Progressive Mine Instability and Subsidence Response: A Case Study

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GENERALIZED GEOLOGIC COLUMN (KOSANKE, ET AL., 1960)
GENERALIZED SITE STRATIGRAPHIC COLUMN

General Descriptions
(-0 to 48 ft) Black loess consisting mainly of topsoil and lean clay to silty clay

Unit 1 (-48 to 87 ft) Thinly bedded clayey shale with occasional limestone nodules in places

Unit 2 (-87 to 115 ft) Thinly bedded silty shale with occasional thin limestone nodules and/or interbeds, and isolated interbeds of clayey shale and claystone

Unit 3 (-115 to 130 ft) Thick limestone with isolated intervals of clayey shale to claystone in places

Unit 4 (-130 to 159 ft) Interbedded silty shale with thin limestone and occasional clayey shale (thereafter becoming carbonaceous and silty towards bottom where shale content decreases)

Herb No. 9 Coal, black, vitrinite to semivitrinite, thin pyrite nodules/ lenses

Unit 5 (-130 to 159 ft) Thin claystone to fine mudstone overlain by mudstone to silty mudstone with occasional limestone nodules followed by thin limestone, claystone to mudstone, and silty to clayey shale

Key to Symbols
- Unconsolidated
- Limestone
- Silty Limestone
- Silty shale
- Clayey shale
- Carbonaceous shale
- Coal, faulted
- Coal, mixed
- Soft floor material (undifferentiated)
- Claystone
- Mudstone (Silty mudstone to claystone)

Note: Drawing is for general stratigraphic representation, drawing not to scale. Both locations are approximate. Please refer to boring logs for more detailed information.
BLOWUP OF PROGRESS MINE MAP WITH PROJECT SITE WITH BORING LOCATIONS SUPERIMPOSED
SCREEN CAPTURES FROM BOREHOLE CAMERA SHOWING EXAMPLE OF MVI CONDITIONS AT BORING RCC-2
SKETCHES OF THE THREE PRINCIPAL MODES OF FAILURE OF MINE WORKINGS IN ILLINOIS WHICH CAN RESULT IN SURFACE SUBSIDENCE
SUBSIDENCE FAILURE MECHANICS OF ROOM-AND-PILLAR WORKINGS AND THE OVERBURDEN
HOLE MOISTURE CONTENT AND RQD PROFILES IN MINE FLOOR
FLOOR SAMPLE

RCC-2
Run: 11
Depth: 167.5 - 169.0
Rec: 1.1'
SUBSIDENCE ACTIVITY IN THE VICINITY OF THE CARE CENTER
SUPERIMPOSED OVER THE AVAILABLE MINE MAP
A SKETCH OF SOME DEFORMED FLEXIBLE BLOCKS RESULTING FROM A SINGLE SAG EVENT OVER AN ABANDONED MINE
MOST RECENT MEASURED SETTLEMENT AR MONITORING POINTS INSTALLED IN A COMMON MORTAR JOINT AROUND THE BUILDING (PRE-2012 SUBSIDENCE)
ESTIMATED TOTAL SUBSIDENCE AT MONITORING POINTS ON THE CARE CENTER OVER TIME (PRE-2012 SUBSIDENCE)
PLAN VIEW OF IMSIF MONITORING POINTS PLACED IN AND AROUND THE CARE CENTER
RELATIVE ELEVATIONS OF MONITORING POINTS INSTALLED IN A COMMON MORTAR JOINT AND THE FLOOR SLAB USING MOST RECENT MANOMETER DATA

Notes:
1. Manometer surveys done on 10/29-30/2012 by MEA, Inc.
2. Settlements are in feet.
APPROXIMATE LOCATIONS OF MAIN CRACK SYSTEMS IN THE FLOOR SLAB
SLAB CRACK NEAR EXIT 9 OPEN ABOUT 0.015 FT ALONG MOST EASTERN CRACK SYSTEM- SOUTHEAST VIEW
SEPARATION OF CONSTRUCTION JOINT OF ABOUT 0.017 FT ACROSS ROOMS 516 TO 517 IN HALLWAY- NORTHWEST VIEW
EXAMPLE OF THICKER GRID STRIP INSTALLED ALONG THE 100 WING HALLWAY. NOTE EXPANSION AT JOINT OF PERPENDICULAR ELEMENT- SOUTH VIEW
EXAMPLE OF WALL/CEILING CORNER MOLDING INSTALLED IN ROOM 502 – SOUTHEAST VIEW
A PATCHED VERTICAL CRACK WHICH REOPENED TO APPROXIMATELY 0.01 FT ABOVE DOOR TO “CLEAN UTILITY” ROOM IN 500 WING – NORTHEAST VIEW
DRYWALL RIPPLES ABOVE DOOR FOR ROOM 402 – NORTHWEST VIEW
PHOTOGRAPH DEPICTING AN ADDITIONAL DRAIN INSTALLED ON THE SPRINKLER LINE IN THE RESTROOM OF ROOM 408 – NORTH VIEW
FRACTURING IN BRICK AND FOUNDATION BLOCK IN RE-ENTRANT CORNER OF 400 AND 500 WINGS. BRICK FRACTURE OFFSET OF 0.07 FT WAS MEASURED – SOUTHWEST VIEWS
FRACTURING IN BRICK AND FOUNDATION BLOCK IN RE-ENTRANT CORNER OF 400 AND 500 WINGS. BRICK FRACTURE OFFSET OF 0.07 FT WAS MEASURED – SOUTHWEST VIEWS

Close up of main damage
PATCHED TENSILE CRACKING IN VENEER AROUND WINDOWS FOR ROOMS 506–NORTHEAST VIEWS
PATCHED TENSILE CRACKING IN VENEER AROUND WINDOWS FOR ROOM 508 – NORTHEAST VIEWS

Room 508

Cracking above north side was open 0.03 ft.
PATCHED CRACKING IN VENEER ABOVE THE EXIT
7 DOOR – SOUTH VIEWS
PATCHED CRACKING IN VENEER ABOVE THE EXIT 7 DOOR – SOUTH VIEWS
Joint separation in hallway

PHOTOGRAPHS ON OCTOBER 19, 2012 OF EXTENSION OF CONSTRUCTION JOINT THROUGH ROOMS 516 AND 517
INTERIOR CRACKING AROUND WINDOW IN ROOM 517 – NORTHEAST VIEWS
INTERIOR CRACKING AROUND WINDOW IN ROOM 517 – NORTHEAST VIEWS
FRAME ADJUSTMENTS ON NORTH SIDES OF DOORS FOR ROOM 518
FRAME ADJUSTMENTS ON NORTH SIDES OF DOORS FOR ROOM 519
Overview

VENEER AND FOUNDATION BLOCK DAMAGE IN THE VICINITY OF ROOM 516 WINDOW – NORTHEAST VIEWS
0.07 ft. foundation block separation and brick cracking up to 0.02 ft.

VENEER AND FOUNDATION BLOCK DAMAGE IN THE VICINITY OF ROOM 516 WINDOW – NORTHEAST VIEWS
REPORTED MEASUREMENTS OF STRUCTURAL DEFORMATIONS

NOMENCLATURE
- STRUCTURE TILT, $\omega$
- ANGULAR DISTORTION, $\beta_{ij} = \delta_{ij}/\epsilon_{ij}$
- DEFLECTION RATIO, $\Delta_{ij}/\delta_{ij}$
- CURVATURE, $\epsilon_{ij} = (\theta_{ij} - \theta_{ij}/\epsilon_{ij}$
- LATERAL STRAIN, $\epsilon_{ij} = v_{ij}/\epsilon_{ij}$

NOTES
- $\omega$: tilt measured off structure
- ◦ settlement point
- + tension
- - compression
MEASURED ANGULAR DISTORTION AND TILT ALONG EAST AND WEST SIDE OF THE 400 WING OF THE CARE CENTER-2000 SUBSIDENCE
MEASURED ANGULAR DISTORTION AND TILT ALONG EAST AND WEST SIDE OF THE 400 WING OF THE CARE CENTER-
2000 SUBSIDENCE
Thank You!

Any Questions?

For More Information:

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