Christopher Johnson

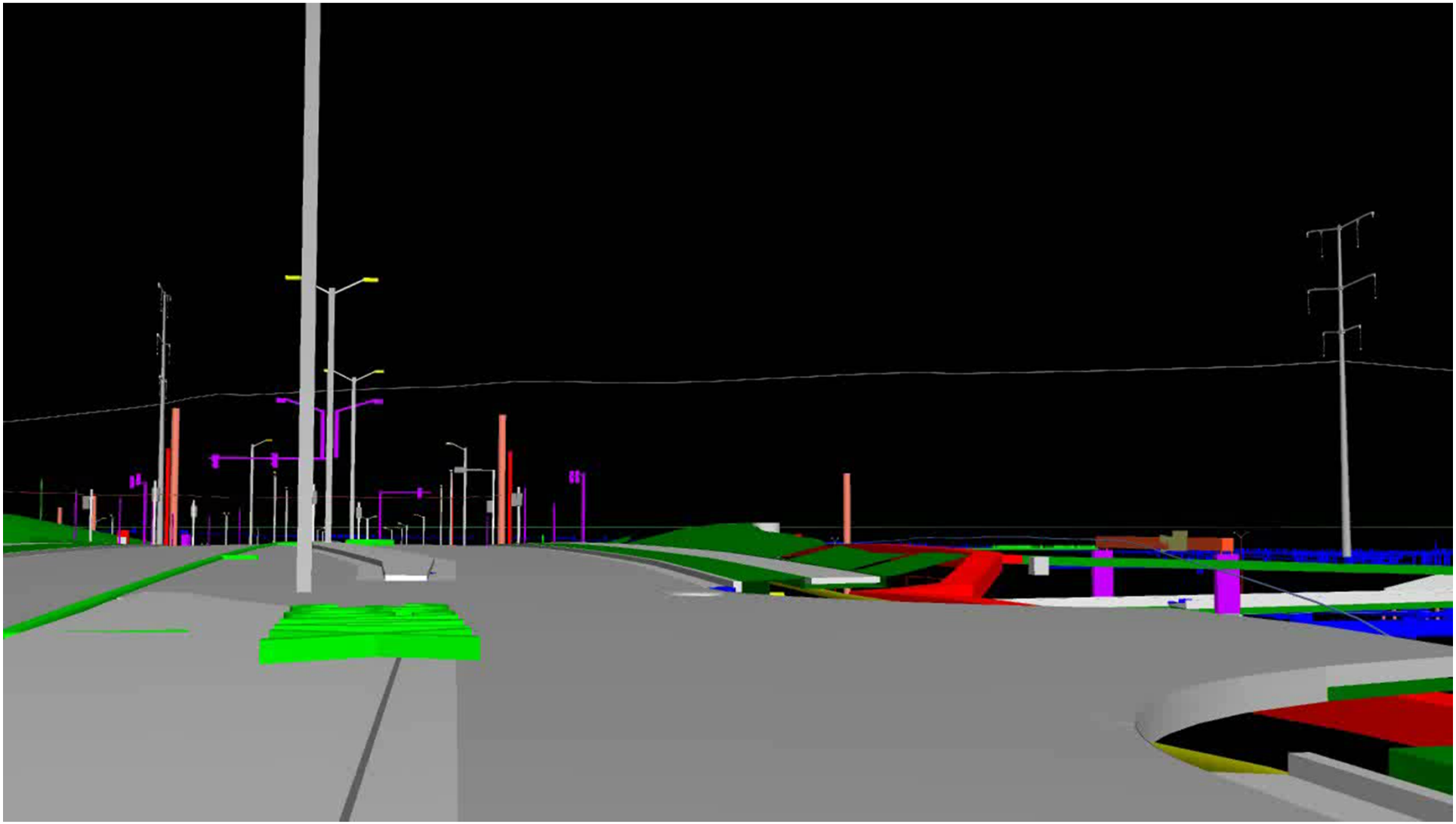
Technologist/Visualization Specialist

3D MODELING OF ZOO INTERCHANGE FOR WISDOT

April 14, 2015

Iowa DOT 3D Design and Modeling for Highway Structures Workshop

Clash Detection Model



Background

- CAD/CAE Manager for WI Mega Projects
- Mechanical Engineering
- Technologist/Visualization Specialist
- Developer (BASIC, VBA, VB .NET, JavaScript)
- TRB Subcommittee Member (ABJ95 Visualization in Transportation)

Project Background

- Zoo Interchange
  - $1.7 B Construction
  - 12 mile System Interchange
  - 5 miles of Arterials
  - 350,000 ADT (highest in WI)
  - 68 Bridges
  - 108 Retaining Walls
  - 115 Sign Structures

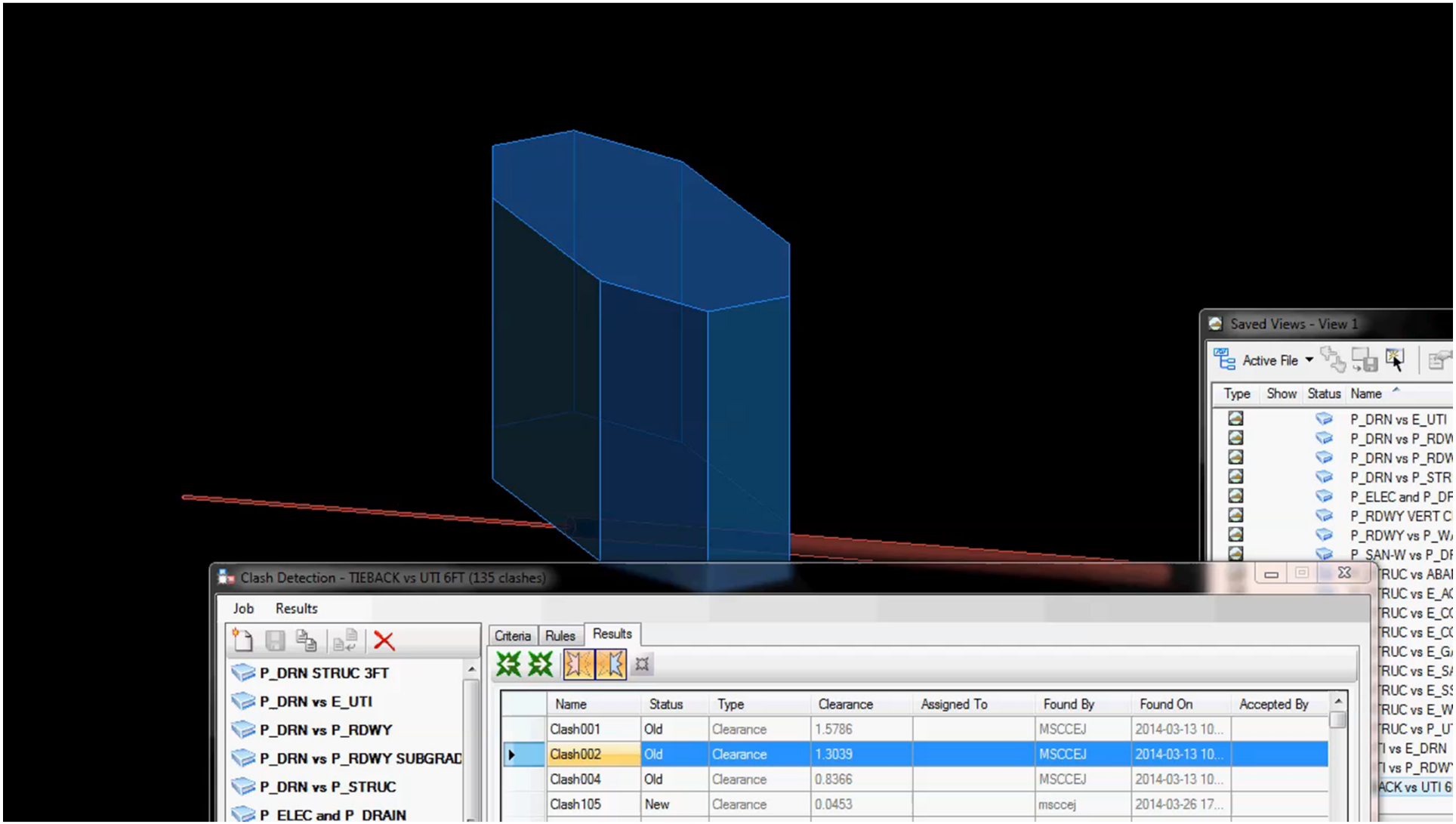
Modeling Schedule

Project Phases

Design Disciplines

	30%/Functional	60%/Preliminary	90%/Final
Existing Ground	X		
Existing Utilities	X		
Existing Structures	X		
Proposed Roadway		X	
Proposed Bridges		X	
Proposed Retaining Walls		X	
Proposed Drainage		X	
Proposed Sign Structures			X
Proposed Lighting			X
Proposed Signals			X
Proposed FTMS			X
Proposed Utilities			X

Clash Detection



Modeling Approaches

- Categories

Network

Drape

Template

Individual

Value

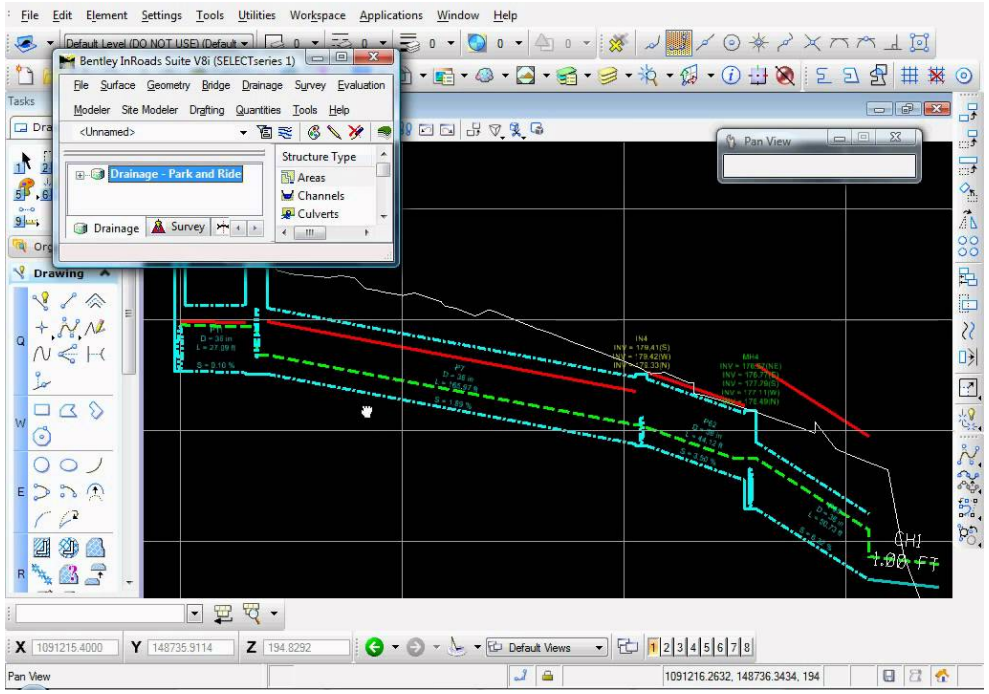
Modeling Approaches

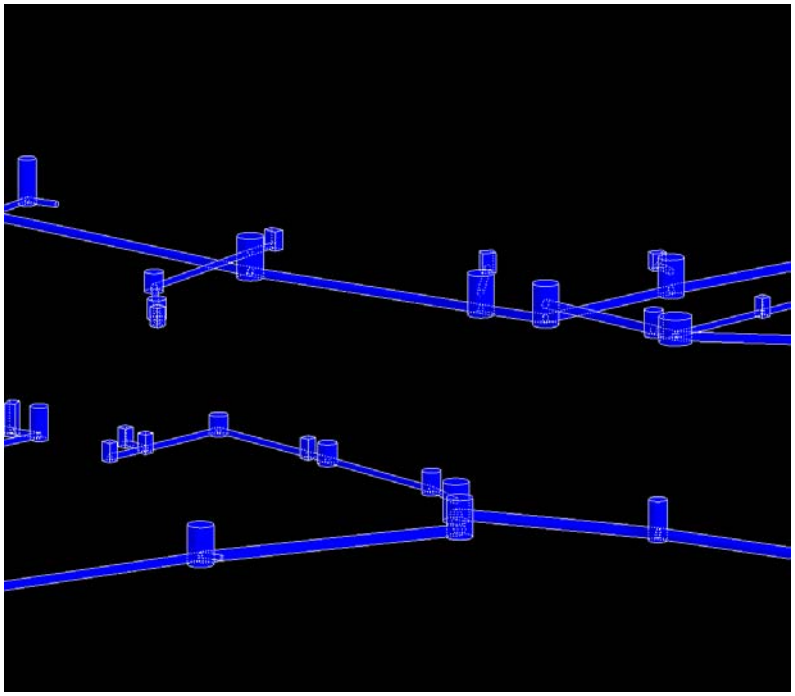
- Model approaches used on each discipline

Discipline	Modeling Approach
Existing Utilities	Network & Drape
Proposed Utilities	Drape
Proposed FTMS	Drape
Proposed Lighting	Drape
Proposed Signals	Drape
Proposed Roadway	Template
Proposed Retaining Walls	Value
Proposed Sign Structures	Individual
Proposed Storm Sewer	Network
Proposed Bridges	Individual

Modeling Approaches - Network

- Structures and pipes are modeled within a design application

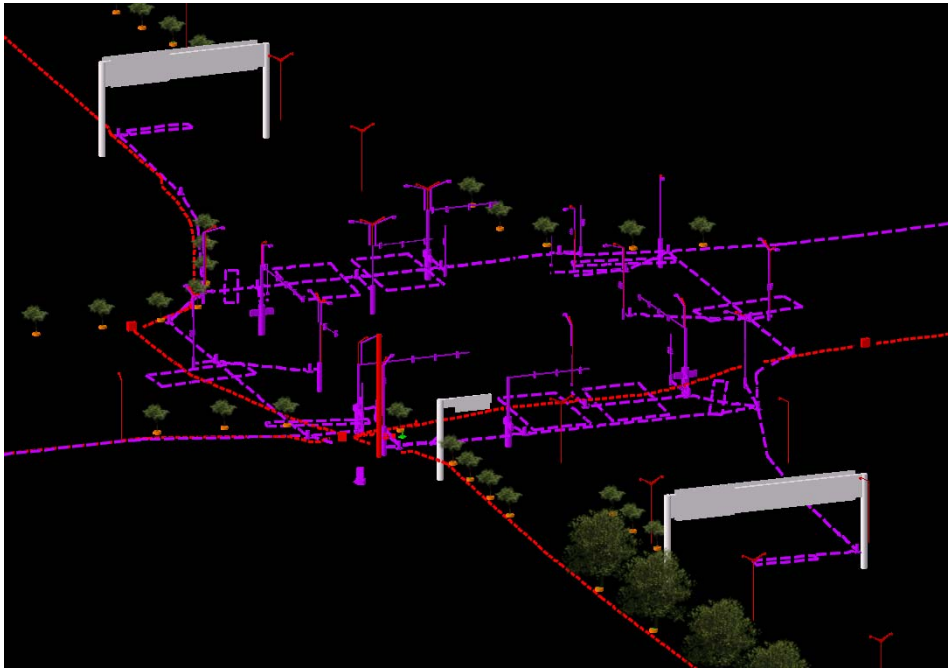


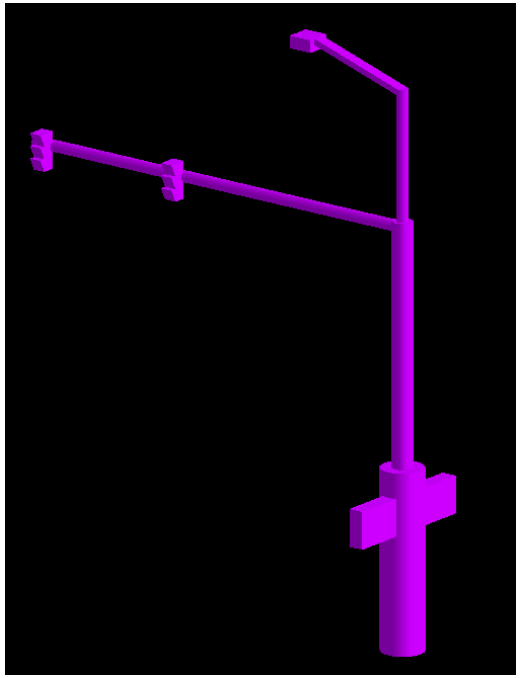


Used on: Existing Utilities, Proposed Storm Sewer

Modeling Approaches - Drape

- A 2D layout of cells/blocks and linear elements is draped on a terrain model using automation

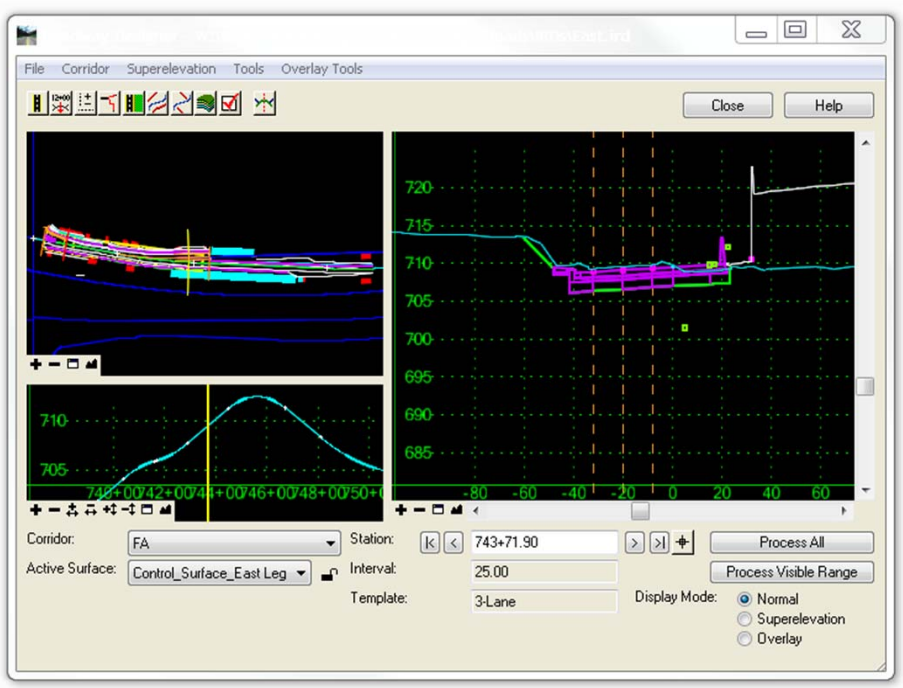


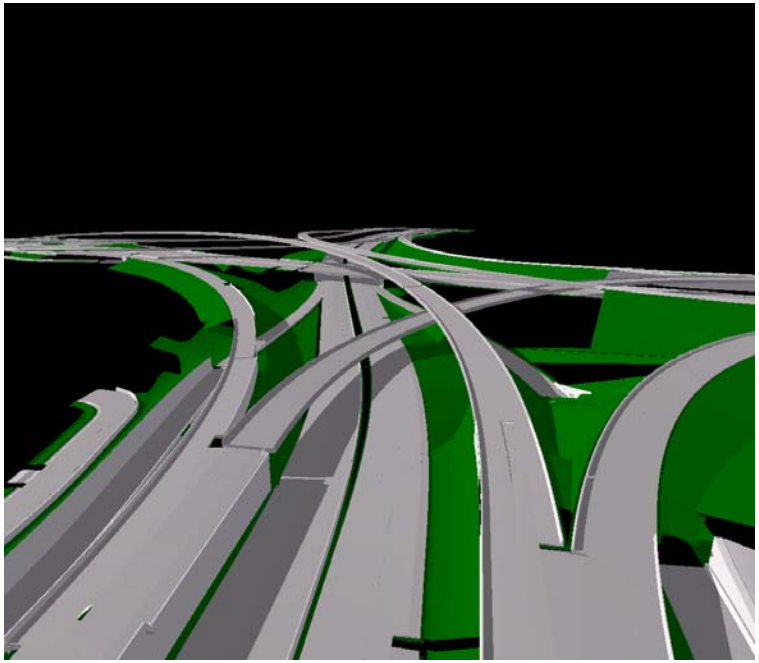


Used on: Proposed FTMS, Lighting, Signals, Signing

Modeling Approaches - Template

- Components in a template are extruded along an alignment within a design application

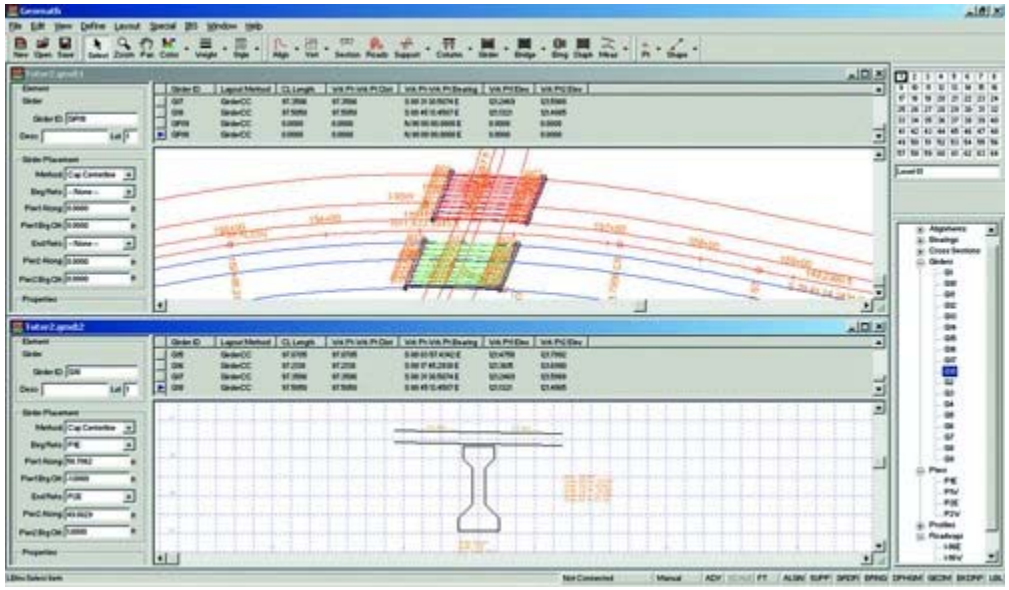


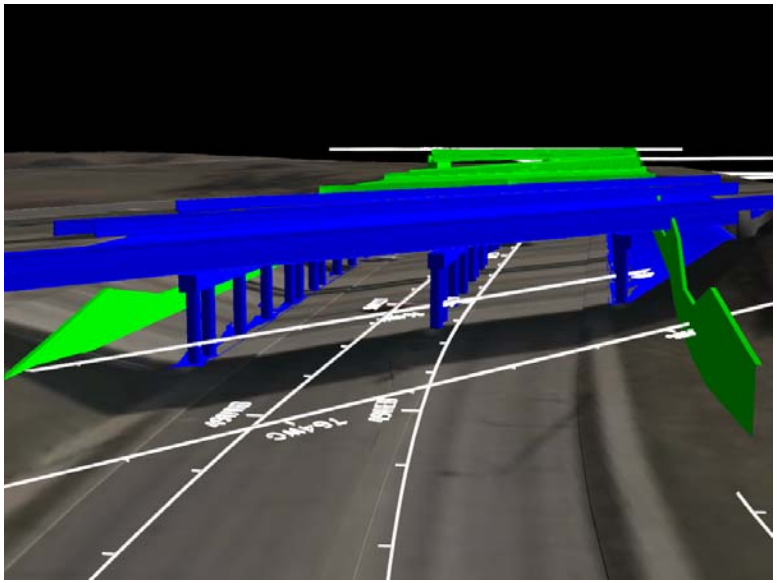


Used on: Proposed Roadway

Modeling Approaches - Individual

- A combination of templates, alignments, and individual items are used within a design application



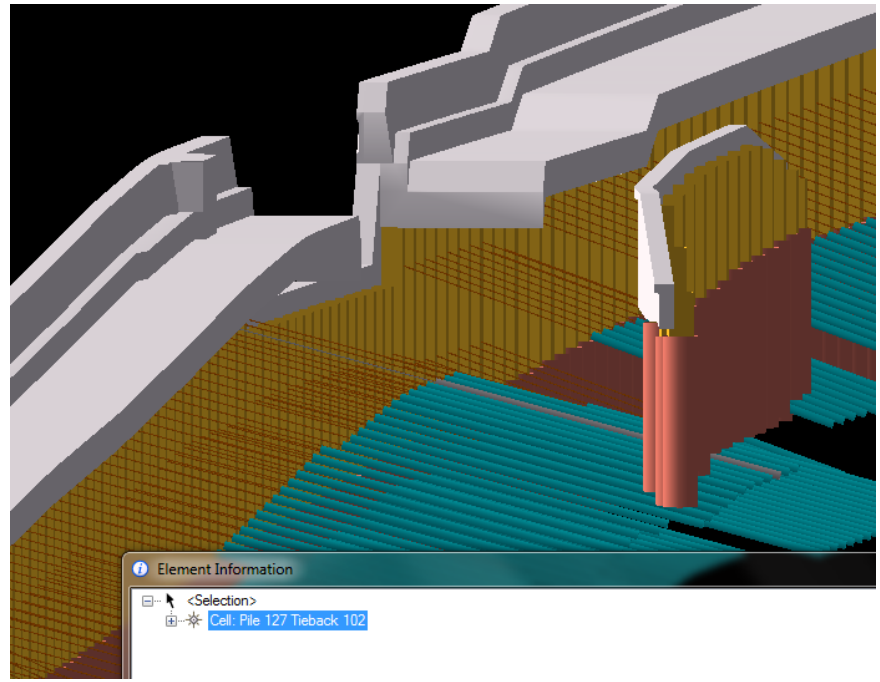


Used on: Proposed Structures

Modeling Approaches - Value

- Value-based modeling using automation

	A	B	C	D	E	F	G	H	I	J	K
1	PILE_NO	TB_NO	STA	OFF	ELE	VERT_ANG	HOR_ANG	B_LEN	UB_LEN	B_DIA	UB_DIA
2	59	1	1423.77	1.73438	742.82	30	90	24	15	6	1
3	60	2	1431.27	1.73438	743.24	30	90	24	15	6	1
4	61	3	1438.77	1.73438	743.65	30	90	24	15	6	1
5	62	4	1446.27	1.73438	744.09	30	90	24	15	6	1
6	63	5	1453.77	1.73438	744.54	30	90	28	15	6	1
7	64	6	1461.27	1.73438	744.99	30	90	28	15	6	1
8	65	7	1468.77	1.73438	745.45	30	90	28	15	6	1
9	66	8	1476.27	1.73438	745.93	30	90	28	15	6	1
10	67	9	1483.77	1.73438	746.42	30	90	30	15	6	1
11	68	10	1491.53	1.73438	746.93	30	90	30	15	6	1
12	69	11	1499.03	1.73438	747.44	30	90	30	15	6	1
13	70	12	1506.53	1.73438	747.95	30	90	30	15	6	1
14	71	13	1514.03	1.73438	748.47	25	90	23	15	6	1
15	72	14	1521.53	1.73438	749	25	90	23	15	6	1
16	73	15	1529.03	1.73438	749.52	25	90	23	15	6	1
17	74	16	1536.53	1.73438	750.05	25	90	23	15	6	1
18	75	17	1544.03	1.73438	750.57	25	90	26	15	6	1
19	75	18	1544.03	1.73438	743.57	25	90	15	15	6	1
20	76	19	1551.53	1.73438	751.1	25	90	26	15	6	1
21	76	20	1551.53	1.73438	744.1	25	90	15	15	6	1
22	77	21	1559.03	1.73438	751.62	25	90	26	15	6	1
23	77	22	1559.03	1.73438	744.62	25	90	15	15	6	1



Used on: Proposed Retaining Walls

Modeling Approaches - Value

[redacted]

Value of Cost Savings Delivered

- Estimated Cost Impacts from One Post-Draft Review

Job Name	Results	Y (RFI)	Y (RDC)	Est. Impact	Comments
P_DRN STRUC 3FT	23	3	3	$ 9,110.00	Used awarded bidder's unit price; 4 structures
P_DRN vs E_UTI	284	90	0	0	Investigation yeilded no conflict or workplans not available
P_DRN vs P_RDWY	37	10	9	$ 55,480.00	Used awarded bidder's unit price; 548 LF pipe
P_DRN vs P_RDWY SUBGRADE	126	57	28	$171,935.00	Used awarded bidder's unit price; 1768 LF pipe and 3 structures
P_DRN vs P_RDWY SUBGRADE EAST	37	16	5	$ 30,703.00	Used awarded bidder's unit price; 18% of similar results (above)
P_RDWY vs P_WALL	245	25	16	???	Unknown impacts to design; resulted in elevation checks on 15 of 22 walls
P_ELEC and P_DRAIN	127	62	47	$ 54,082.00	Used awarded bidder's unit price; 28 conduits, 15 pullboxes, 11 microwave detectors and 6 lightpoles moved
P_RDWY VERT CLR	27	0	0	0	
P_UTI vs P_RDWY	268	0	0	0	
P_DRN vs P_STRUC	59	8	6	$ 11,665.50	Used actual replacement cost from recent construction; 6 anchor slabs
P_STRUC vs P_UTI	23	3	3	?	2 utilities conflicted with C&G and sign bridge footing
P_STRUC vs ABAN	117	0	0	0	
P_STRUC vs E_SS	162	2	0	0	
P_STRUC vs E_SAN	59	0	0	0	
P_STRUC vs E_W	115	31	30	$ 59,400.00	Used awarded bidder's unit price; 198 LF ductile iron
P_STRUC vs E_GAS	132	6	5	???	
P_STRUC vs E_AG	21	0	0	0	
P_STRUC vs E_CONDUIT	224	1	0	0	
P_STRUC vs E_CONDUIT BYOTHERS	379	28	2	?	Electrical coordinated with wall designers
TIEBACK vs UTI 6FT	104	68	67	$ 3,930.00	Used awarded bidder's unit price; 2 tiebacks
P_UTI vs E_DRN	39	1	1	$234,580.00	Used awarded bidder's unit price; 317 LF steel casing with ductile iron
P_SAN-W vs P_DRN	6	6			
	2741	**479**	**269**	**$630,885.50**	

$630,000

Civil Integrated Management (CIM) Model

CH2MHILL