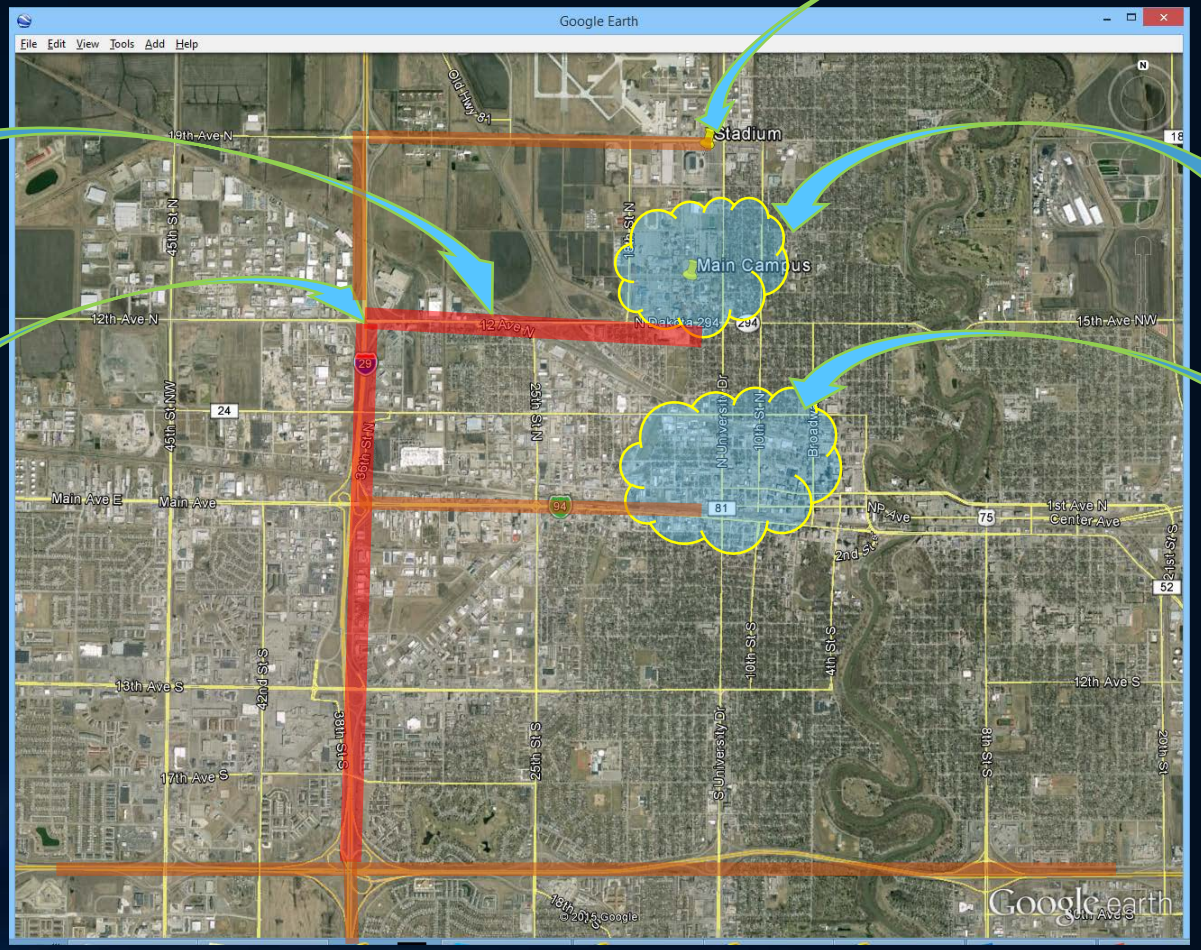
Component 3: Exercise Debrief

FEBRUARY 22, 2017

Case Study Format and Purpose

- Provide overview of civil design issues related to Intelligent Transportation Systems (ITS)
- Explore approaches to integrating ITS components into field settings
- Application: Design camera installation to support deployment of ITS for a major university trip generator – football game

Representative Case Study



Stadium

Major Arterial

Campus

Freeway Interchange

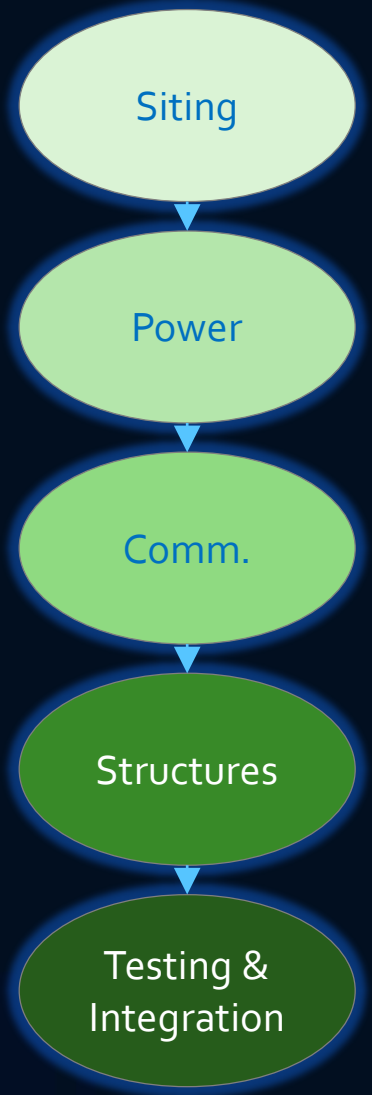
Town Center

Primary Congestion

Secondary Congestion

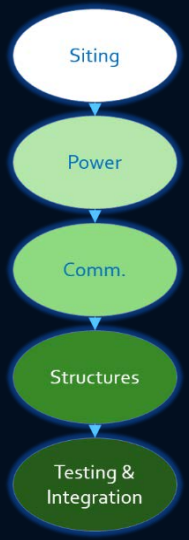
Exercise Activities

- Task 1: Siting
  - Identify locations where camera can fulfill functions
  - Consider relative merits of locations
- Task 2: Power
  - Utility coordination
  - Tie to infrastructure or not
- Task 3: Communication
  - Own versus lease
  - Utility coordination
- Task 4: Structures
  - Jurisdictional standards on structures
  - Use of existing structures
- Task 5: Integration and Testing
  - Determine how project completion will be determined



Camera Siting

- Coverage of roadways of interest
- Costs
- Considered three sites
  - South of Arterial
  - North of Arterial, near NB Off Ramp
  - North of Arterial, on existing sign structure



Camera Siting

Site #	1	2	3
Location	S of 12th Ave	N of 12th Ave Near NB Off Ramp	N of 12th Ave On sign post
Line of sight	●	◐	●
Access for installation	●	●	●
Traffic impact for installation	◐	◐	●
Proximity to power	◐	○	●
Proximity to communication	●	●	●
Proximity to conduit plant	○	○	●
Ability to erect a structure	●	●	n/a
Need to protect a new structure	◐	○	●
Ability to use an existing structure	●	●	●
Costs to provide adequate mounting	○	○	●
Environmental impact	●	●	●
Conflicts with existing roadway furniture	●	●	○
Remedial work for existing infrastructure	●	●	●

Camera Siting

- Use of existing sign structure (Site 3) is preferred technically
  - State requires coordination
    - Responsibility for non-state equipment installation
    - Structural analysis for addition of cabinet and camera
- With delay risks, installation of new poles South of arterial (Site 1) is selected

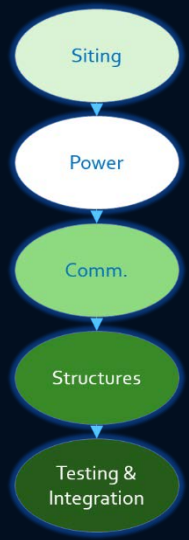
Camera Siting

- How would the analysis of alternatives change if the area had an endangered species of mole?
  - Earthwork may be limited
  - Reuse of existing structures could be preferred
- In this scenario, are locations for siting the camera other than the three considered attractive?
  - Sites considered are most advantageous
    - Locations outside of interchange show only one roadway clearly
    - Locations West of Interstate limit arterial coverage

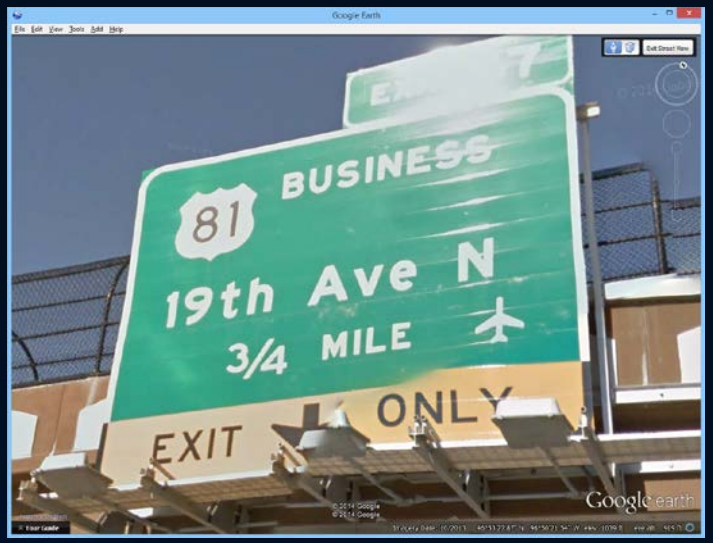
Camera Siting

- What locations should be considered if the State DOT revokes their agreement to allow the surveillance deployment to take place in the interchange right of way?
  - Moving East would limit Interstate coverage
  - Reallocation of funding to other project elements may be more beneficial

Power



- All ITS sites need power
- Most commonly gained from regional power company
- Least cost is from existing service location
- State offered power from existing drop
  - Nearby static sign



Power

- Anticipated power budget

ITS DEVICE TYPE	MAX WATTAGE	EXPECTED WATTAGE	DUTY CYCLE	KWH/ YEAR	COST/ YEAR
Camera	100	75	100%	657	$78.89
Ethernet Switch	50	25	100%	219	$26.30
Light	10	5	1%	0	$0.05
Ventilation	10	7	10%	6	$0.74
Cabinet Monitor	10	5	100%	44	$5.26
Convenience outlet	200	200	1%	18	$2.10
Total	380	317		945	$113.34

Power

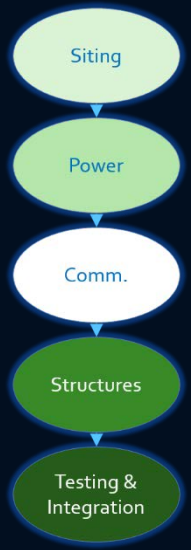
- Communication design will introduce additional devices
- Revised power budget

ITS DEVICE TYPE	MAX WATTAGE	EXPECTED WATTAGE	DUTY CYCLE	KWH/ YEAR	COST/ YEAR
Camera	100	75	100%	657	$78.89
Ethernet Switch	50	25	100%	219	$26.30
4G Router	10	5	100%	44	$5.26
Strip Heater	150	150	5%	66	$7.89
Light	10	5	1%	0	$0.05
Ventilation	10	7	10%	6	$0.74
Cabinet Monitor	10	5	100%	44	$5.26
Convenience outlet	200	200	1%	18	$2.10
Total	540	472		1054	$126.49

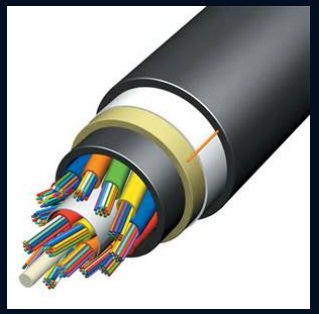
Power

- Which components of the site should be powered by the Battery Backup System (BBS), if one was required?
  - BBS will support emergency operation on the short term
  - Camera surveillance can be very valuable
  - For short term, need camera, Ethernet switch, and 4G router
- How would components of the site need to be revised if power came from a solar source?
  - Mounting of solar panels
    - Many factors in determining height, location, and orientation
  - Sufficient power storage
    - May need separate cabinet

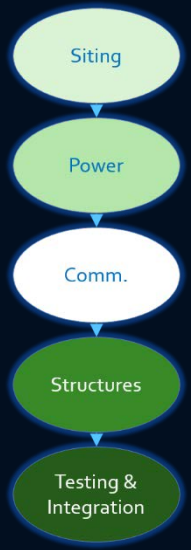
Communication



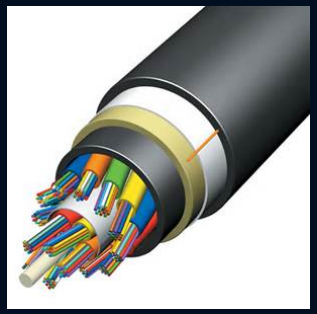
- Specific plans required to access all locations with communication need
- Extensive range of options available
- Distance from existing infrastructure drives costs for wireline
  - "Last mile" may be different than trunk



Communication



	Costs			Service Characteristics		
	Installation	Electronics	Recurring	Bandwidth	Reliability	Security
Owned Fiber	> $50,000	$10,000	$0	●	●	●
Owned Copper	> $50,000	$10,000	$0	◐	◐	◐
Unlicensed Wireless	$0	$12,000	$0	○	○	◑
Wired ISP	> $50,000	$0	$50	○	◐	◐
Wireless ISP	$0	$1,000	$200	○	○	◐

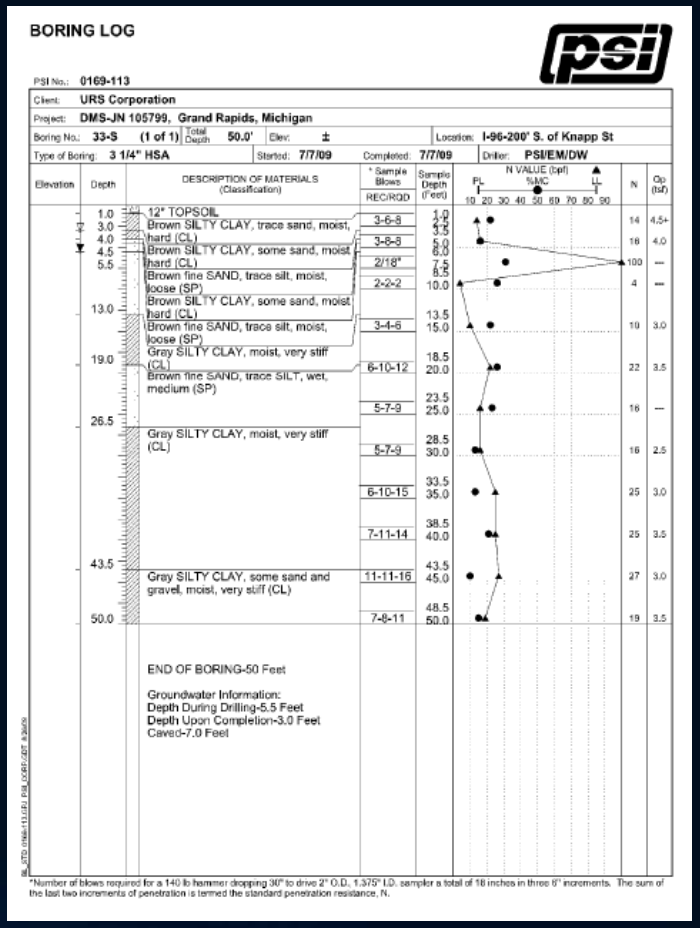


Communication

- How would your evaluation of the communication alternatives and siting alternatives change if the city installed fiber optic cable under the freeway concurrently with this project that passed 100 feet to the North of the arterial?
  - The same factors should be considered in light of the new development
  - Use unlicensed wireless Ethernet bridge from planned camera site to fiber access at signal cabinet.
- If off-grid power requirements limit site duty cycle, how would communication requirements be altered?
  - Communication always available
  - Other devices including camera used on reduced schedule

Mounting Structures

- Existing structure
  - Major advantage is cost
- New structure
  - Location
    - Soil condition
    - Protection from traffic
  - Height
  - Strength
    - Load of device
    - Load of cabinet
  - Cabinet mounting



BORING LOG

PSI No.: 0169-113

Client: URS Corporation

Project: DMS-JN 105799, Grand Rapids, Michigan

Boring No.: 33-S (1 of 1) Total Depth 50.0' Elev: ± Location: I-96-200' S. of Knapp St

Type of Boring: 3 1/4" HSA Started: 7/7/09 Completed: 7/7/09 Driller: PSI/EM/DW

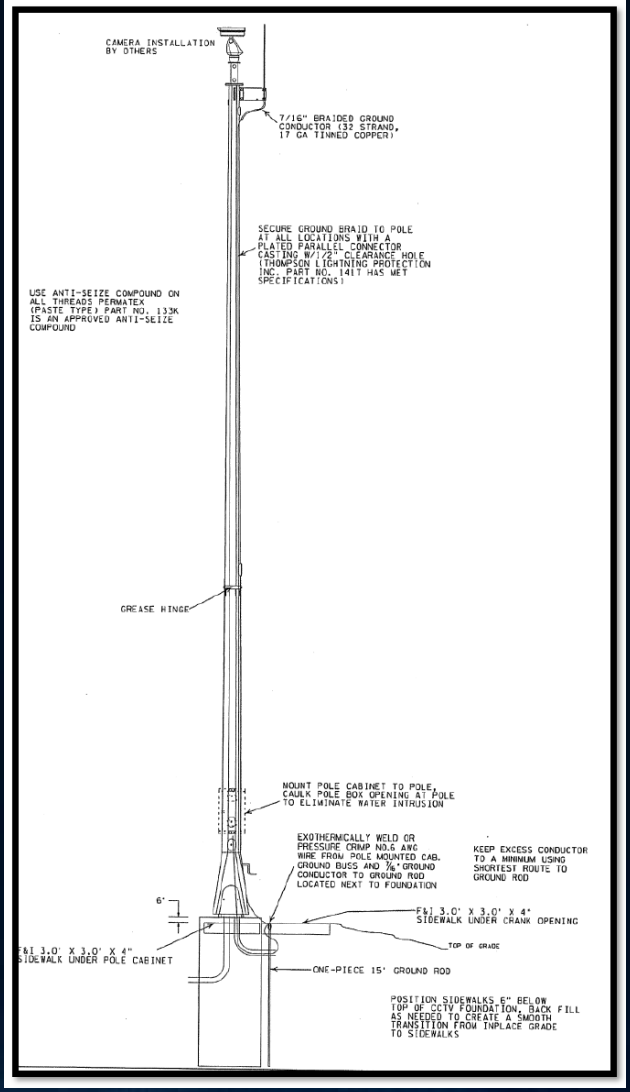
Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows REC/RQD	Sample Depth (Feet)	N VALUE (bpf) PL %MC LL 10 20 30 40 50 60 70 80 90	N	Qp (tsf)
	1.0	12" TOPSOIL		1.0			
	3.0	Brown SILTY CLAY, trace sand, moist, hard (CL)	3-6-8	3.5		14	4.5+
	4.0	Brown SILTY CLAY, some sand, moist hard (CL)	3-8-8	5.0		16	4.0
	4.5	Brown fine SAND, trace silt, moist, loose (SP)	2/18"	6.0		100	—
	5.5	Brown SILTY CLAY, some sand, moist hard (CL)	2-2-2	7.5 10.0		4	—
	13.0	Brown fine SAND, trace silt, moist, loose (SP)	3-4-6	13.5 15.0		10	3.0
	19.0	Gray SILTY CLAY, moist, very stiff (CL)	6-10-12	18.5 20.0		22	3.5
		Brown fine SAND, trace SILT, wet, medium (SP)	5-7-9	23.5 25.0		16	—
	26.5	Gray SILTY CLAY, moist, very stiff (CL)	5-7-9	28.5 30.0		16	2.5
			6-10-15	33.5 35.0		25	3.0
			7-11-14	38.5 40.0		25	3.5
	43.5	Gray SILTY CLAY, some sand and gravel, moist, very stiff (CL)	11-11-16	43.5 45.0		27	3.0
	50.0		7-9-11	48.5 50.0		19	3.5

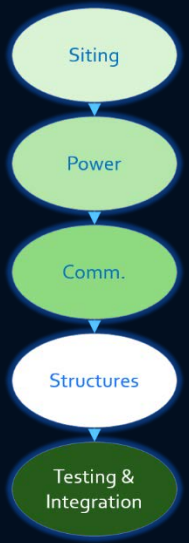
END OF BORING-50 Feet

Groundwater Information:
Depth During Drilling-5.5 Feet
Depth Upon Completion-3.0 Feet
Caved-7.0 Feet

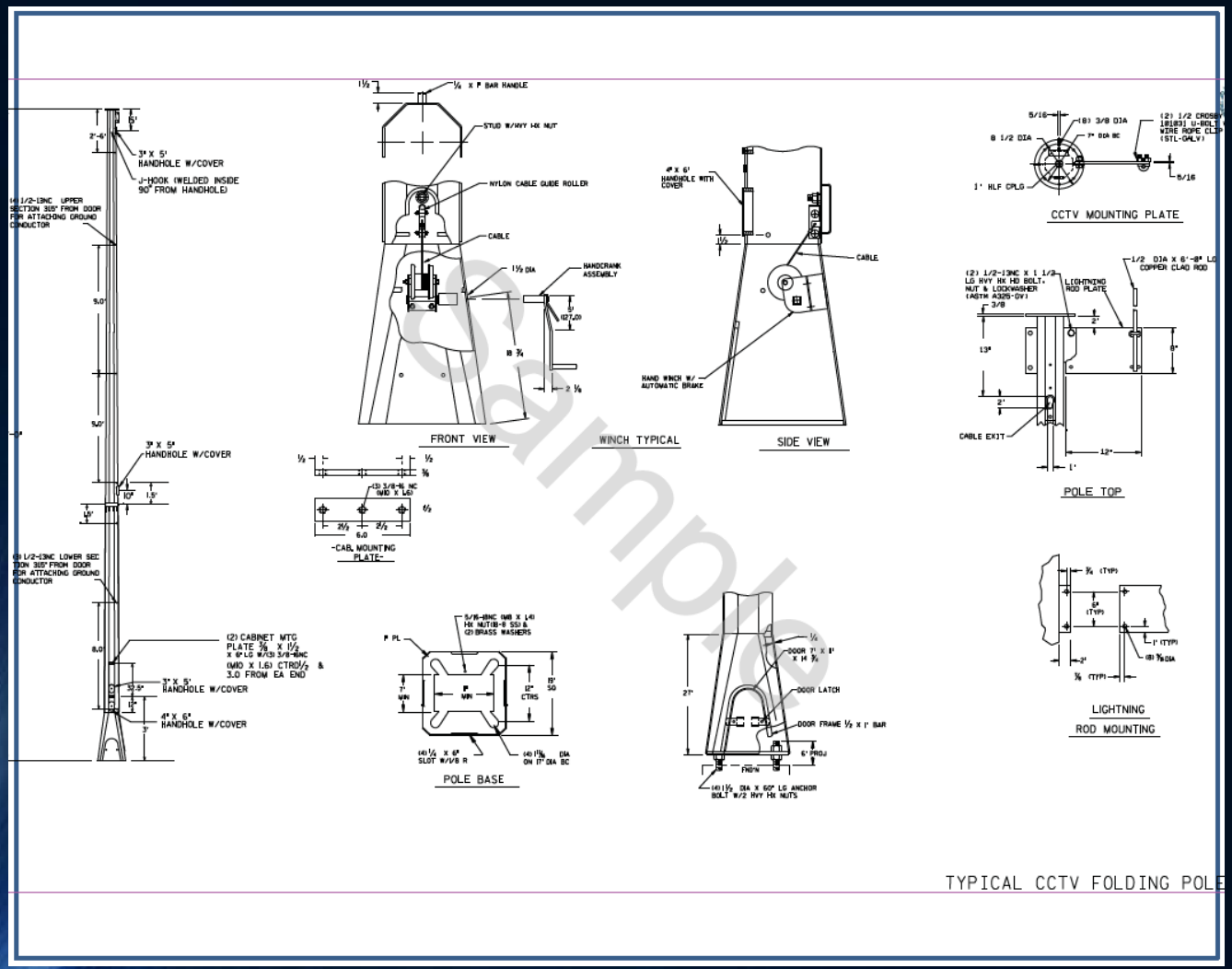
*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

Mounting Structures





Mounting Structures



Siting

Power

Comm.

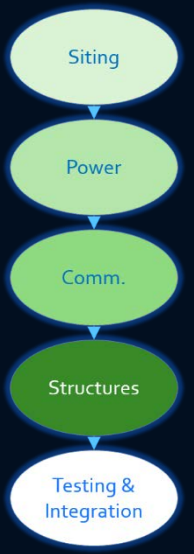
Structures

Testing & Integration

Mounting Structures

- How would the design change if a BBS that weighed 40 lbs. was included in the cabinet?
  - Minimal change to foundation size for added weight and wind load
- How would the design change if a solar power source was used for power that included 400 lbs. for solar power electronics and battery capacity? How would 27 square feet of solar panels be mounted?
  - Location requirements considered including
    - Height for orientation and vandalism resistance
      - Added weight
      - Wind loading
    - Possible separate structure

ITS Device Integration and Testing



- Devices must operate to meet requirements
- What characteristics are required to integrate with system?
  - System compatibility
  - Standards
- Test plans need to be linked back to requirements
  - Testing should be incremental and progressive
  - Frequently test plans for each device and an integrated system test plan need to be developed to test all requirements

ITS Device Integration and Testing

- Is there particular information that is most valuable for the test to be successful?
  - Test to camera requirements
  - Verify highest level need of delivering surveillance information

ITS Device Integration and Testing

- How would completion of the camera component relate to expected user needs of:
  - Reduced complaints from drivers and transit users!
    - This is addressed indirectly by supporting better performance of the roadway.
  - Better wayfinding
    - This is not addressed by this project.
  - Reduced delays/congestion
    - This is addressed indirectly by providing better information to traffic managers.
  - Reduced emissions and fuel consumption
    - This is addressed indirectly by supporting better performance of the roadway.
  - Safer driving environment
    - This is addressed indirectly by supporting better performance of the roadway.

ITS Device Integration and Testing

- How would you involve the interested agencies, institutions, and organizations (shown in Table 8 of the exercise appendix) in the project development or project evaluation?
  - Camera implementation engages the City DOT and the State DOT
  - Invite others
    - Project planning sessions including goal setting
    - Demonstrations of completed implementation

Other Issues

- Each agency will have a set of topics that must be addressed
  - Each customer and location will be unique
  - Use departmental checklists to assure coverage of topics
  - The community of contractors for each customer can provide needed support

Case Study Format and Purpose

- Provide overview of civil design issues related to Intelligent Transportation Systems (ITS)
- Explore approaches to integrating ITS components into field settings
- Application: Design camera installation to support deployment of ITS for a major university trip generator – football game
- Acceptable designs rely on interaction of engineering skills and project needs in the deployment location