



ODOT Project 467(06)

SR 8/I-271 Reconstruction

City of Macedonia

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District 4**

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October 29, 2008

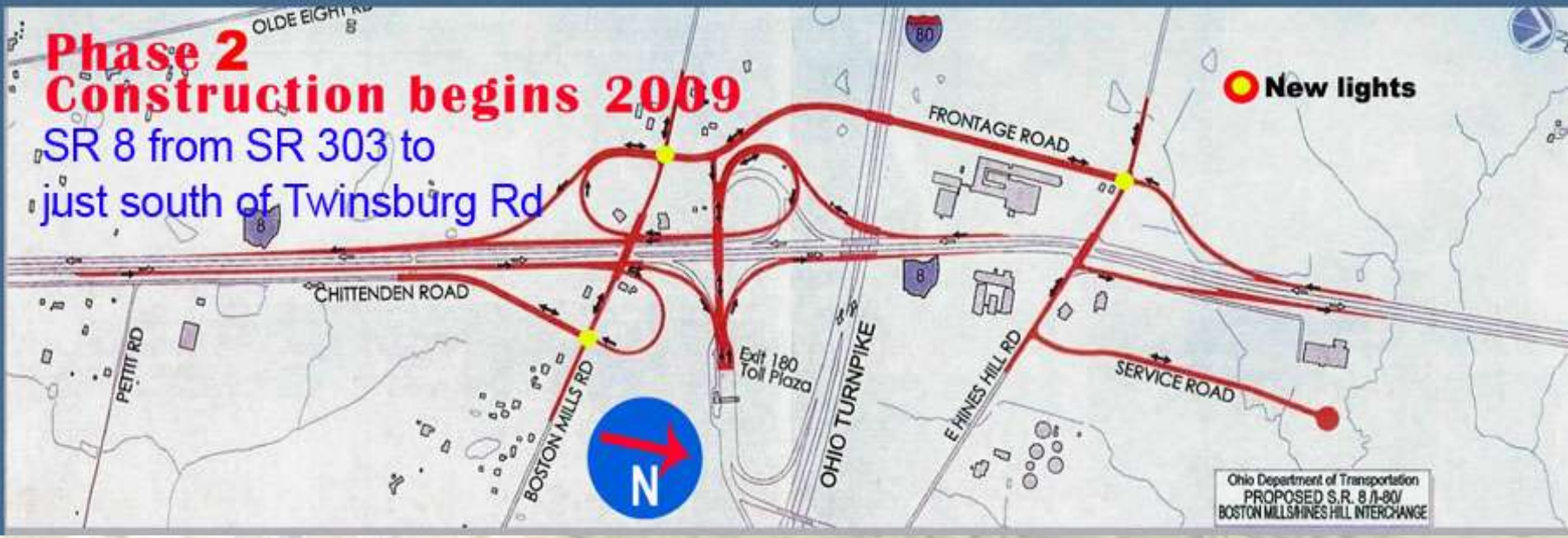
Phase 1 Construction begins 2008

SR 8 from just south of
Twinsburg Rd to I-271



Phase 2 Construction begins 2009

SR 8 from SR 303 to
just south of Twinsburg Rd



July 2006 – Preconstruction



July 2007



Basel Excavation RI 031-271
July 15, 2007
Aerial Aspect Photography 016-432-1043

June 2007 Looking NB 8 /Ramp A,B to left



State Route 8 / I-275 Interchange, 9000
mi, 20, 2007
Aerial aspect 000000.jpg 2200 1000 3000

January 2008

Twinsburg Rd ready for beams



January 2008

1757B left/bottom 1758A top/right over Highland



January 2008

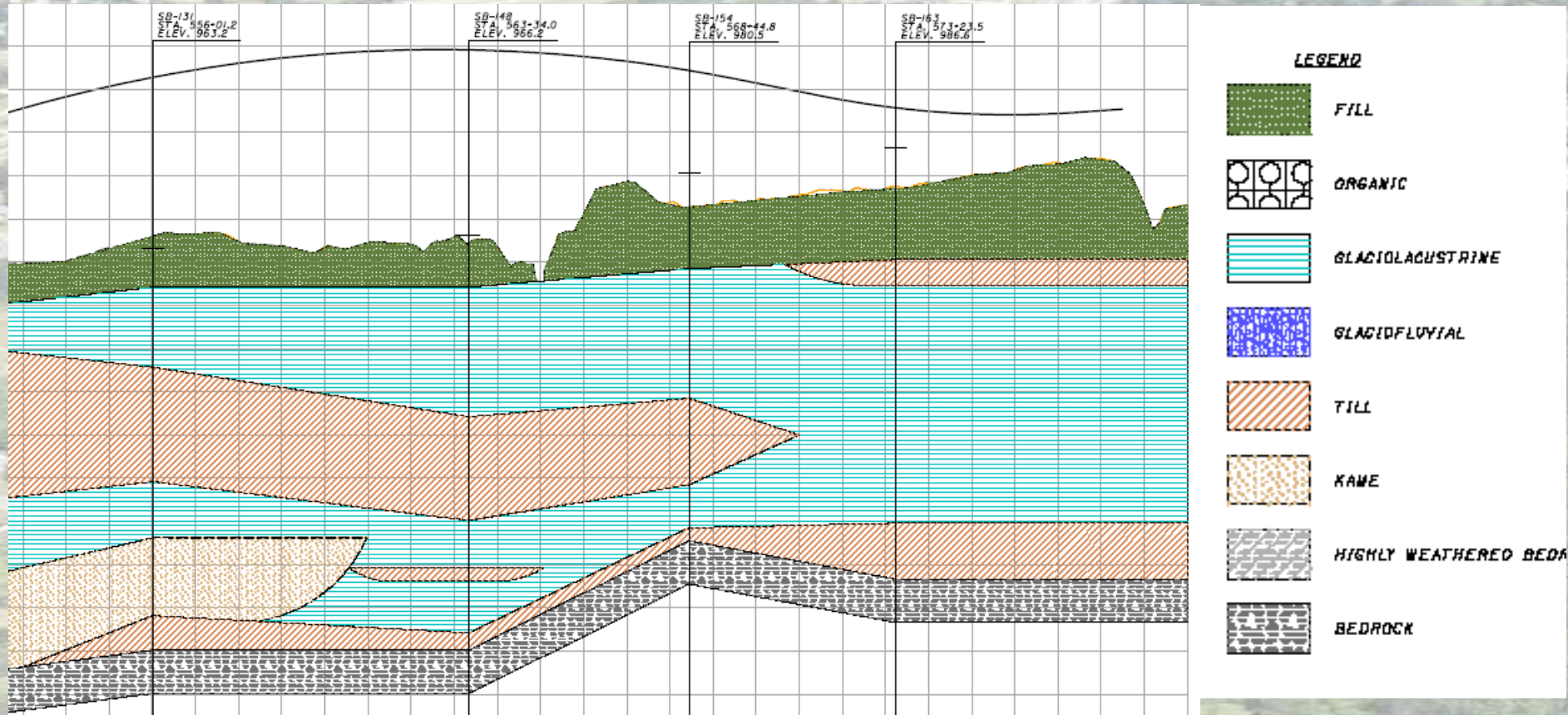
I271 bottom/ Ramp A-B at the top



Subsurface Exploration

- Phased Approach:
 - Phase I (PDP Step 7) Preliminary Exploration – 22 soil borings, widely spaced.
 - Phase II (PDP Step 8) – 105 soil borings; CPT Testing Program; Extensive laboratory testing including triaxial shear testing and consolidation testing. Boring depths up to 130 ft.
- Most of the site lies in a deep, glacially buried valley, which parallels SR 8 from its intersection with Twinsburg Road to its intersection with I-271. Depth of the buried valley reaches up to 125 ft within the project area.

Typical Geologic Cross-Section



- Multiple glacial advances/retreats filled valley with soft/loose and compressible glaciofluvial and glaciolacustrine sediments (A-4 to A-6 soils); Flat, poorly draining topography, and adjacent streams left soft, organic deposits near the ground surface; High static groundwater table – within 10 ft of ground surface over project.

Engineering Properties of Soils

Material Description	Glacial Description	ODOT Classification	Average OCR	Average Compression Index	Average Swell Index	Average Undrained Strength (psf)
SR 8 - "Shallow" Clays	Till	A-6a to A-6b	9.1	0.25	0.03	1,650
Ramp A/B, I-271 - "Shallow" Clays, low plasticity	Glaciolacustrine	A-6a	2.3	0.19	0.03	1,300
Ramp A/B, I-271 - "Shallow" Clays, medium plasticity	Glaciolacustrine	A-6b	3.0	0.27	0.05	1,350
Deep Clays, medium plasticity	Glaciolacustrine	A-6b	2.3	0.26	0.05	1,250
Deep Clays, high plasticity	Glaciolacustrine	A-7-6	3.5	0.37	0.08	1,250
Loose Silt Materials, Across Project	Glaciolacustrine	A-4a to A-4b	8.0	0.12	0.01	--

Key Observations:

Glaciolacustrine soils are soft/loose materials based on SPT results and visual descriptions, but all are overconsolidated.

Piezocone testing indicates that non-plastic silts (A-4a and A-4b) dissipate pore pressures 2-3 orders of magnitude faster than soils with higher plasticity and clay content.

Geotechnical Engineering Challenges

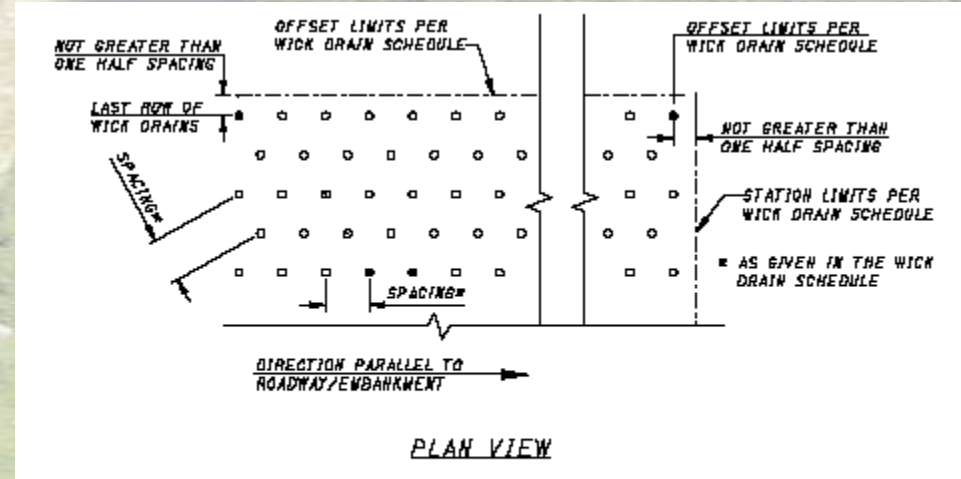
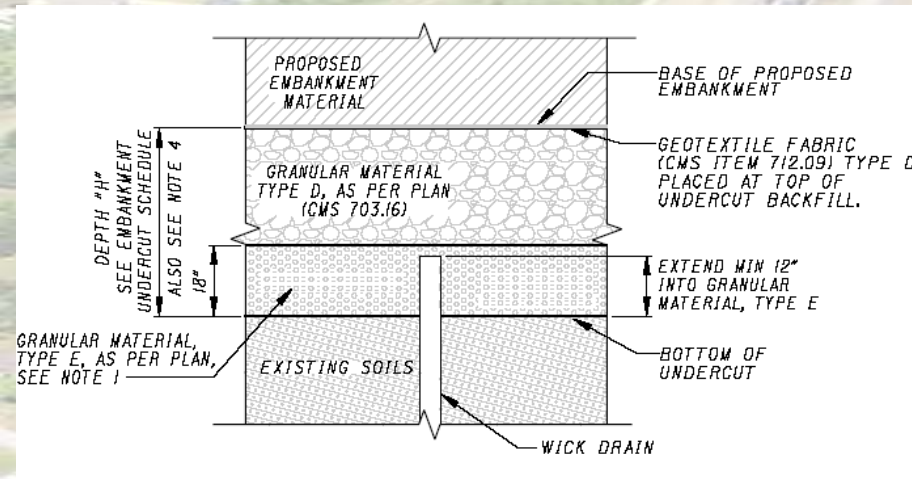
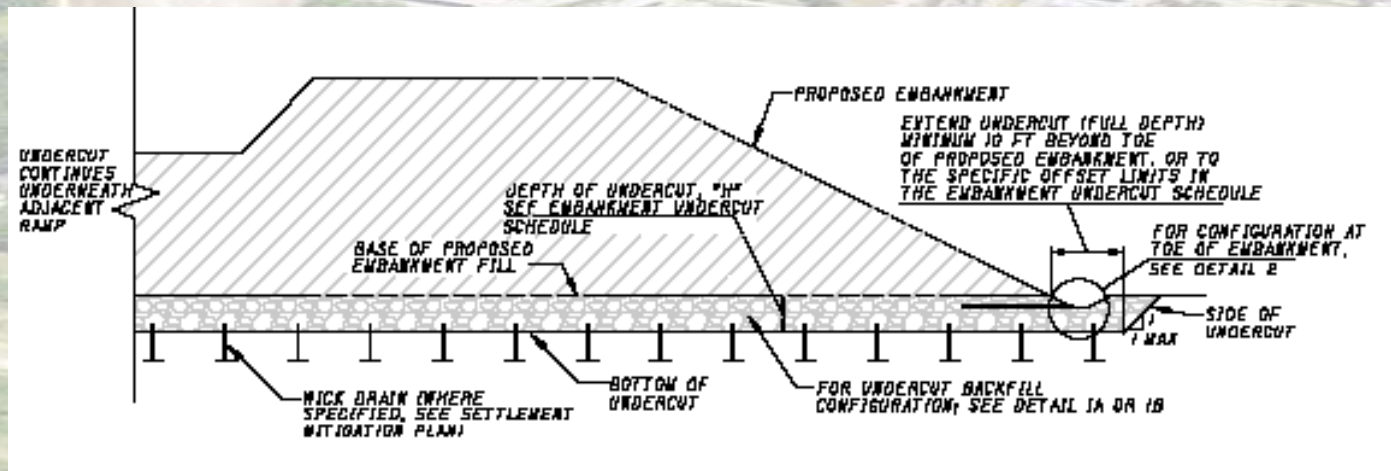
- Thick Glaciolacustrine and Till deposits consist of compressible, fine-grained soils (A-4, A-6, and A-7 classifications). Even accounting for overconsolidation, up to 18-inches of settlement predicted under high embankments and MSE Walls.
- Predicted time for consolidation from 1 to 3 years – unacceptable.
- Deep foundations required for bridge structures. Deep bedrock + soft overburden + lateral loads = high bending moments; Settlement at abutments = downdrag on foundation elements.
- High water table and organic surficial deposits = poor subgrade for embankment construction.

Geotechnical Engineering Controls

- Settlement Mitigation Plan – Installation of 750,000 LF of wick drains; 3 to 9-months of preloading; monitoring using 63 settlement plates.
- Subgrade Improvement Plan – Original plan called for 1 to 5 ft of undercut/replacement; Contractor VE design used thinner undercuts and geogrid-reinforced backfills.
- Sleeved piles and preloading to reduce downdrag on pile foundations at bridge abutments.
- No special controls for MSE walls – Wall manufacturer undaunted by estimated settlement magnitudes.

Geotechnical Engineering Controls

- Some Typical Details



② TYPICAL WICK DRAIN CONFIGURATION
NOT TO SCALE

Embankment Settlement

90% of earthwork completed 2007 Season

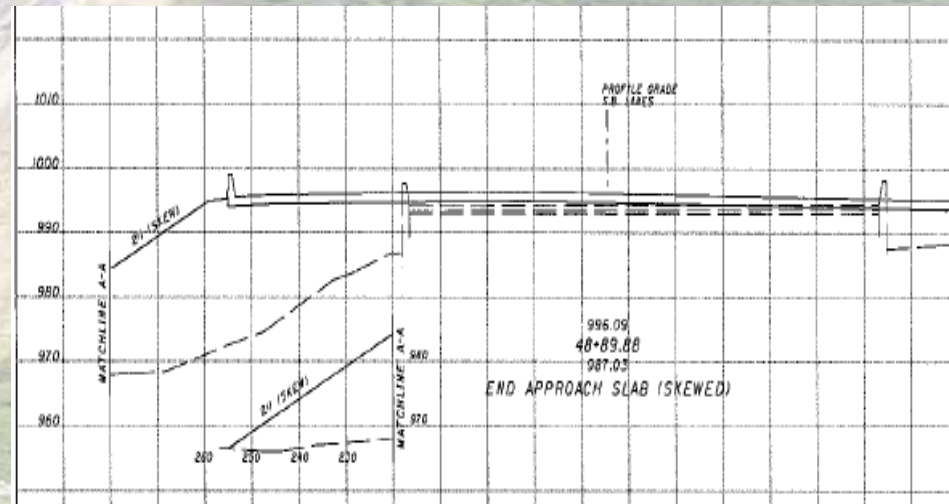
Settlement Phase of major fill areas:

1) **SUM-271-1186L** 271SB
over SR 8

end settlement date:
1/10/08, 1/16/08

released **12/7/07, +34 days**
early than schedule

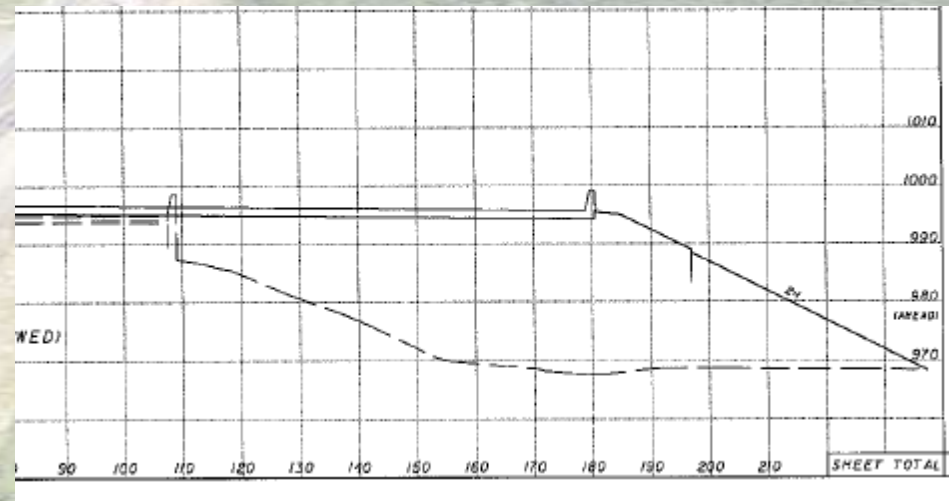
Maximum measured
settlement: 8.4-in.



Settlement

2) **SUM 271-1186R** next
phase of 271
end settlement date:
1/9/08, **1/16/08**

Not accessible until
phase change fall 2008

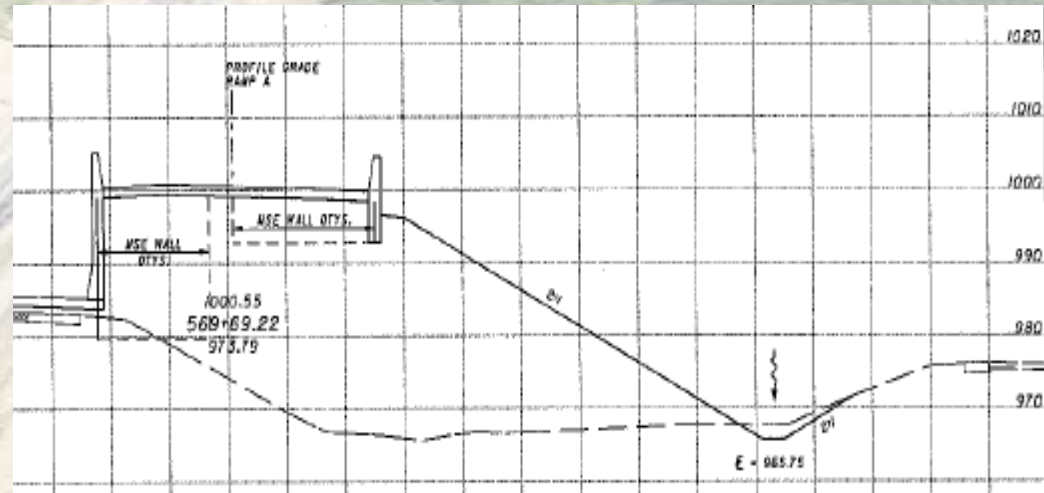


Settlement

3) **Wall 6, 1758** fwd abutment
I-271 NB fill, Ramp A str
over Highland

End settlement date: **4/2/08**

Maximum measured
settlement: 2.3-in (Wall 6)
3.7-in (1758 fwd)

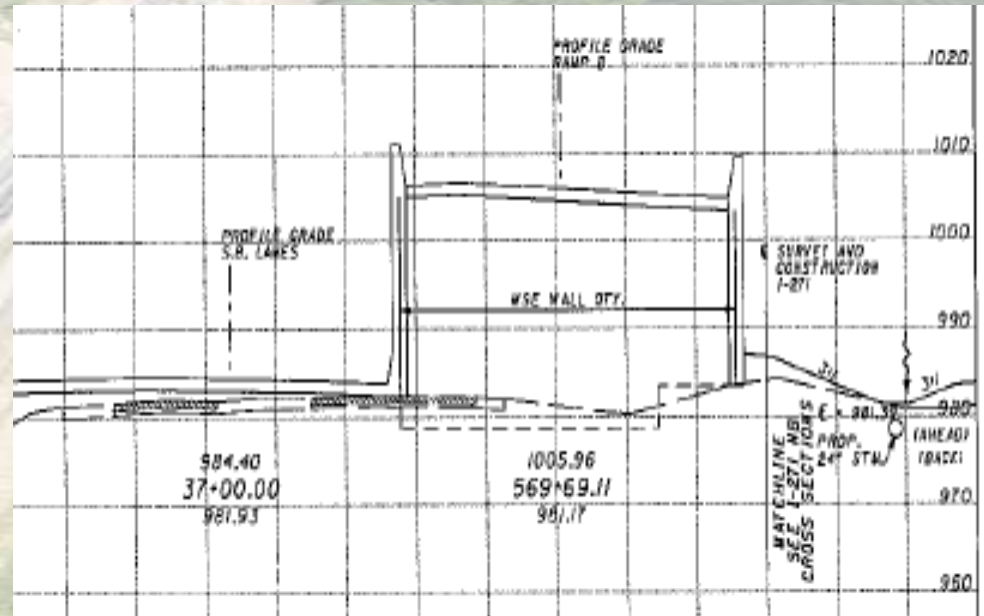


Settlement

4) **Wall 7, 1757B** fwd abut
I-271 SB exit ramp B over
Highland

end settlement date:
4/11/08

Maximum measured
settlement: 2.1-in.



Settlement

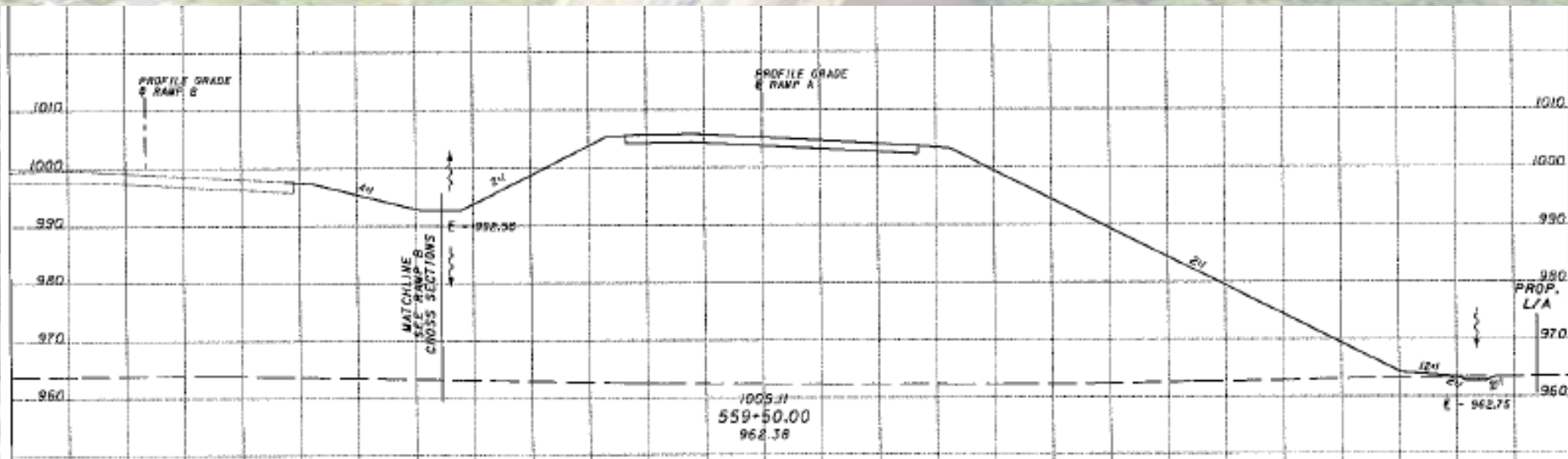
5) Ramp A, B,C

1724 fwd and rear
1709 A flyover fwd abut
1757B, 1758A rear abut
Wall 5

End settlement date: **4/17/08** (9 months)

Maximum measured settlement: 14.6-in.
(Ramp A/B/C Embankment)

Maximum measured settlement: 9.8-in.
(Bridges)

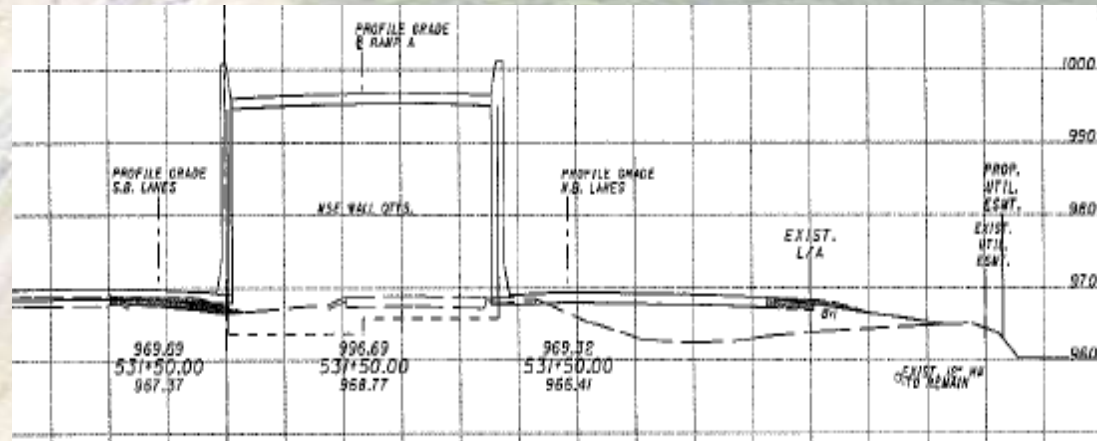


Settlement

6) **1709A** rear- flyover, **Wall 2**
SR 8 NB ramp to Ramp A

End settlement date: **6/11/08**
(completed: 12/11/07)

Maximum measured
settlements: 3.6-in. (Wall 2)
8.7-in (1709A)



Settlement – Comparison With Predictions

- Measured vs. Estimated Total Settlements Under Mass Fills

Project Area	Fill Height (ft)	Predicted Settlement (in)	Measured Settlement (in)	% Difference
I-271, Wall 7				
Settlement Plate SPW-10	18	3.3	3.4	-3.0%
SPW-12	13	2.5	1.9	24.0%
Ramp A/B/C, Wall 5				
SPR-1	24	9.5	9.2	3.2%
SPR-3	21	6.5	7.6	-16.9%
SPR-5	32	13.3	12.1	9.0%
SPR-7	35	11.2	9.4	16.1%
SR 8, Ramp A/Wall 2				
SPW-4	10	2.2	2.4	-9.1%
SPW-9	22	3.3	3.6	-9.1%
			AVERAGE =	11.3%

- Measured Time for 90% Settlement varied from 12 to 35 weeks; average of 20 weeks
- Predicted time for 90% Settlement varied from 8 to 28 weeks; average of 17 weeks

Bridge Construction

- 11 Structures on the project**
- 6 rehab/ modifications**
- 5 structures added to inventory**

**Winter 2008- working on substructure
caissons, piling columns, caps**

Foundation Design

- Competent foundation soils at great depth – deep foundations needed. Cost analysis indicates that deep drilled shaft foundations are more economical than driven piles.
- Final Design: Abutments supported on pile foundations; Piers supported on drilled shafts. Foundation depths up to 100 ft. Many bridges have abutments behind MSE Walls.
- End bearing on rock – vertical loads not problematic.
- Major design consideration for piers is lateral loads – up to 100 kips per shaft

Foundation Design

- Drilled shafts develop lateral capacity through soil reaction only – unlike battered piles. Soil stiffness important and foundation design required soil-structure interaction analysis.
- Soil stiffness evaluated using p-y curves generated with LPILE computer program. LPILE-generated stiffness modeled in STRUDL using linear spring elements.
- Predicted p-y curves are nonlinear for the clayey soils on this project. Iteration was required to make stiffness compatible with calculated displacements.

Foundation Design

High predicted settlements - Downdrag concerns at abutment pile foundations

- Original design called for use of bituminous coating of piles; precluded in Stage 2 due to cost estimates
- Downdrag partially mitigated by preloading program; However, significant downdrag loads added in pile design

SUM 271-1186L Phase 1

abutment pile driven, piers complete, pouring seats
setting beams Feb/March 2008



SUM -8-1709 ramp A
setting caisson cage- 85' depth



SUM -8-1709 pier 1 caisson pour



SUM -8-1709 caisson pour



SUM-8-1758A Caisson Repair Procedure



SUM 8-1758A Pier 1

Caisson foundations, completing piers over Highland Rd



Twinsburg Rd Ph 1 substructure



SUM 8-1636 Twinsburg Rd Ph. 1

Beams set 1/30/08 ready for pour Spring '08



SR 8 NB over Twinsburg Rd.



SUM -8-1724B over Brandywine
Ramp B- short fill, no MSE wall



Disputes

“ Water for Dust Control”

Is water application within the project limits used to clean the highways both under construction and utilized by through traffic incidental to **C&MS 614 Maintenance of traffic Lump Sum** or is it compensable through the contract unit bid item

C&MS 616 Dust Control mgal Water?

Over \$1M in Dust Control

**QUESTIONS?
COMMENTS?**

