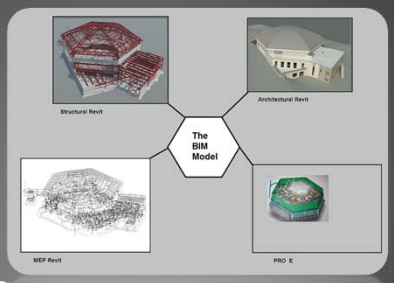
WINDEEE DOME – THE BIM MODEL

The BIM model for WindEEE



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BIM MODEL – 3D SECTION

BIM ensures better coordination and clash detection

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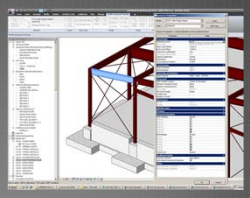
OTHER BIM TOOLS – TAKE OFFS

- Takeoff depends on the level of detail
- Rebars were not modeled in Revit



- Steel Takeoff 220 tons
- Concrete takeoff 2000 cu.m.

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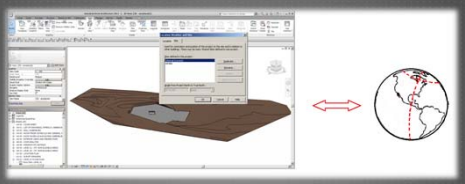
THE WINDEEE DOME – SITE PLAN

- Geo-Spatial consortium used to position building
- Building was strategically placed to take advantage of site topography



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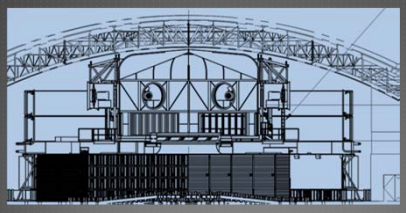
BIM MODEL - SECTION THRU DOME



A section generated by the Revit

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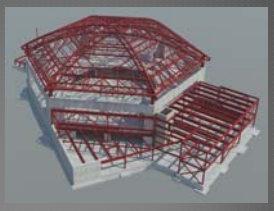
THE WINDEEE DOME - STRUCTURE

- Reinforced Concrete is used for the 3-storey hexagonal building
- Features a hexagonal steel dome spanning 40 meters (133 ft)

The dome supports a complex array of forces



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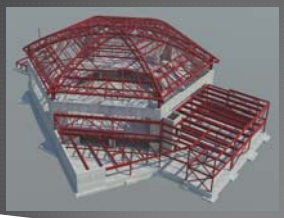
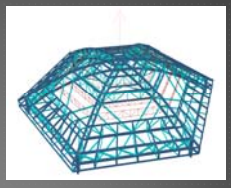
THE WINDEEE DOME - STRUCTURE

Analysis and design software linked to Revit Structure





- STAAD Model (Above) ^
- << Revit Structure (Left)

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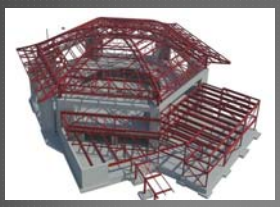
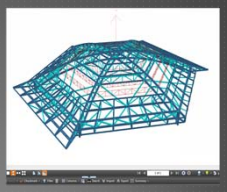
THE WINDEEE DOME – EARLIER MODEL

Revisions of designs are easier and faster to implement





- STAAD Model (Above) ^
- << Revit Structure (Left)

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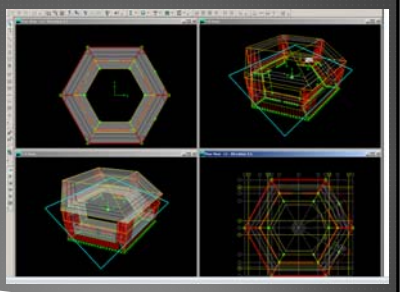
REINFORCED CONCRETE DESIGN

Reinforced Concrete components were analyzed and designed mainly using ETABS(T) and S-Concrete (T)



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THE WINDEEE DOME – LEVEL 1

Ground level directly below the test chamber floor

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THE WINDEEE DOME – LEVEL 2

The 2nd floor level supports the 6 Fan-walls surrounding the test chamber

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THE WINDEEE DOME – R C RING BEAM

RC tension ring resists the 2250 KN lateral thrust exerted by trusses

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THE WINDEEE DOME – CONCRETE BUTTRESSES

Six (6) reinforced concrete buttresses were designed and detailed to resist a portion of the lateral thrust.

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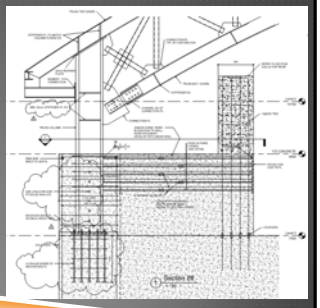
THE WINDEEE DOME – STRUT AND TIE MODEL



Above: Forces resisted by the concrete buttresses

Right: Buttress reinforcement details

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Interface between steel and Concrete

Right:

Interface between the steel plate girders and shear wall

Below:

BIM Ensured best fit.

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SLEEVES AND PENETRATIONS

With so many sleeves and penetrations to serve the specialty equipment, BIM was crucial in ensuring clash detection during the design phase.

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CAST-IN PLATES

Embedded plates in the underside of the 2nd floor slab was positioned to receive the test chamber floor system.

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MAIN TRUSSES – 133 FT. SPAN

The Photo shows the main three trusses bearing on the corner columns.

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THE WINDEEE DOME - CONSTRUCTION

Construction of this facility is slated to be completed by end of this year.

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THE WINDEEE DOME – TEST CHAMBER

The upper test chamber assembled on ground and later hoisted into place and attached to the steel trusses

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THE WINDEEE DOME – IT FITS!

Below: Test Chamber hoisted into place (hung from trusses)

Above:

It fits!

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THE WINDEEE DOME – TEST CHAMBER

- The upper test chamber completely hung from Dome steel trusses
- Six large fans are part of the upper test chamber assembly

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THE WINDEEE DOME -

- The large door opening shown will be used to test a truck-mounted turbine blade
- Simulated wind will be blown from inside the building

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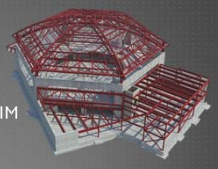
BIM – LESSONS LEARNED

- Worked with BIM technology since 2005
- Structural Revit was successfully used
- Some lessons learned along the way:
  - Continuous coordination of BIM files
  - Skip modelling of small scale elements
  - Insert CAD details as objects into a BIM model
- BIM is the future of the Industry



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THE WINDEEE DOME - CREDITS

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