



Practical Considerations for Façade Inspections

Presented By:

**EVAN MOORE
with
INNOVATIVE ENGINEERING**

Learning Objectives

- Learn and Understand
 - The History of Façade Inspections and the Ordinances that Require Them
 - The Roles that a Façade Serves
 - The Source of Common Façade Problems
 - The Process of Performing a Façade Inspection

Historic Precedent for Façade Inspections



2-Year-Old Girl Dies After Being Hit in Head by Falling Brick on Upper West Side. NBCUniversal Media, LLC., n.d. Web.

Practical Considerations for Façade Inspections

Historic Precedent for Façade Inspections



2-Year-Old Girl Dies After Being Hit in Head by Falling Brick on Upper West Side. NBCUniversal Media, LLC., n.d. Web.

Practical Considerations for Façade Inspections

Façade Ordinances

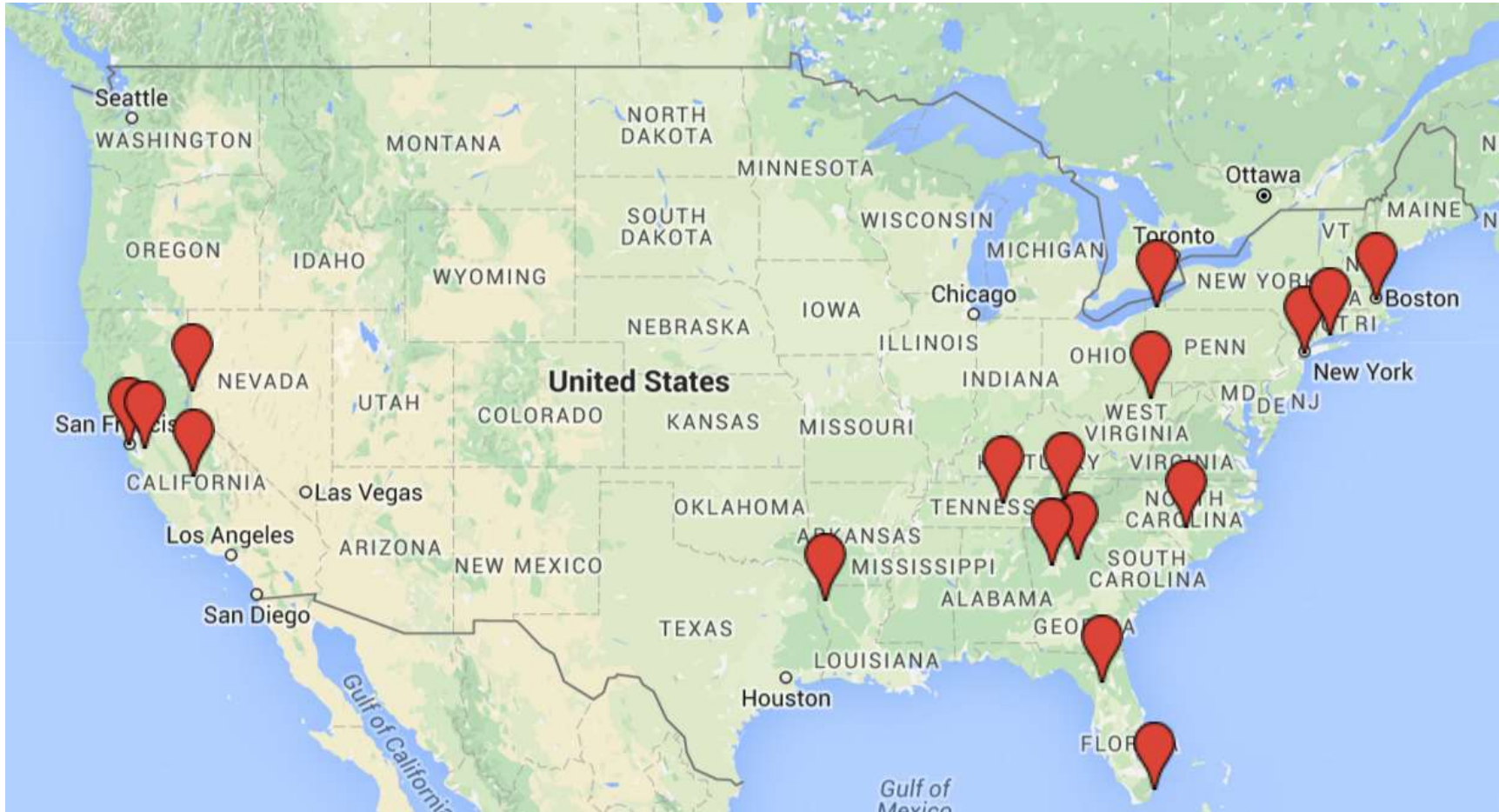
US City	Year	Criteria for Inclusion		Frequency	Required Method of Inspection	Penalty
New York, NY	1980	6 stories ≥		5 years	Visual & close-up inspection	Initially \$1,000 and \$250/Month
Columbus, Ohio	1985	20 years ≥ within 10 feet of a public right of way		5 years	Determined by Architect or Engineer	Initially \$500 with \$250/Month
Boston, MA	1995	70 feet ≥ or classified as a high-rise structure		5 years or 1 year if unoccupied	Visual for buildings less than 125 feet, Up-close inspection for buildings in excess of 125 feet	\$100/Day
Chicago, IL	1996 (1976)	80 feet ≥		Critical Exam every 4, 8, or 12 years w/ ongoing inspection at half of that interval. Alternately ongoing inspections can be performed every 2 years	Critical Exams require visual and close-up inspections. Ongoing inspections only require visual inspections.	\$1,000/Day- \$2,500/Day
Milwaukee, WI	2001	15 years old or older and 5 stories in height or greater		5, 8, or 12 years depending on building category	Visual & close-up inspection	\$150/Day- \$5,000/Day
Detroit, MI	2003	5 stories ≥		5 years	Visual & close-up inspection	Initially \$500 with \$250/Month
Pittsburgh, PA	2004	All buildings and structures (Some use groups are exempt)		5 years	Visual & close-up inspection	\$1,000
St. Louis, MO	2009	6 stories ≥		5 years	Visual & close-up inspection	\$500/Day
Philadelphia, PA	2010	6 stories ≥		10 years after occupancy certificate is issued and 5 years thereafter	Visual & close-up inspection	\$2,000
Cleveland, OH				Proposed		

Practical Considerations for Façade Inspections

A map of the United States showing the locations of the 10 largest cities in the world. The cities are marked with red pins and labeled: New York, Los Angeles, Tokyo, London, Paris, Sydney, Hong Kong, Seoul, Singapore, and Taipei. The map also shows state boundaries and names, and major bodies of water like the Gulf of California and the Gulf of Mexico.

Practical Considerations for Façade Inspections

Recent Façade Inspections



Practical Considerations for Façade Inspections

Façade Inspection Comparison



- Fayetteville, NC

Façade Inspection Comparison



- Boston, MA

Façade Inspection Comparison



- Fayetteville, NC
- No Façade Ordinance

Façade Inspection Comparison



- Boston, MA
- Façade Ordinance

Façade Inspection Comparison



- Fayetteville, NC
- No Façade Ordinance
- Estimated Repair Costs: \$336,000

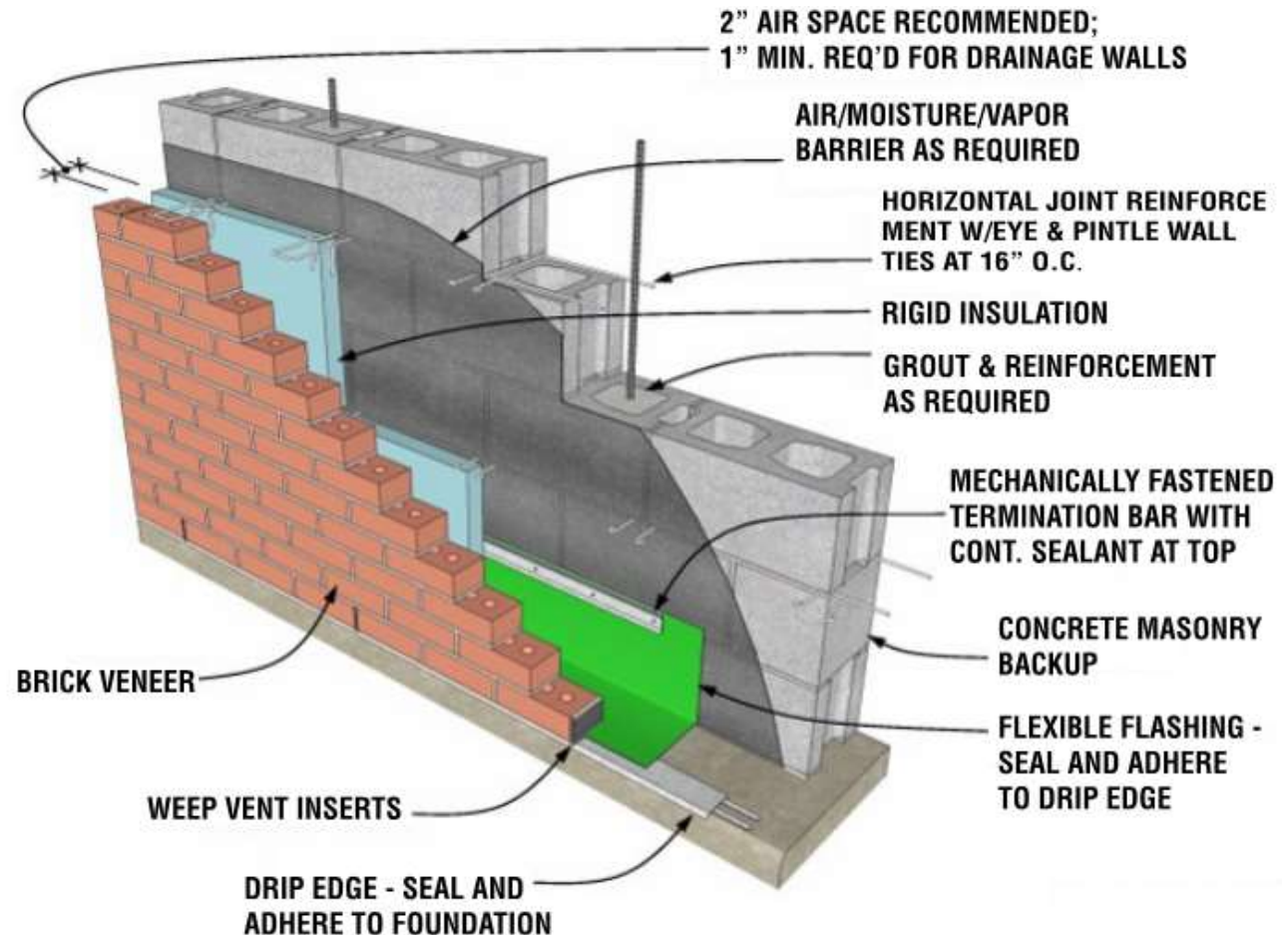
Façade Inspection Comparison



- Boston, MA
- Façade Ordinance
- Estimated Repair Costs: \$460,000

Roles Served by A Building's Façade

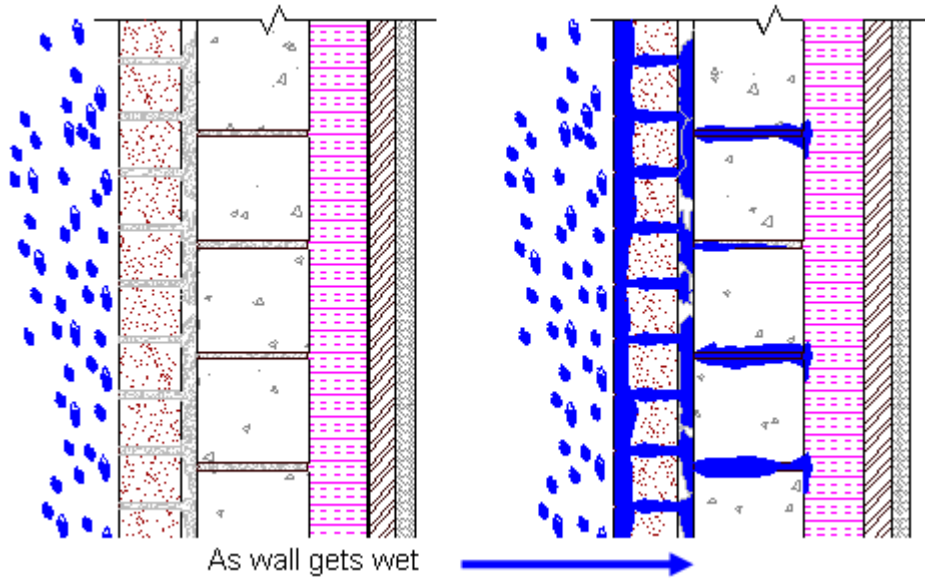
- **Structural**
 - Wind
 - Seismic
 - Blast
 - Gravity
- **Environmental**
 - Water
 - Air
 - Sound
- **Architectural**



Digital image. International Masonry Institute, n.d. Web.

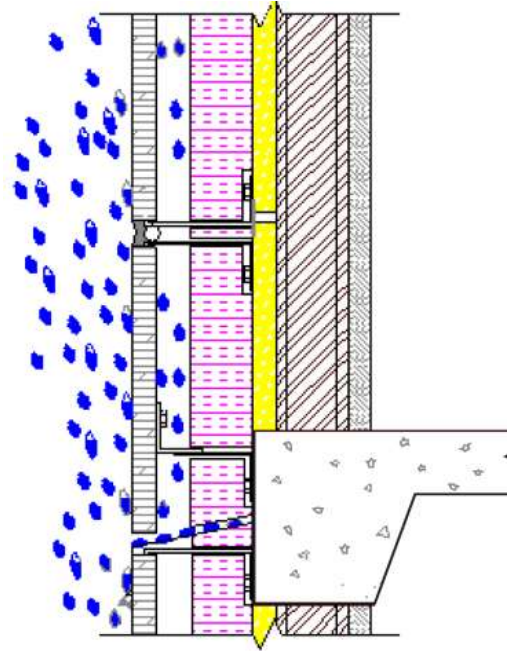
Common Façade Configurations

Mass Type



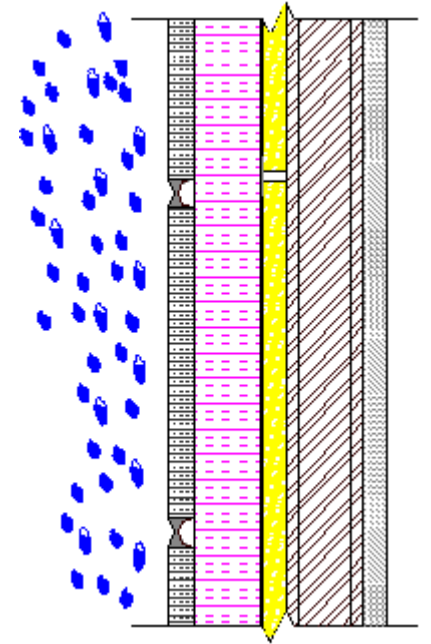
Mass Wall Diagram. Digital image. Whole Building Design Guide. National Institute of Building Sciences, n.d. Web.

Cavity Wall Type



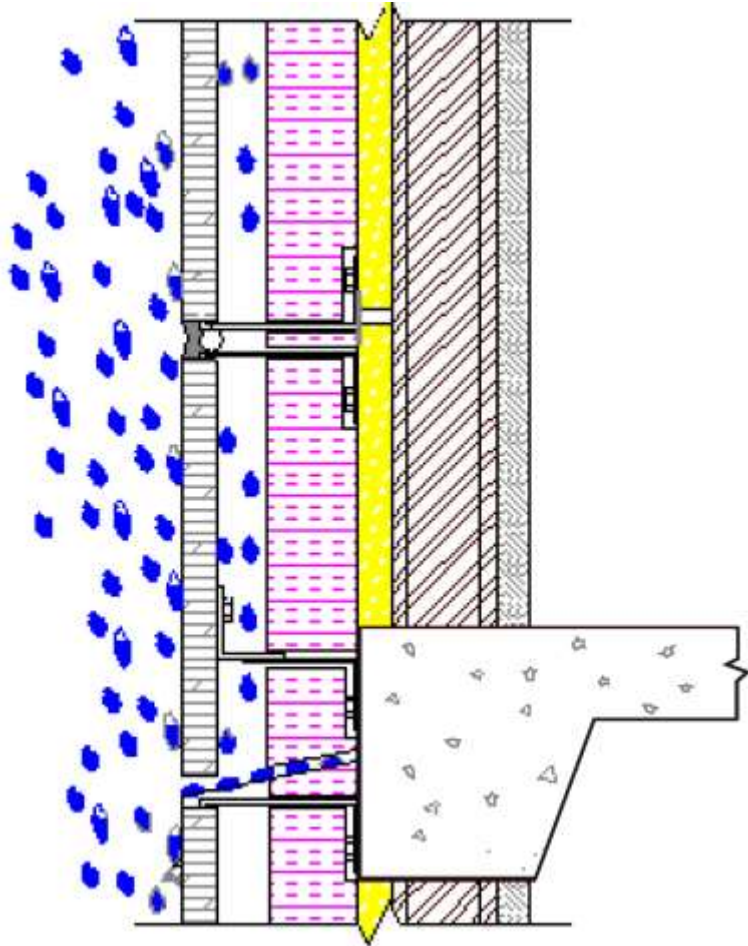
Cavity Wall Diagram. Digital image. Whole Building Design Guide. National Institute of Building Sciences, n.d. Web.

Barrier Wall Type



Barrier Wall Diagram. Digital image. Whole Building Design Guide. National Institute of Building Sciences, n.d. Web.

Cavity Wall Common Deficiencies



Cavity Wall Diagram. Digital image. *Whole Building Design Guide.* National Institute of Building Sciences, n.d. Web.

- **Non-Load Bearing Masonry Cavity Wall**
 1. Deteriorated Mortar Joints
 2. Cracks In Masonry
 3. Masonry Spalls
 4. Relief/Lintel Angle Deterioration
 5. Tie/Support Deterioration
 6. Failing Previous Repairs

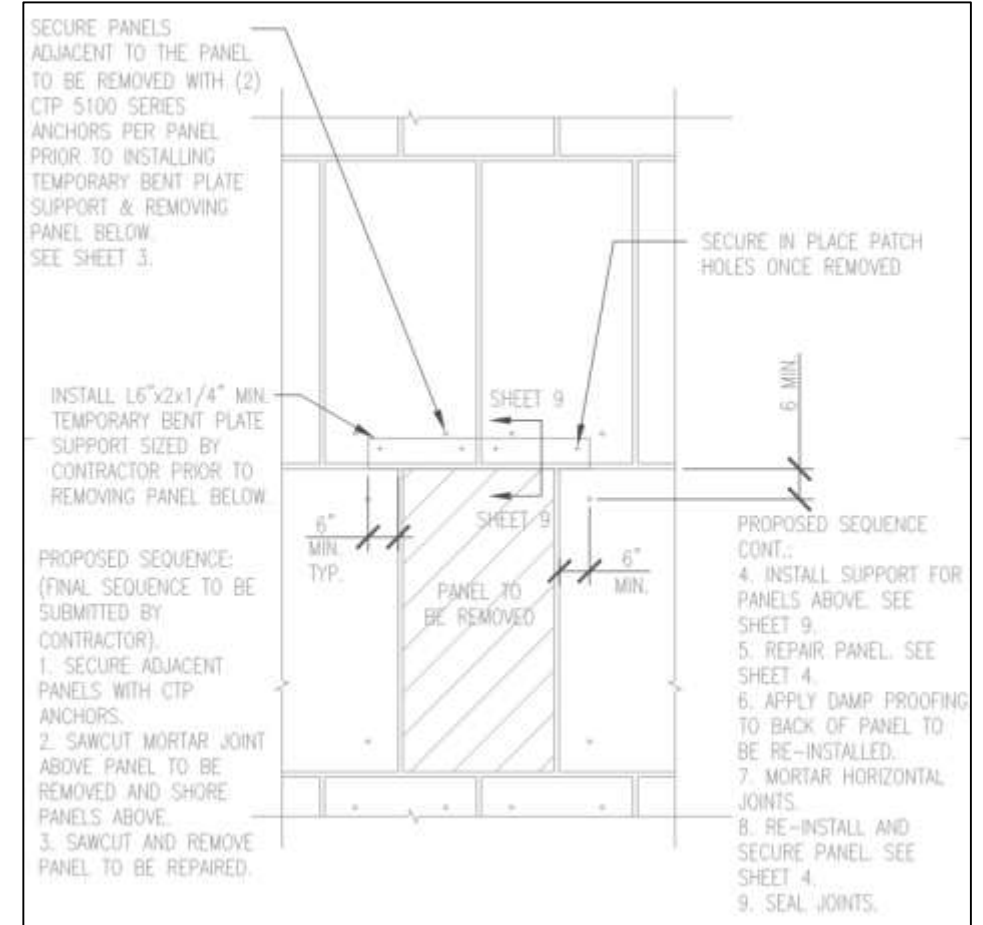
Cavity Wall Common Repairs

- **Non-Load Bearing Masonry Cavity Wall**
 1. Deteriorated Mortar – Remove loose mortar to sound substrate and repoint joint with mortar repair material similar in strength to existing
 2. Cracks In Masonry
 3. Masonry Spalls
 4. Relief/Lintel Angle Deterioration
 5. Tie/Support Deterioration
 6. Failing Previous Repairs



Cavity Wall Common Repairs

- Non-Load Bearing Masonry Cavity Wall
 1. Deteriorated Mortar
 2. Cracks In Masonry
 3. Masonry Spalls – Patch or Remove and replace damaged masonry. Shore existing masonry as required.
 4. Relief/Lintel Angle Deterioration
 5. Tie/Support Deterioration
 6. Failing Previous Repairs



Façade Deficiency Classification

- **Serviceability Failures**
 - Effect Operations
 - Water Leakage
 - Air Leakage
 - Inhibit Ability to Perform as Expected
- **Safety Related Failures**
 - Of Immediate Concern
 - Hazardous/Will Become Hazardous to Public
 - Potential for Property Damage



Typical Façade Deficiency Sources

- **Movement of Materials**
 - Thermal
 - Moisture
 - Elastic Deformation
 - Creep
 - Corrosion
 - Unstable Soils
- **Aging, Weathering, and Degradation of Materials**
- **Weather Tightness of Materials**
- **Poor Detailing and Execution**
- **Lack of Maintenance**



Typical Façade Deficiency Sources

- **Movement of Materials**
 - Thermal
 - Moisture
 - Elastic Deformation
 - Creep
 - **Corrosion**
 - Unstable Soils
- **Aging, Weathering, and Degradation of Materials**
- **Weather Tightness of Materials**
- **Poor Detailing and Execution**
- **Lack of Maintenance**



Poor Detailing and Execution

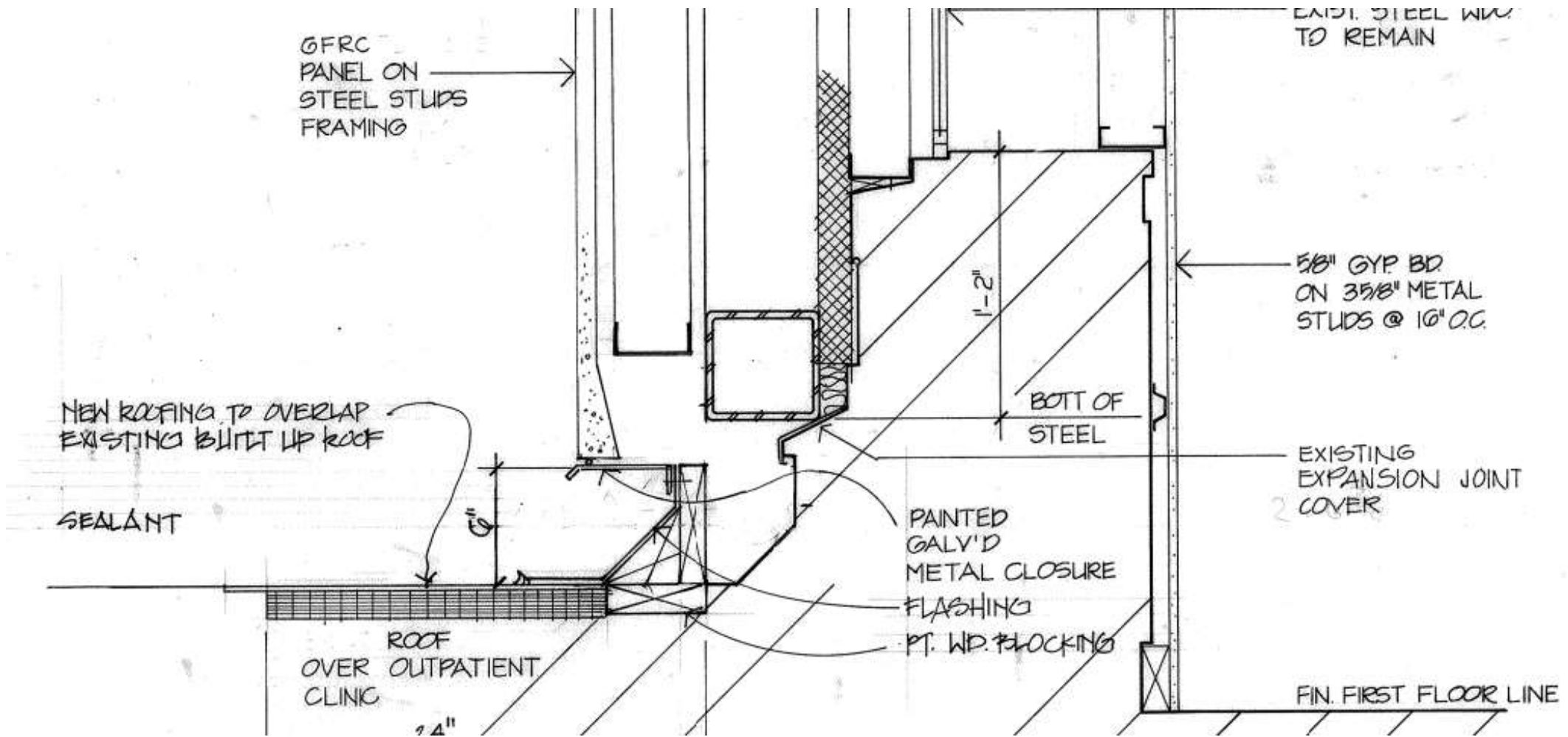


Practical Considerations for Façade Inspections

Poor Detailing and Execution



Poor Detailing and Execution



Poor Detailing and Execution



Practical Considerations for Façade Inspections

Poor Detailing and Execution



Practical Considerations for Façade Inspections

Weather Tightness of Materials

- **Common Problems**

- Corrosion
- Water Staining
- Organic Growth
- Efflorescence
- Surface Scaling
- Damage to Interior Finishes
- Freeze/Thaw Damage



Weather Tightness of Materials

- **Common Problems**

- Corrosion
- Water Staining
- Organic Growth
- Efflorescence
- Surface Scaling
- Damage to Interior Finishes
- Freeze/Thaw Damage



Lack of Maintenance



Practical Considerations for Façade Inspections

Lack of Maintenance

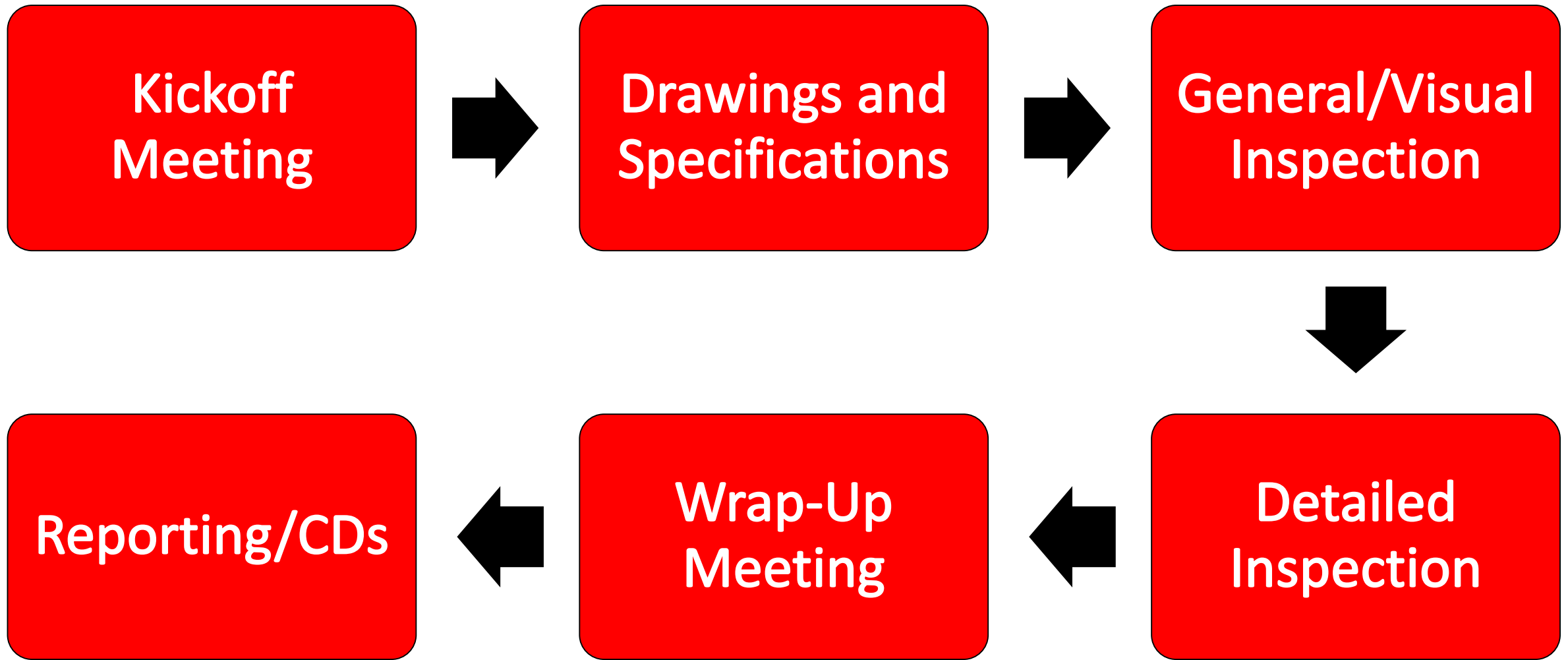


Practical Considerations for Façade Inspections

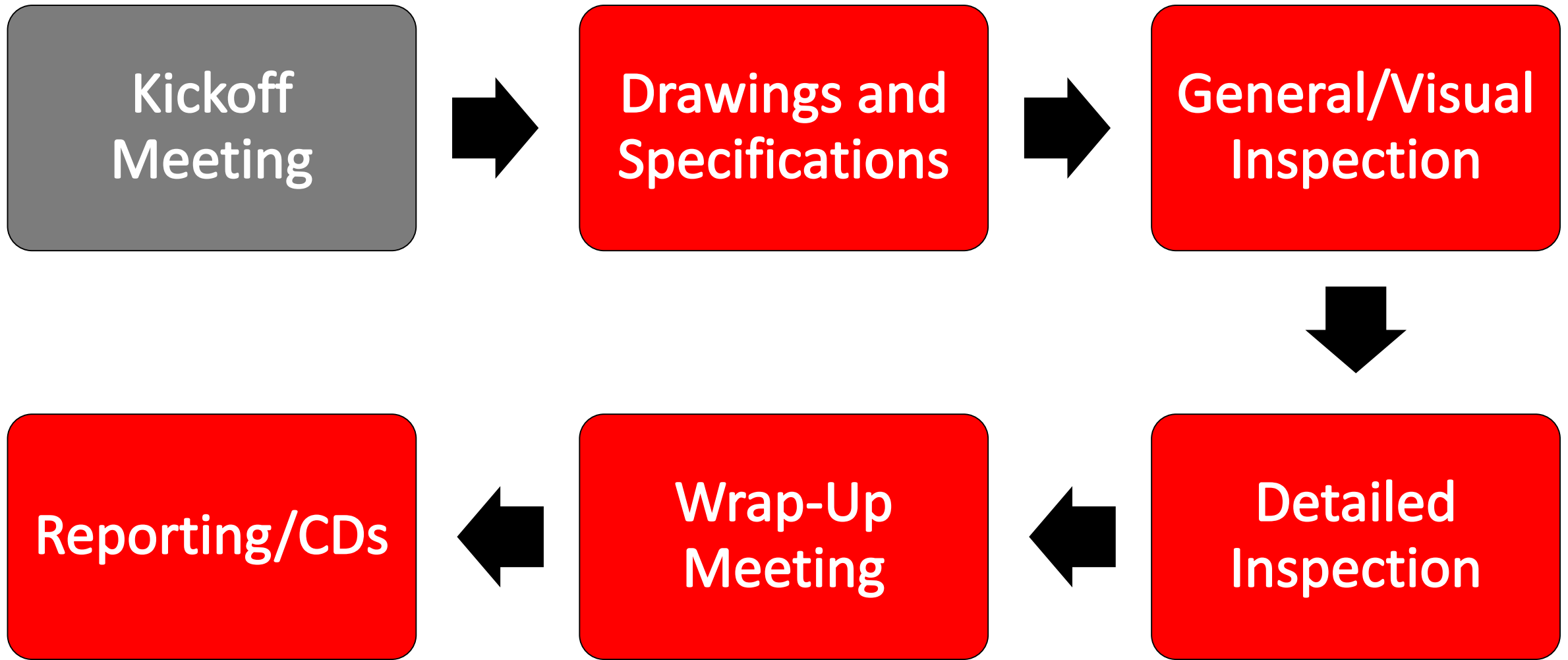
Lack of Maintenance



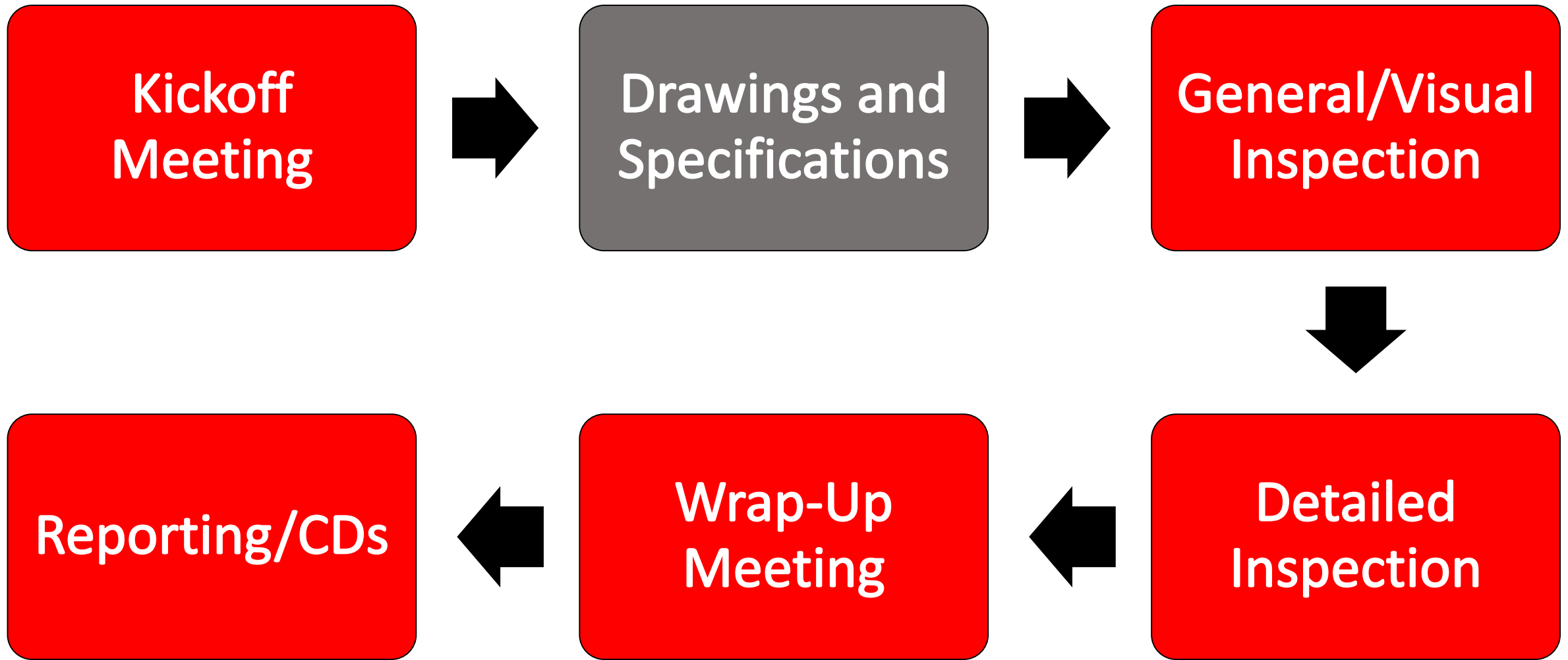
Inspection Process



Inspection Process

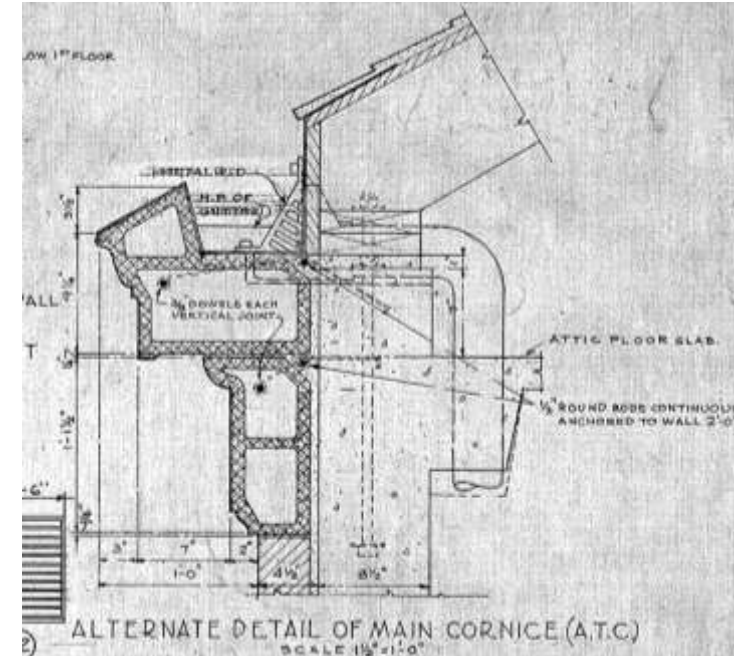


Inspection Process



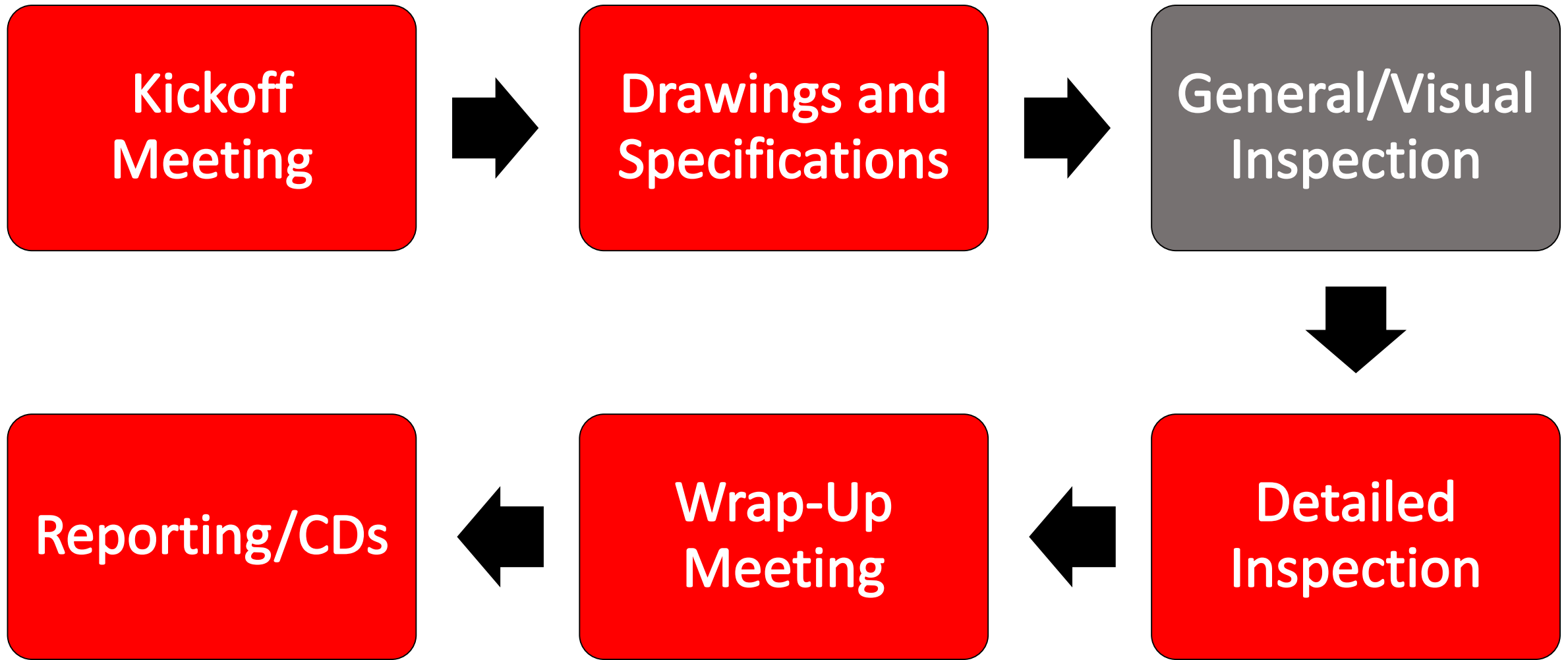
Drawings and Specifications

- Invaluable resource
- Confirms façade construction
- Establish history of façade and projects that affected it
- Common to be told no drawings exist
- Be persistent!



3. MATERIALS:
(a) Architectural Terra-Cotta:
(a-a) Materials: Terra cotta to be made from suitable selected clays, grog, and fusible minerals which have been thoroughly ground and sifted free of lumps, carefully proportioned and mixed, and properly burned to produce a strong, homogeneous body which will give a sharp, metallic, bell-like ring when struck.
(a-b) Types: Closed back, solid slab, and open back.

Inspection Process



General/Visual Inspection



Practical Considerations for Façade Inspections

Visual Inspection: Two Key Points

- **Appropriate Lighting Conditions**
- **Visual Cues**



Visual Inspection: Two Key Points

- **Appropriate Lighting Conditions**
- **Visual Cues**



Visual Inspection: UAV (Drone)

- Define areas of interest
- Help reduce access costs
- Not a replacement for hands on up-close inspections



Visual Inspection: UAV (Drone)

- Define areas of interest
- Help reduce access costs
- Not a replacement for hands on up-close inspections

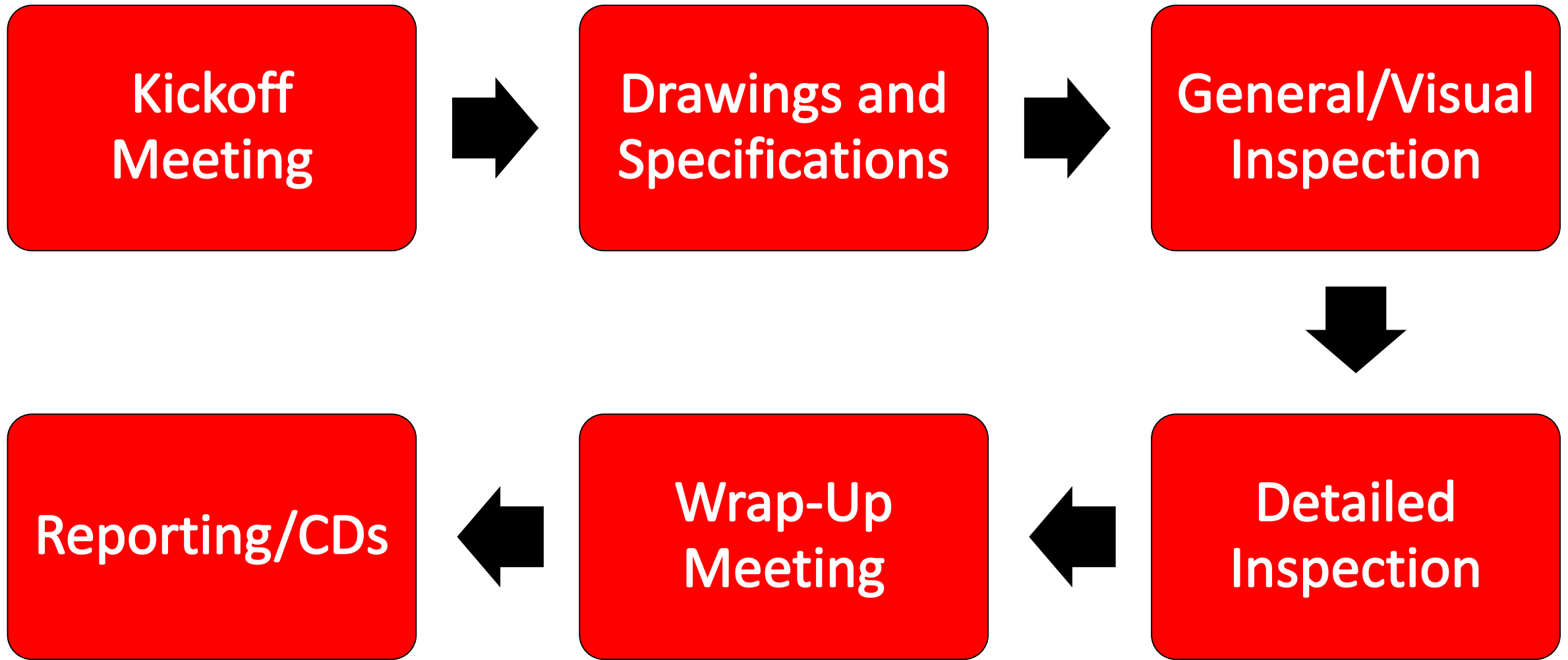


Visual Inspection: UAV (Drone)

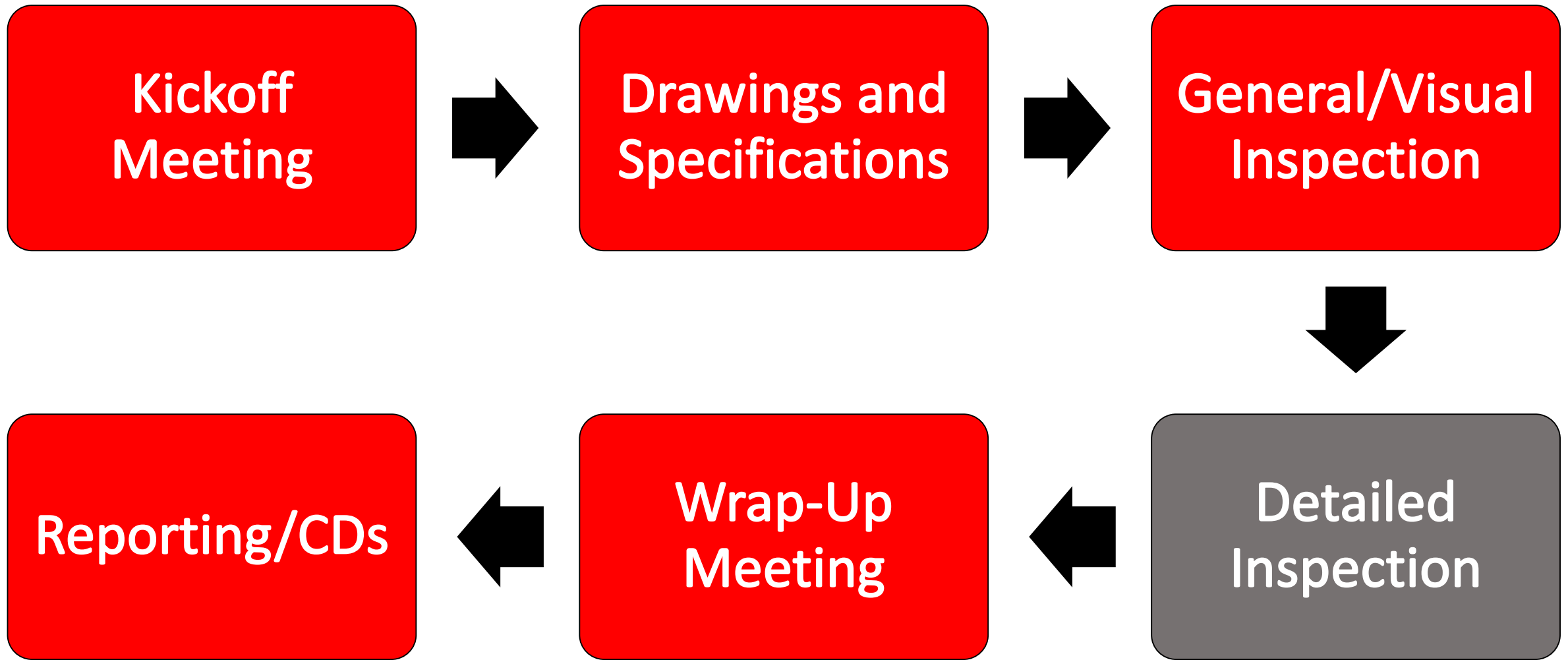
- Define areas of interest
- Help reduce access costs
- Not a replacement for hands on up-close inspections



Inspection Process



Inspection Process



Detailed Inspection

- **Access Technique Selection**

- Ladders
- Scaffolding
- Lifts
- Buckets
- Swing Stages
- Rope Access



Detailed Inspection

- Access Technique Selection

- Ladders
- Scaffolding
- Lifts
- Buckets
- Swing Stages
- Rope Access



Access Techniques: Aerial Lifts

- **Advantages**
 - Mobile
 - Cost (dependent upon size)
 - Mobilization/demobilization
- **Disadvantages**
 - Special training required
 - Unique hazards
 - Cost (dependent upon size)
 - Limited reach



Access Techniques: Rope Access

- **Advantages**

- Ease of access
- Mobile
- Cost
- Speed of mobilization
- Less disruptive
- Versatility

- **Disadvantages**

- Special training required
- Unique hazards
- Public perception



Access Techniques: Rope Access



Practical Considerations for Façade Inspections

Access Techniques: Rope Access



Practical Considerations for Façade Inspections

Access Techniques: Rope Access



Practical Considerations for Façade Inspections

Access Techniques: Rope Access



Practical Considerations for Façade Inspections

Detailed Inspection

- Some Investigative Tools and Techniques Employed
 - Crack Monitors and Gauges
 - Probing and Sounding
 - Borescope/Remote Camera
 - Metal Detector
 - Thermal Imaging Camera
 - Moisture Meter
 - Exploratory Openings

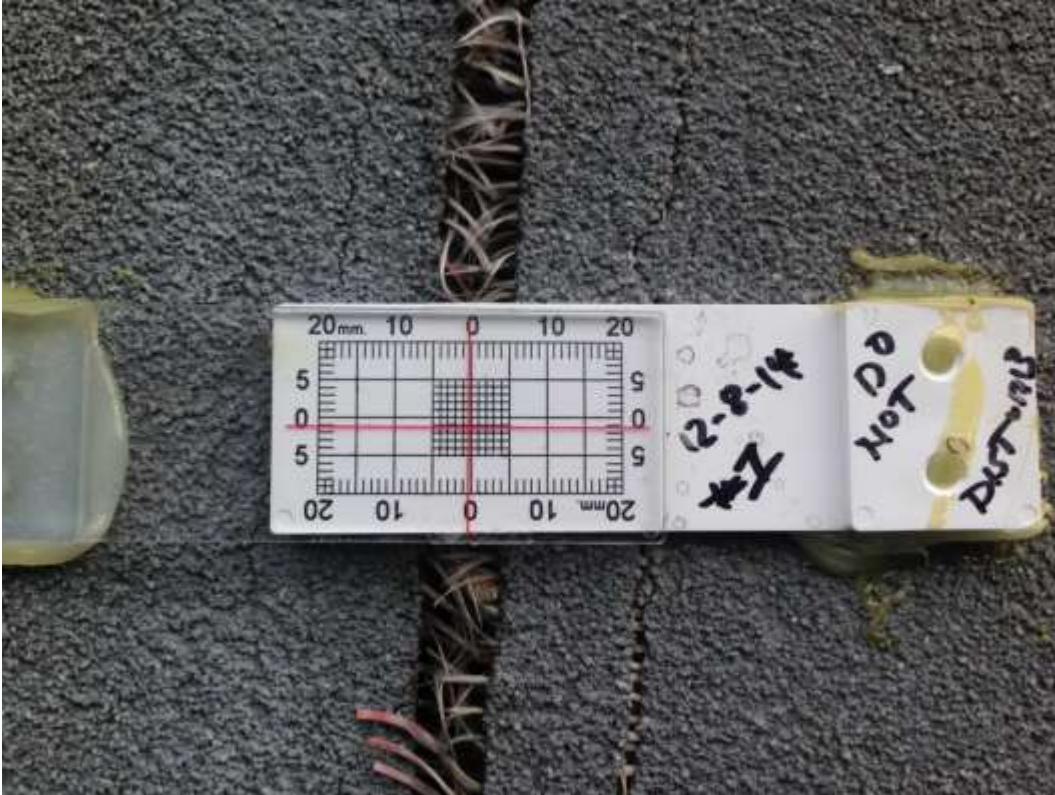


Detailed Inspection

- Some Investigative Tools and Techniques Employed
 - Crack Monitors and Gauges
 - Probing and Sounding
 - Borescope/Remote Camera
 - Metal Detector
 - Thermal Imaging Camera
 - Moisture Meter
 - Exploratory Openings



Investigative Tools and Techniques: Crack Monitors and Gauges



Investigative Tools and Techniques: Probing and Sounding

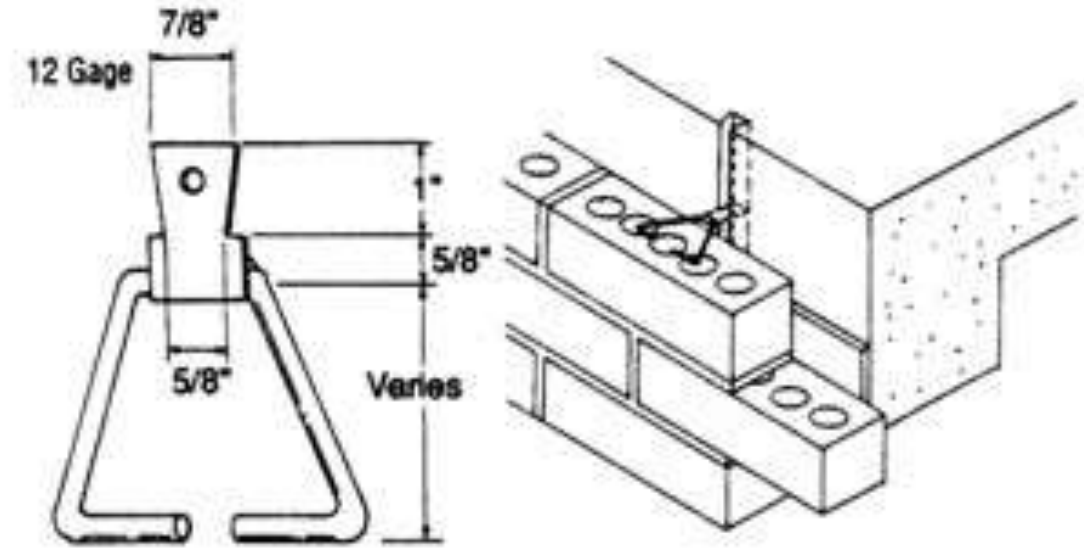


Investigative Tools and Techniques: Borescope

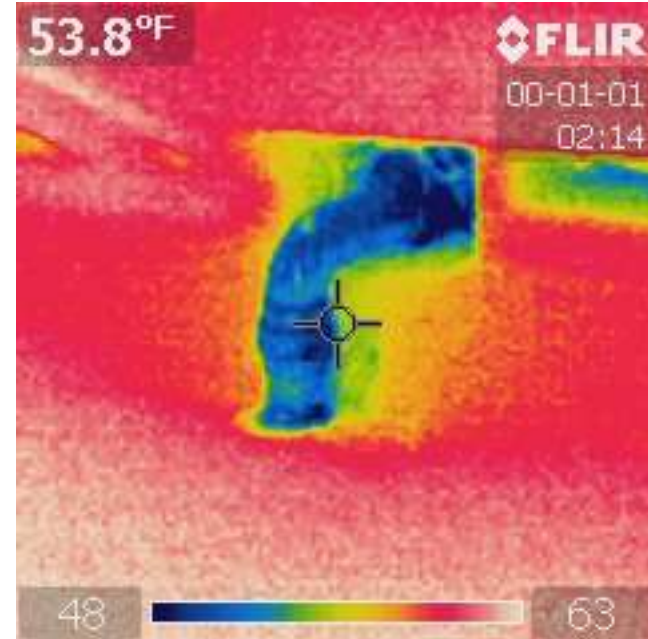


Practical Considerations for Façade Inspections

Investigative Tools and Techniques: Borescope



Investigative Tools and Techniques: Thermal Imaging



Practical Considerations for Façade Inspections

Investigative Tools and Techniques: Exploratory Openings



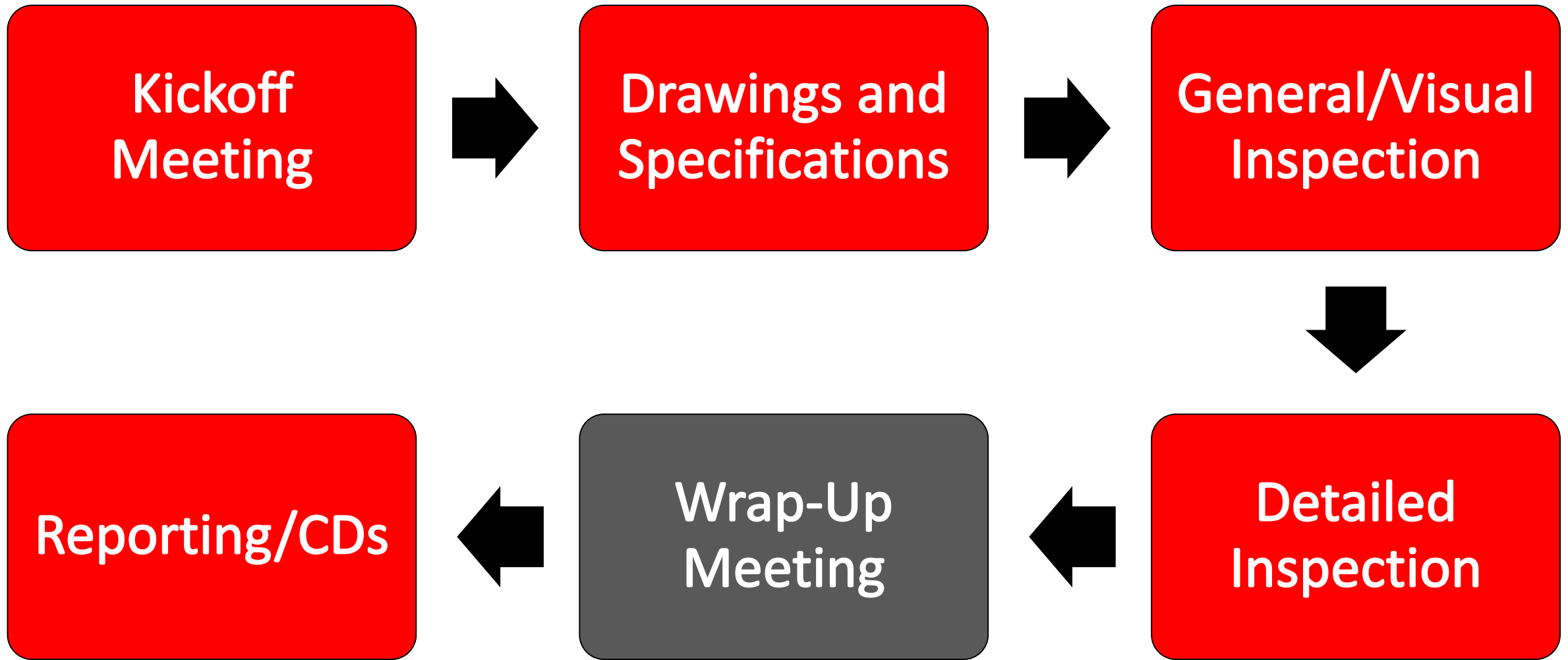
Practical Considerations for Façade Inspections

Investigative Tools and Techniques: Exploratory Openings

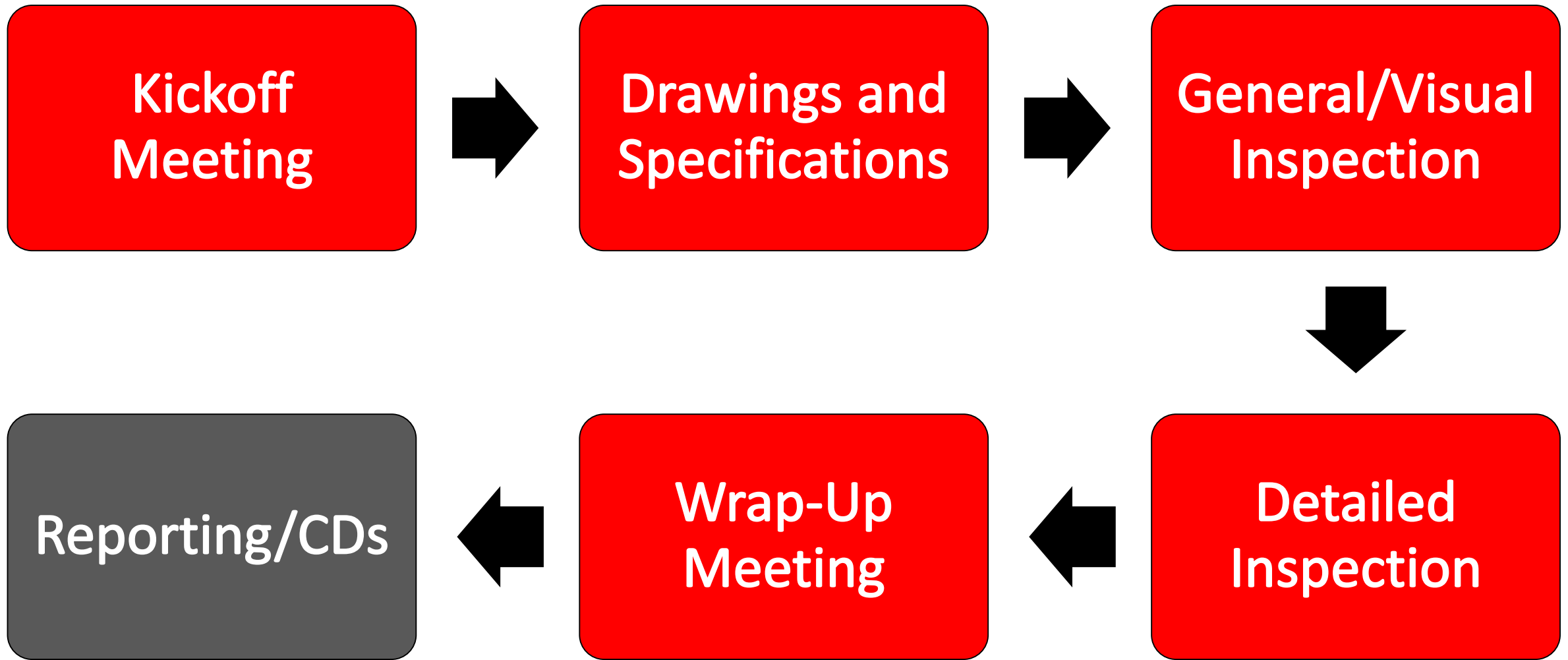


Practical Considerations for Façade Inspections

Inspection Process

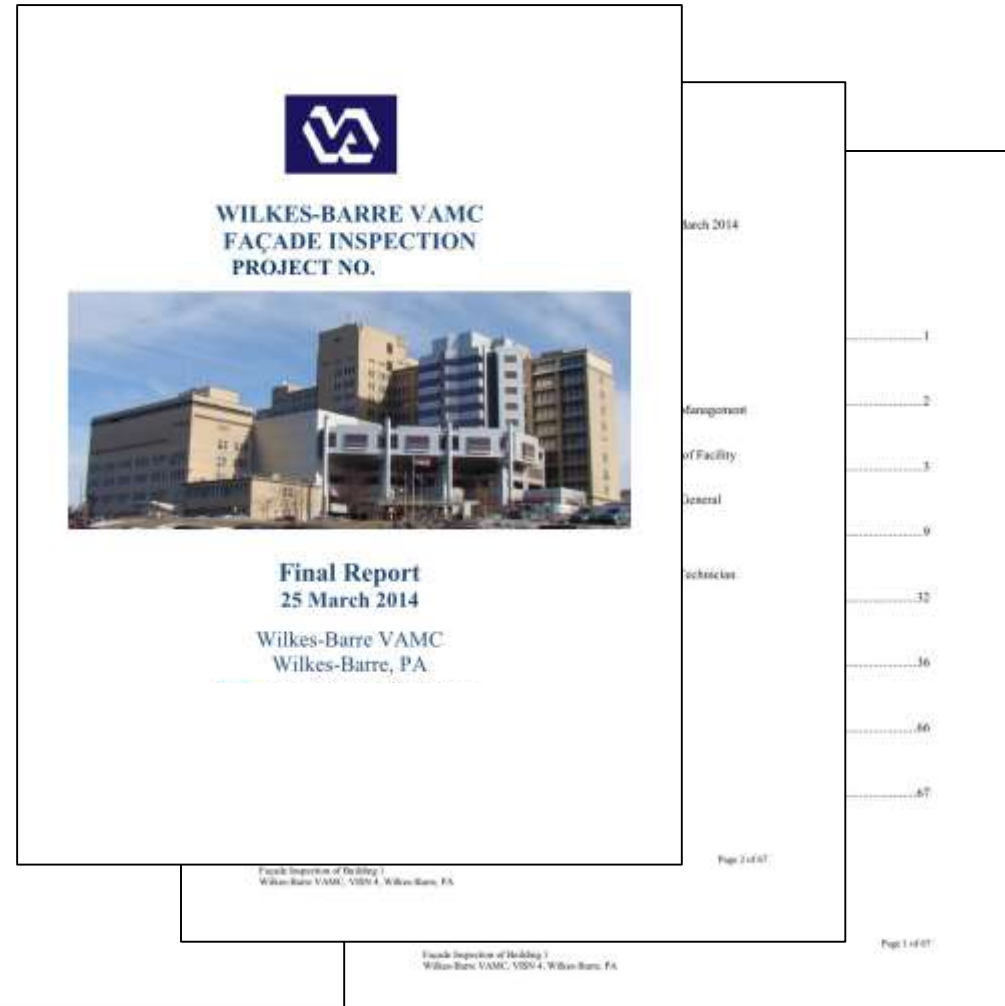


Inspection Process



Reporting/CDs

- Qualify
- Summarize
 - History of Building
 - Findings
 - Repair Recommendations
 - Estimated Costs
- Provide Ample Pictures
- Unsafe Conditions
- Requires Repair
- Ordinary Maintenance



Case Study: Bedford, MA

- **Project Information**
 - Built in 1956
 - Structural System
 - Reinforced Concrete
 - Façade System
 - Non-Loading Bearing Brick
 - Cavity Wall



Case Study: Bedford, MA



Practical Considerations for Façade Inspections

Case Study: Bedford, MA



Case Study: Bedford, MA



Practical Considerations for Façade Inspections

Case Study: Bedford, MA



Practical Considerations for Façade Inspections

Case Study: Bedford, MA



Practical Considerations for Façade Inspections

Case Study: Bedford, MA



Practical Considerations for Façade Inspections

Case Study: Athens, GA

- **Project Information**

- Built in 1960
- Structural System
 - Reinforced Concrete
- Façade System
 - Limestone Panels
 - Non-Load Bearing
 - Cavity Type

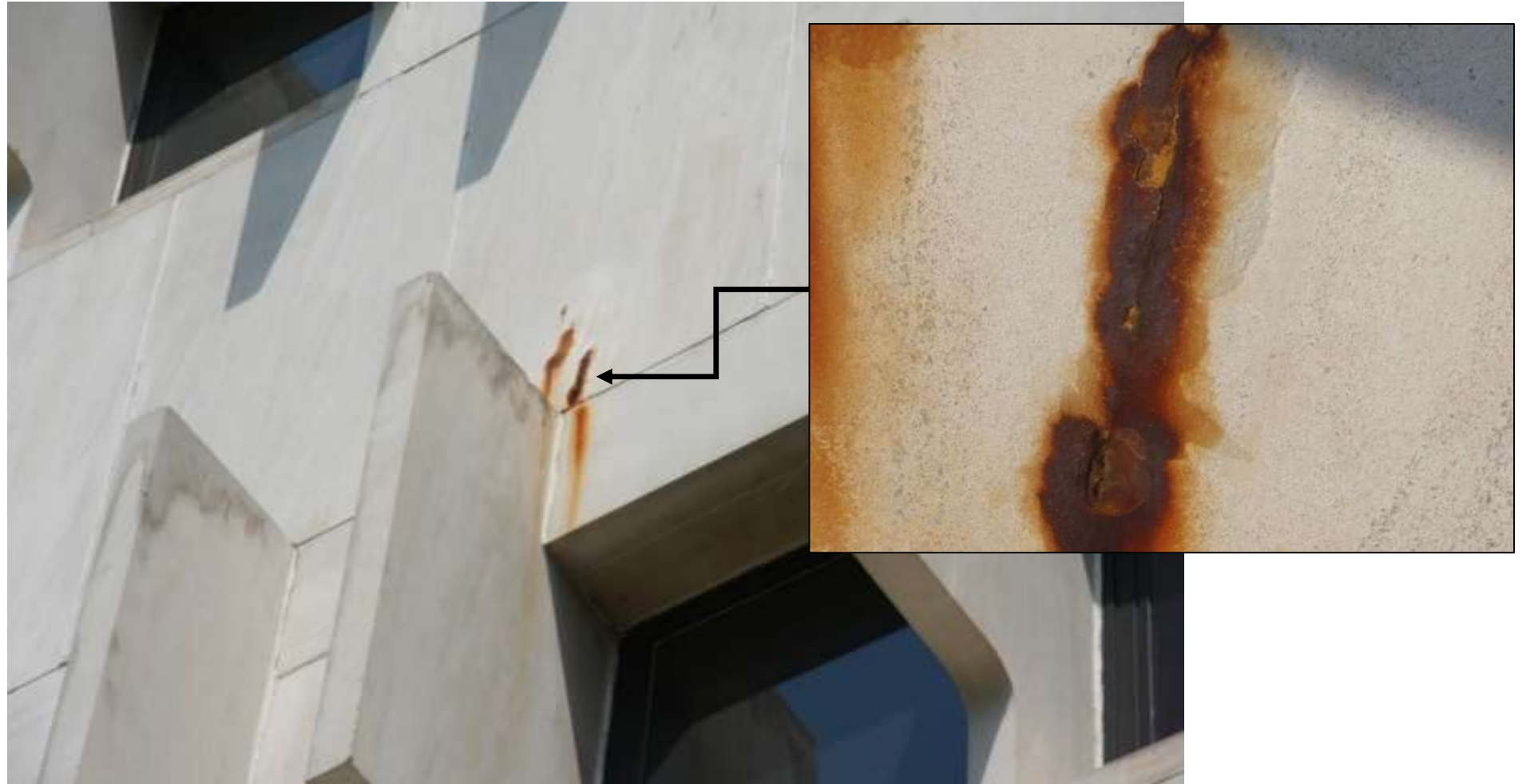


Case Study: Athens, GA



Practical Considerations for Façade Inspections

Case Study: Athens, GA



Practical Considerations for Façade Inspections

Case Study: Athens, GA



Practical Considerations for Façade Inspections

Case Study: Athens, GA



Case Study: Athens, GA

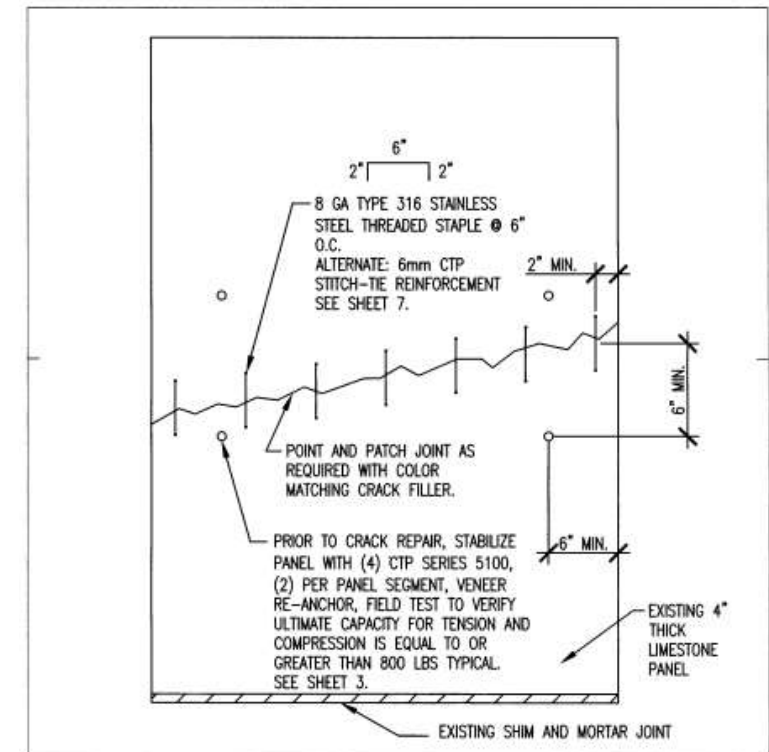
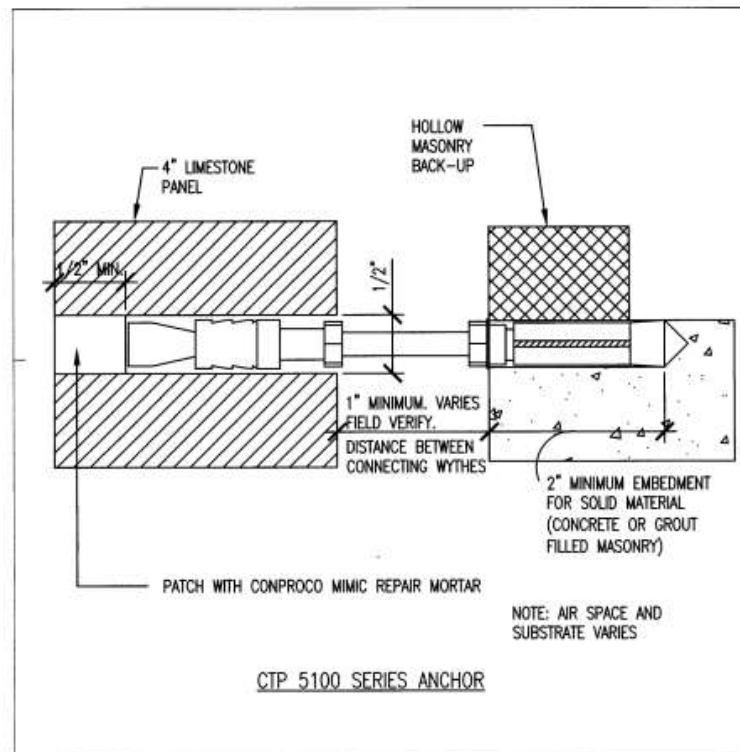
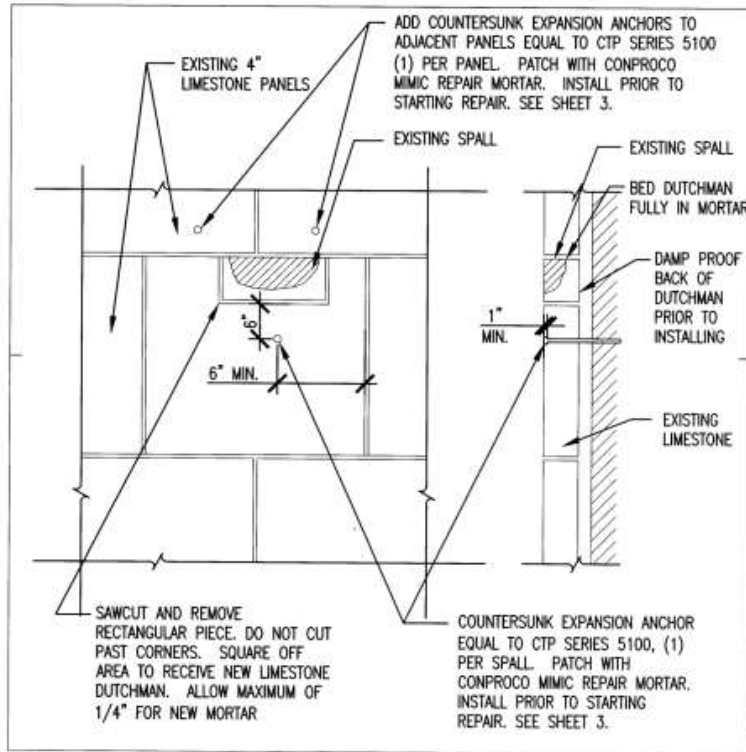



Case Study: Athens, GA





Practical Considerations for Façade Inspections

Case Study: Athens GA



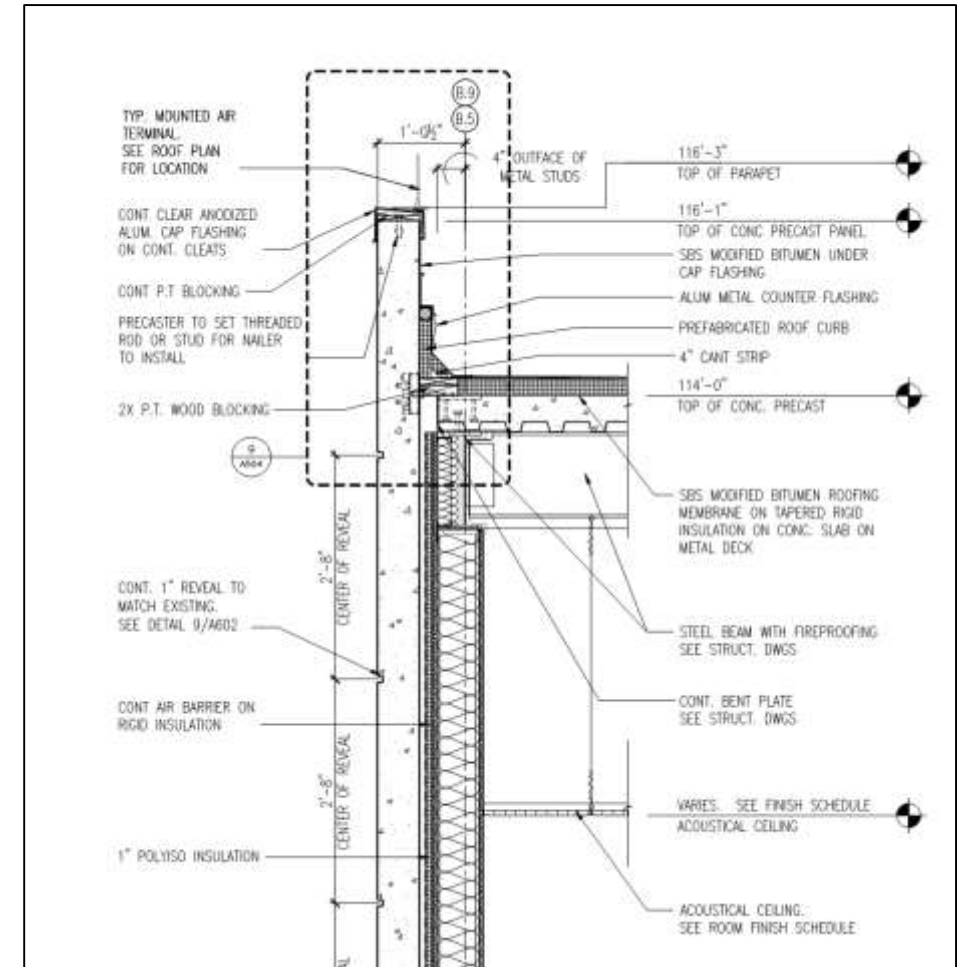
TITLE: SPALL REPAIR OPTION A (DUTCHMAN)		
 INNOVATIVE ENGINEERING INCORPORATED 2500 12th Ave. S.W. Atlanta, GA 30316 770-591-8800 Fax	DESIGN BY: SLW	SHEET NUMBER: 1 OF 9
	DRAWN BY: TJ	
	CHECKED BY:	
	SLW	

TITLE: STONE PANEL ANCHOR		
 INNOVATIVE ENGINEERING INCORPORATED 2500 12th Ave. S.W. Atlanta, GA 30316 770-591-8800 Fax	DESIGN BY: SLW	SHEET NUMBER: 3 OF 9
	DRAWN BY: TJ	
	CHECKED BY:	
	SLW	

TITLE: CRACKED PANEL REPAIR OPTION B (REPAIR IN PLACE)		
 INNOVATIVE ENGINEERING INCORPORATED 2500 12th Ave. S.W. Atlanta, GA 30316 770-591-8800 Fax	DESIGN BY: SLW	SHEET NUMBER: 6 OF 9
	DRAWN BY: TJ	
	CHECKED BY:	
	SLW	

A Few New Design Takeaways

- Interfaces Between Disciplines
- Interfaces Between Materials
- Material Compatibility/Dissimilar Materials
- Durability of Materials



AHA! Moments

- Don't Forget to Look Down!
- When Is a Crack a Crack?
- Water Woes
- Don't Be Afraid to Ask (But Do Your Homework First)
- Garbage In, Garbage Out
- Relevant Design Experience + Hands On Experience = Intuitiveness
- Put Yourself Out There

Questions?

Evan Moore

Innovative Engineering Inc.
3380 Trickum Road
Bldg. 500, Suite 100
Woodstock, Georgia 30188
emoore@ieiusa.com
770-517-5507 Ext. 203