National Corvette Museum

Sky Dome Sinkhole Remediation and Restoration Project

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Scott, Murphy & Daniel, LLC
This is a Corvette
America’s Sports Car
This is a Corvette in a Sinkhole
ANY QUESTIONS???
Overview

• Site Overview / Geology
• Sinkhole Collapse - Video
• Project Team
• Vehicle Recovery
• Sky Dome Evaluation & Sinkhole Exploration
• Sky Dome and Spire Stabilization
• Phase 2 Repairs
Kentucky Karst Mapping

From: KY Geological Survey
Sinkhole Map in Bowling Green
Site Overview
Site Overview
Site Geology

St. Louis Limestone

Ste. Genevieve Limestone
Project Team

- Scott, Murphy & Daniel, LLC - Construction Manager
- K&S Engineering – Structural Design
- Hayward Baker Inc. – Geotechnical Contractor / Geotechnical Design
- DDS Engineering – Civil & Geotechnical Consultants / Surveying
- WKU Geology – Geological Technical Advisor
- Ensafe Inc. – Environmental Consulting
- Kentucky OHSA – Safety Consulting and Oversight
- Wiss, Janney, Elstner Associates, Inc (WJE) – Technical Review
- Young & Associates – Technical Review
Save the ‘Vettes

- Corvette Enthusiasts – Board Members (all vette’s were donated or GM owned)
- Save the Corvettes
- GM to restore
- International Media (Germany, Japan, Australia, etc.)
- Tourism Sky rocketed to a 67% increase
Access To Building
Access to Building
GREAT EIGHT
(by order of Recovery)

• 1. 2009 ZR1 Blue Devil Corvette
• 2. 1962 Tuxedo Black Corvette
• 3. 1993 40th Anniversary Ruby Red Corvette
• 4. 1992 “One Millionth” Corvette
• 5. 1984 PPG Pace Car
• 6. 2009 “1.5 Millionth” Corvette
• 7. 1993 ZR-1 Spider
• 8. 2001 Mallet Hammer Z06
Sky Dome Evaluation

- Structural
  - Structural Engineer Evaluation
  - As-Builts – Perimeter & Spire foundation
Geotechnical Report – Review: was something Missed, NO!

Survey Monitoring – Continuous monitoring during drilling, max delta ¾", spire-control-foundation-slab-structure.

Sky Dome Evaluation & Sinkhole Exploration
Sky Dome Evaluation & Sinkhole Exploration

• Geotechnical
  • HBI drilling test holes – 9 holes drilled, max depth of 79 feet.
    • Major voids detected greater than 20 feet.
  • Down Hole Camera – Go Pro in test holes where major voids were detected.
    • 1st visual of the sinkhole/cave system extends, (north side see back into sinkhole proper)
  • HBI – Micro Pile installations on spire and perimeter foundation (used to aid in site assessment)
Test Holes

Generally 30’ of soil or rock, then cave feature from 30’ to 60’

TOR 8’ to 19.5’
Max depth 79.0’
Voids, Clay Seams, Fractured Rock
Sky Dome Evaluation & Sinkhole Exploration

- Micro gravity Survey – Geophysical Testing 10 foot grid on sky dome and surrounding area
- WKU Geology – Cave exploration and mapping
North Side
South Side
Sky Dome Evaluation & Sinkhole Exploration

- Environmental
  - Air Quality – Working indoors, exhaust, carbon monoxide, natural gases, radon, etc.
  - Release of hydro-carbons, oils, etc. from vehicles
  - EPA notifications – Soil testing for hydro carbons
Sky Dome and Spire Stabilization
Micro Pile Layout Phase 1
Phase 1 Micro Piles

- 5 Micro Piles on the Spire
- 18 Perimeter Micro Piles (every other column / 20’ max spacing)
- All designed for 100 Kip capacity
- Various Bond Zones and Methods
- Depths of Micro Piles from 60 feet to 194 feet
Connection to Spire Foundation
South Side
Un-braced Lengths

South Side
North Side
Phase 2 Repairs

- Project was on hold from April 2014 to November 10th 2014
- Additional Debris Removal
- Concrete Mud Mat / Sheet Pile Mat
- Backfill Sinkhole
- 3 Micro Piles – Spire
- 44 Micro Piles to support structural slab
- Deepest Micro Pile 245 feet
- 8,775 feet of micro piles
- One Way Structural slab
  - 8” slab double mat of #5 rebar 18” o.c.
- Site Drainage improvements
Concrete Mud Mat & Sheet Pile Mat
Access Port
Remote Control Sand Box Time!!!
Phase 2 Micro Pile Layout
Slab Removal
Grade
Beam
Layout
&
HVAC
Duct
Grade Beam Layout & Manhole
Micro Piles
QUESTIONS