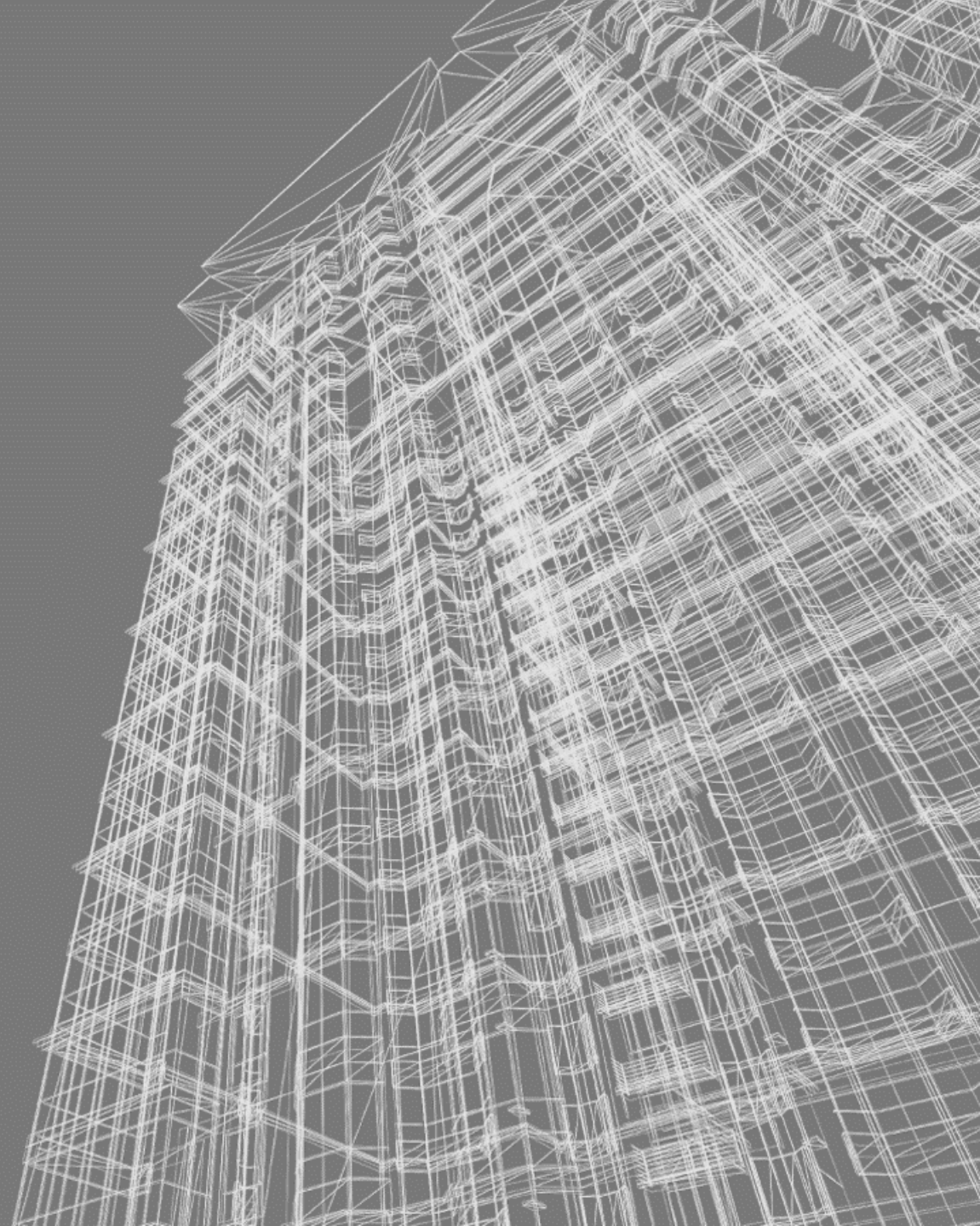


LONGEVITY OF STRUCTURES

and
FUNCTIONING BUILDING
ENCLOSURES

LEE DUNHAM, PE SE
PRINCIPAL
OAC SERVICES, INC.





LONGEVITY OF STRUCTURES AND FUNCTIONING BUILDING ENCLOSURES

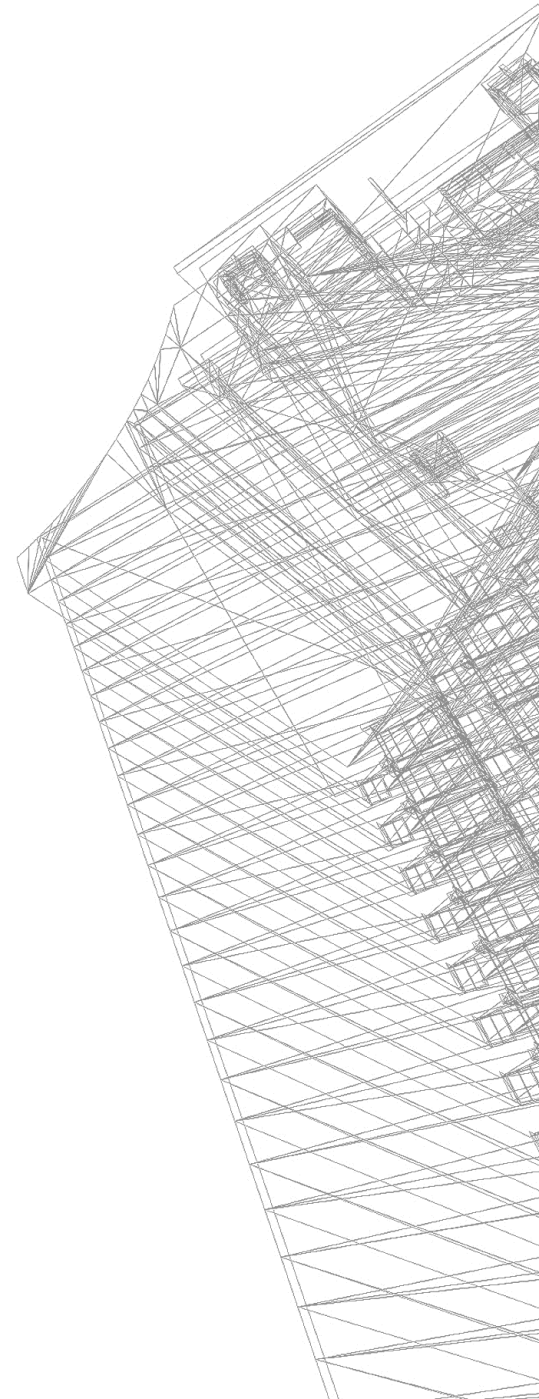
2019 SeaBEC Symposium
Museum of Flight
May 14, 2019

LET'S TALK ABOUT:

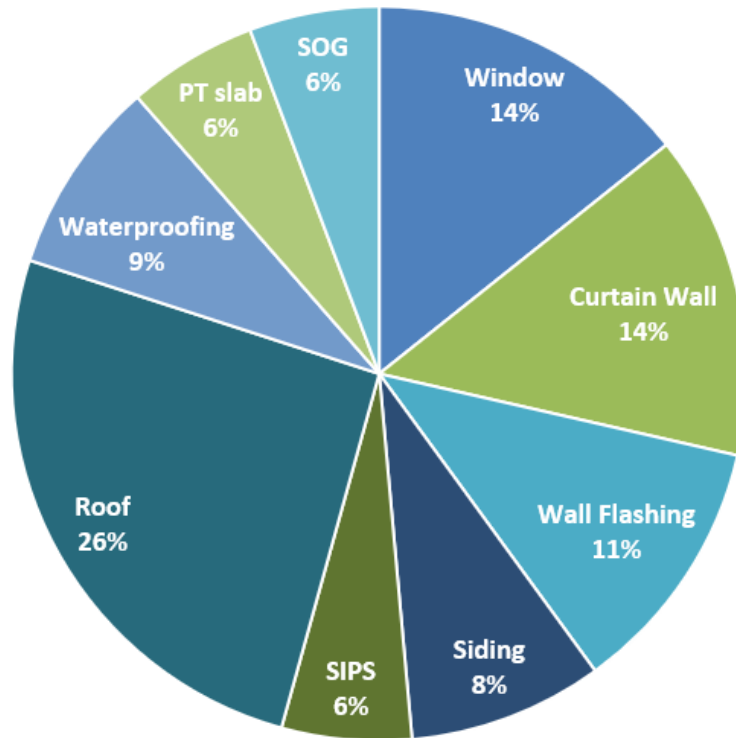
- Changes in building enclosure performance over time
Relative longevity examined through forensics
- Designing / constructing building enclosures in a changing industry
- What can we do better?

Engineers and architects at OAC have investigated 1,500+ building enclosure failures over the last two decades in the Pacific Northwest.

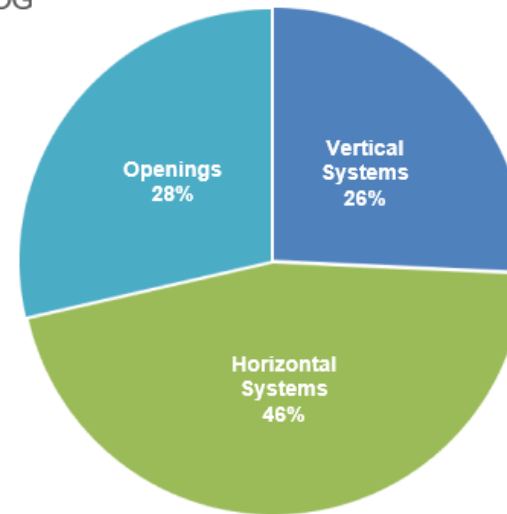
In a **2018 study**, data from 140 of these buildings were analyzed to highlight trends in failures over time.



BUILDING ENCLOSURE FAILURE BY SYSTEM

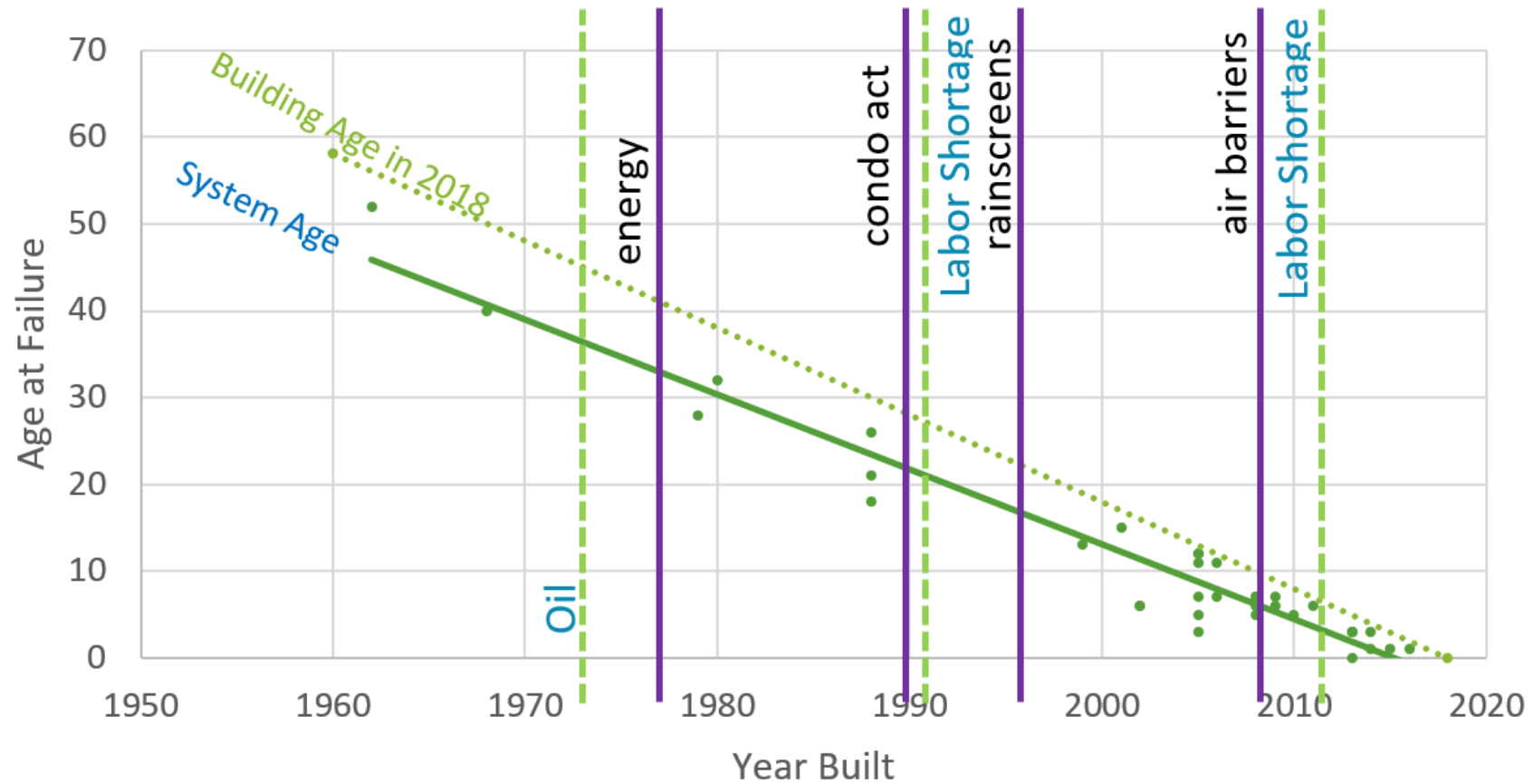


- Window
- Curtain Wall
- Wall Flashing
- Siding
- SIPS
- Roof
- Waterproofing
- PT slab
- SOG

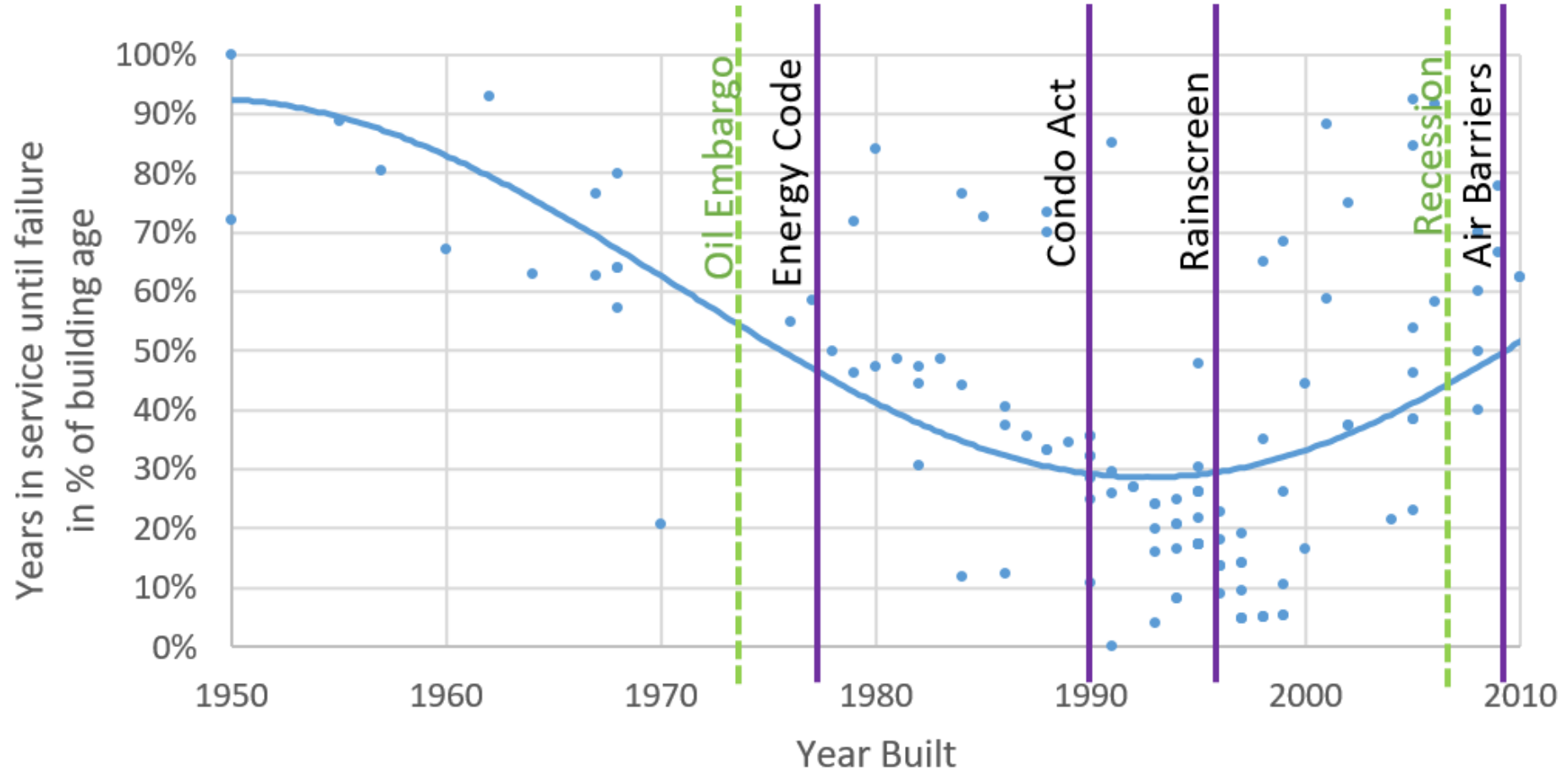


- Vertical Systems
- Horizontal Systems
- Openings

APPARENT DECLINE IN BUILDING LONGEVITY



RELATIVE LONGEVITY TRENDS



DRAINAGE & DRYING BEHIND CLADDING



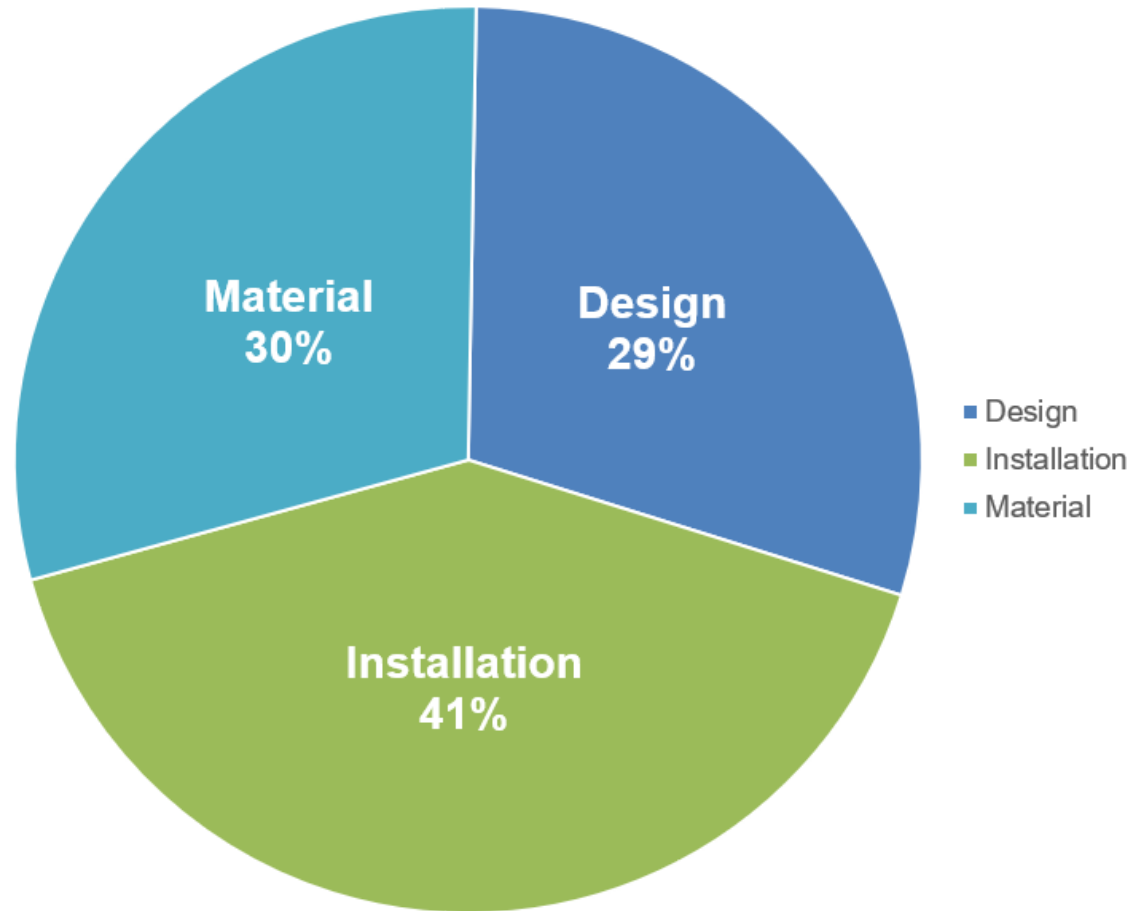
4-story, traditional stucco, Seattle (1984)

DRAINAGE & DRYING BEHIND CLADDING

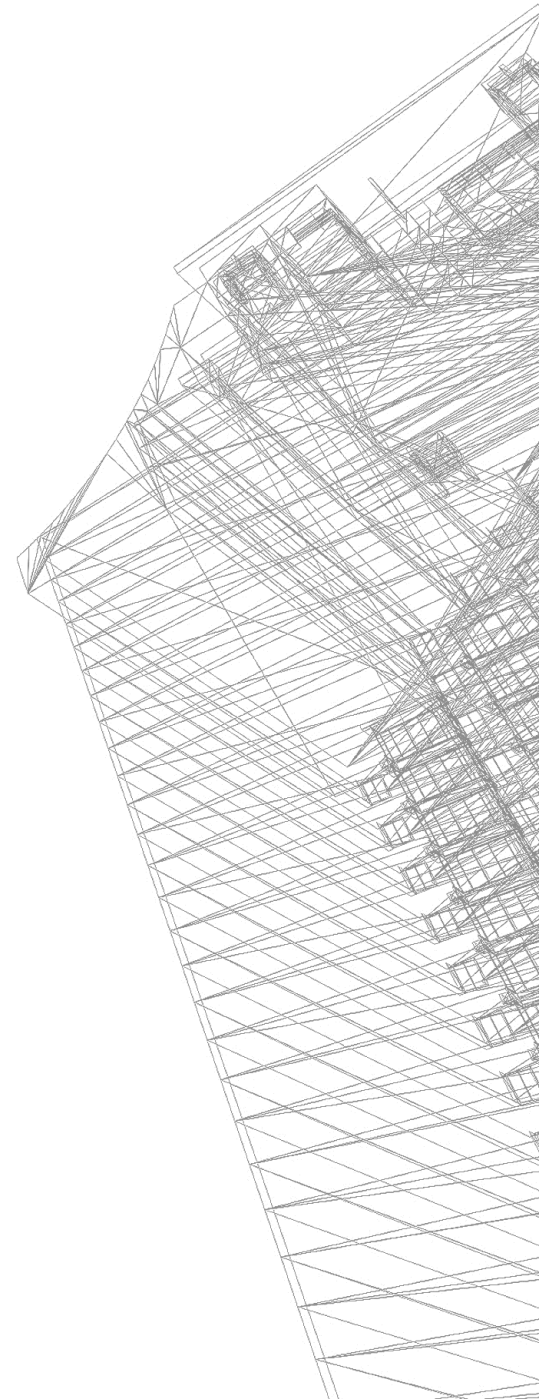
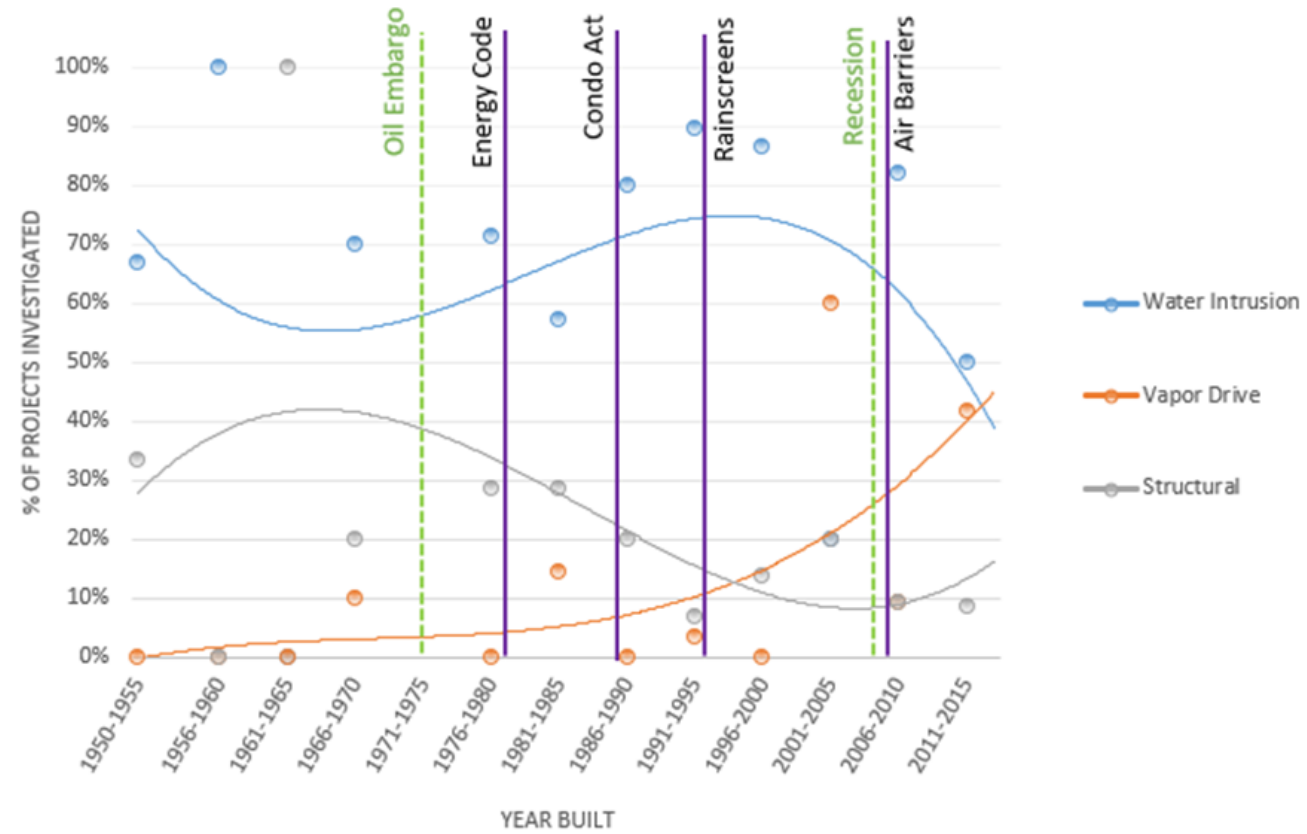
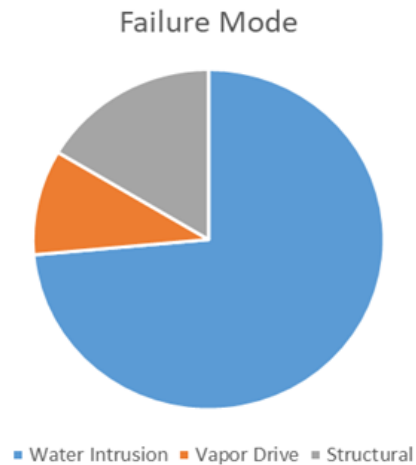


4-story, traditional stucco (marblecrete), Seattle (1979)

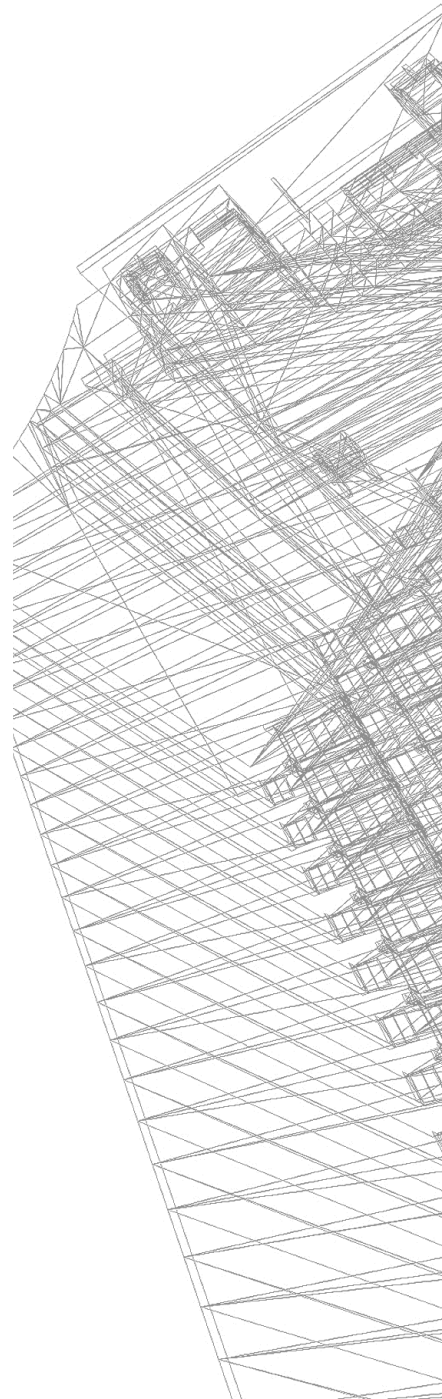
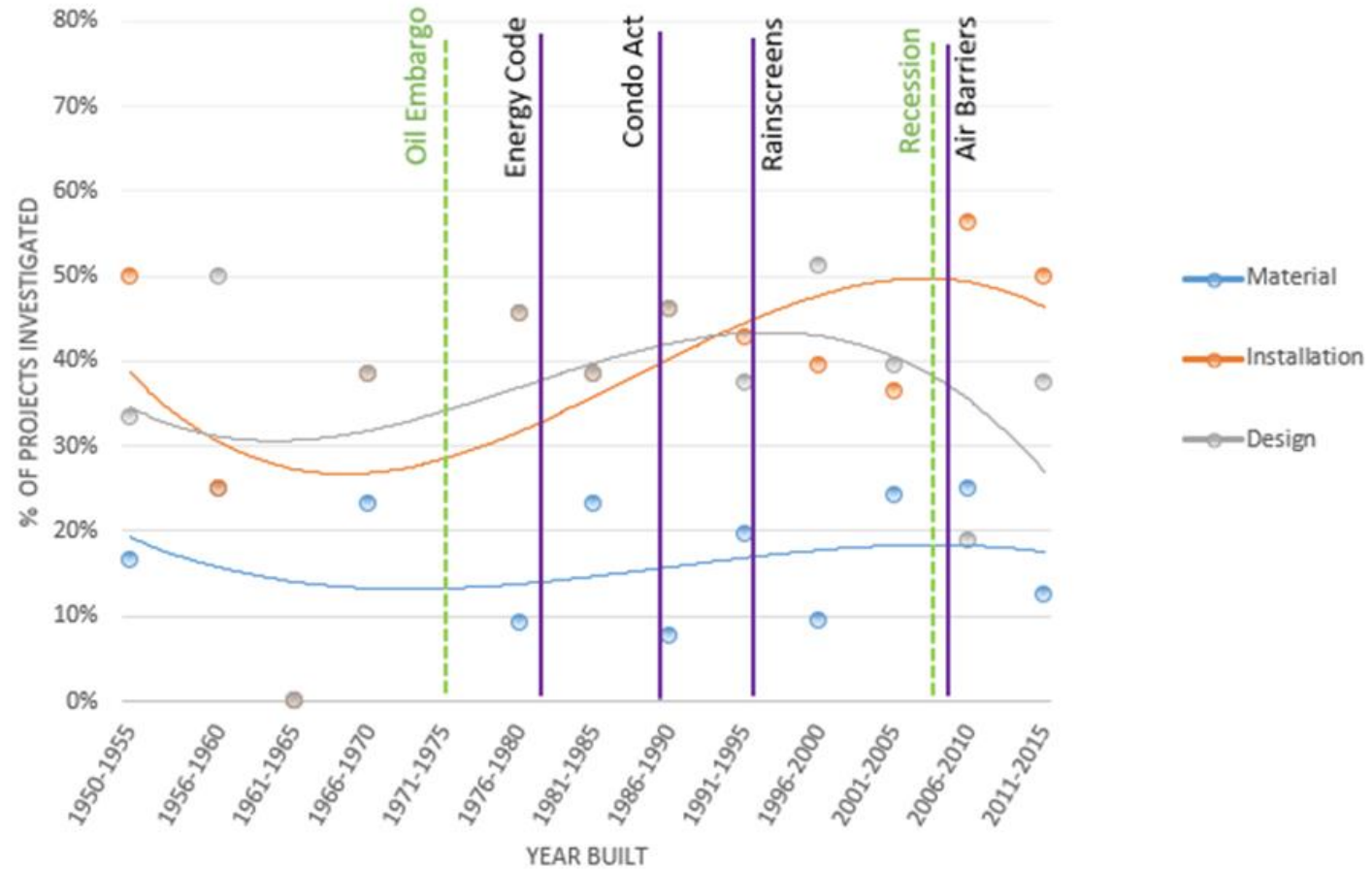
TRENDS IN FAILURE CAUSE



RELATIVE FREQUENCY OF FAILURE MODE



RELATIVE FREQUENCY OF FAILURE CAUSE



DESIGN ISSUES





DESIGN BREATHING & DRYING



- Unvented roof
- Imperfect vapor retarder
- Under-deck insulation
- Condensation damage at wood sheathing and framing
- Diminished air quality

INSTALLATION ISSUES



INSTALLATION

SIMPLE QUALITY CONTROL



- Highrise residential
- Built in 2008
- Investigation 2013
- Post-tensioned construction
- Tendon tails/grease caps

MATERIAL ISSUES



Compatibility



Material
Knowledge
– Risks and
Rewards



Durability /
Time Tested



Temperature
& Moisture
Application
Window



Storage



UNDERSTANDING OF MATERIAL BEHAVIOR



- Alternative cements (slag, fly ash)
- Benefits and risks – know both
- Proactively deal with risky behavior
- Ex: compensating admixtures



DURIBILITY

MUST BE PART OF THE
SUSTAINABILITY
EQUATION



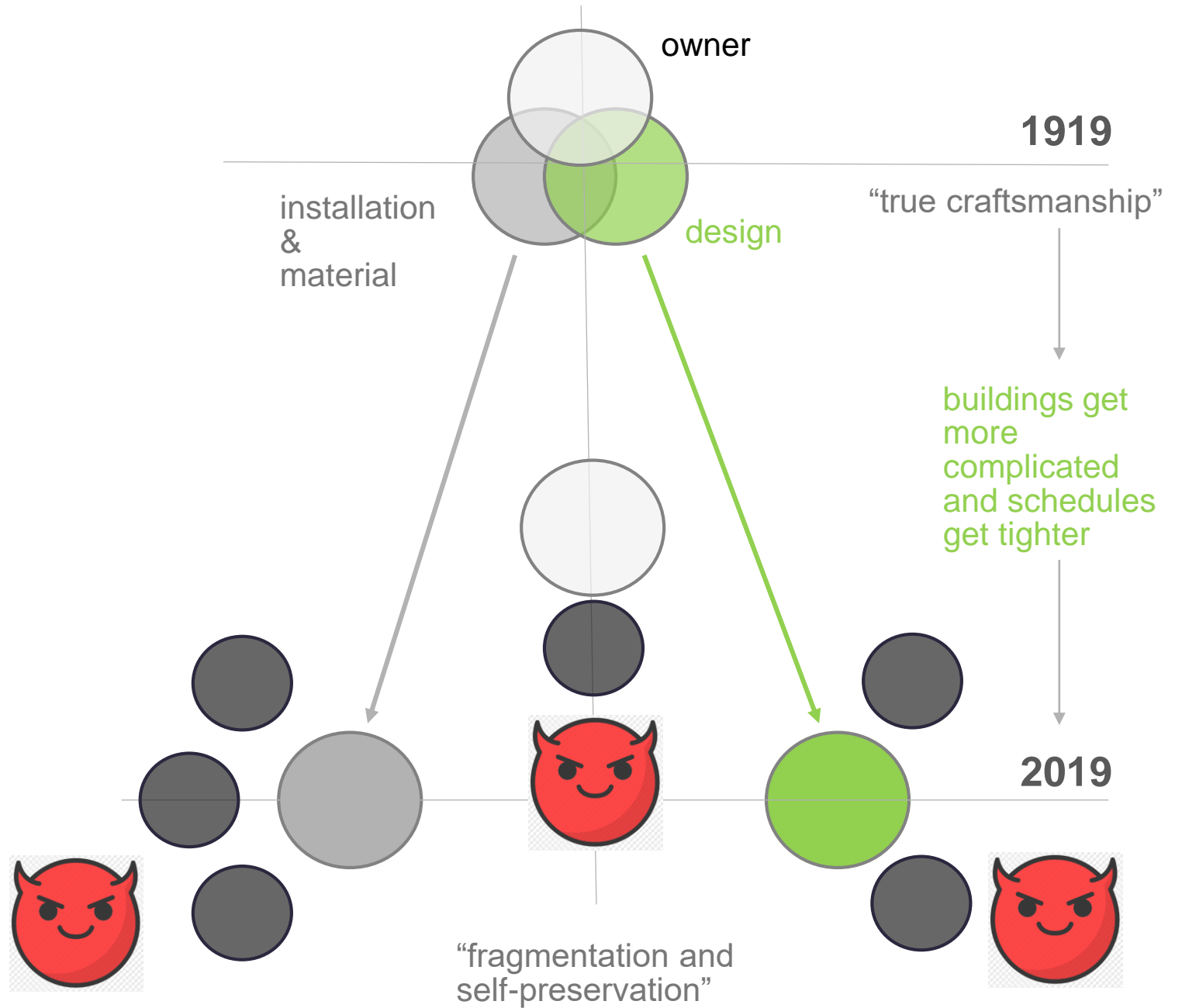


INDUSTRY CHANGES AFFECTING PERFORMANCE

- Change in the Definition of “*Failure*”
- Impact of Changing Code Requirements
- Availability of Skilled Labor
- Rate of Innovation
- Fragmented / Specialized Industry Groups
- Interaction of Design / Manufacturing / Installation

EVOLUTION OF CONSTRUCTION INDUSTRY

LAST 100 YEARS
(according to Dunham)





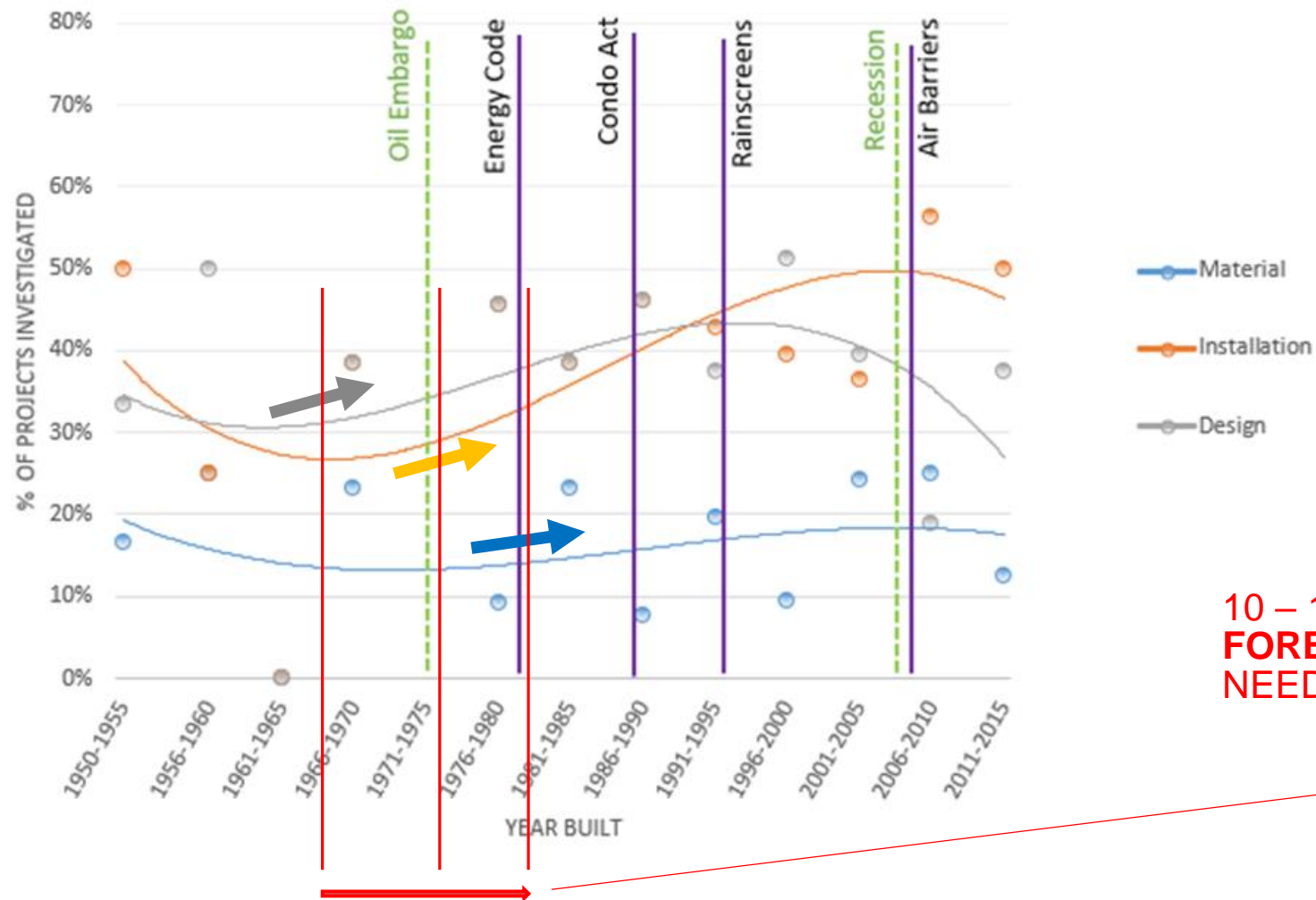
WHAT CAN WE DO BETTER?



DESIGN FOR DURABILITY

this requires knowledge of
material behavior + the
formulation of constructible
details that make
maintenance simple

INTERACTION OF DESIGN, MANUFACTURING & INSTALLATION



10 – 15 YEAR
FORENSIC FEEDBACK LOOP
NEEDS TO BE REDUCED

WHAT CAN WE DO BETTER?



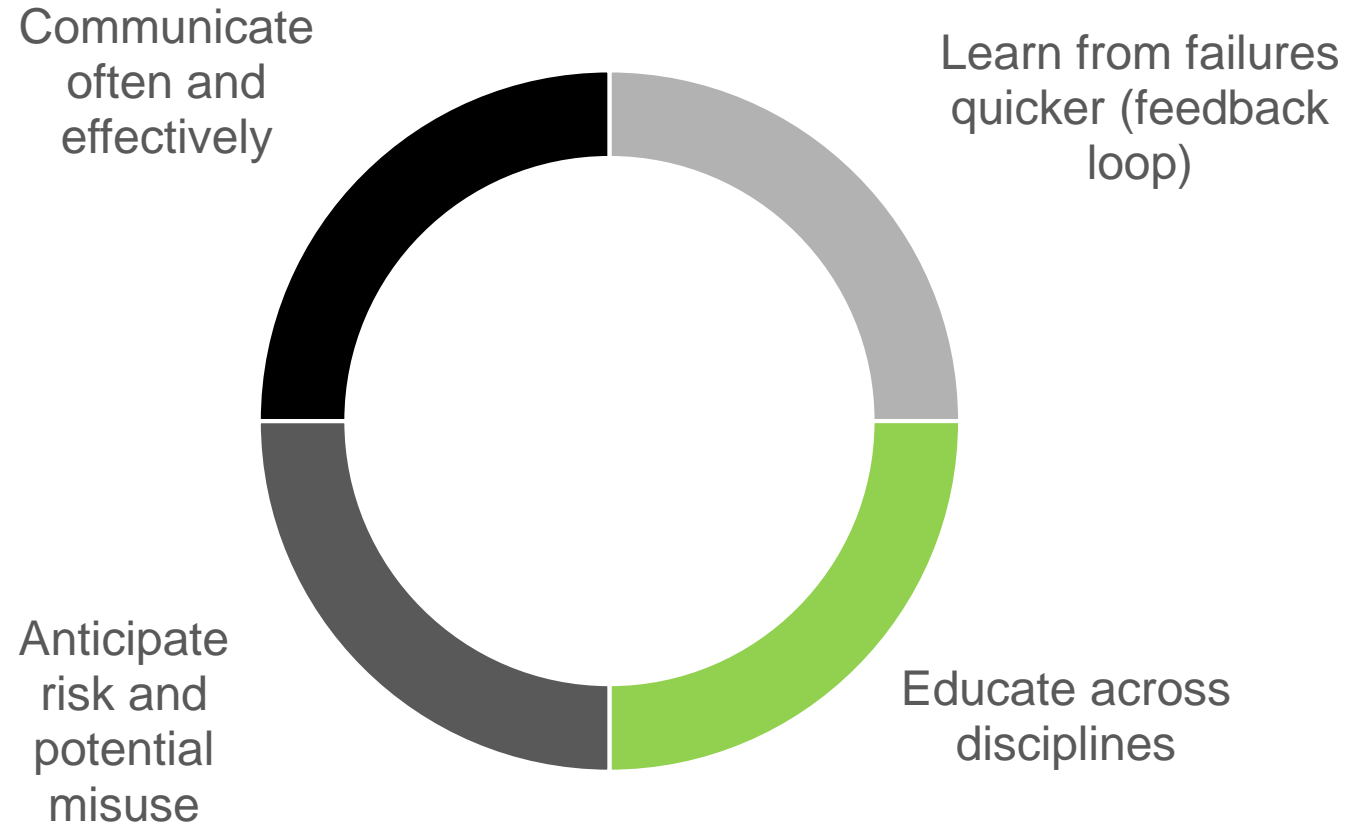
Increase QA/QC

For Designers, Contractors, Owners, Code officials
& Material Suppliers



Decrease building enclosure failures

WHAT CAN WE DO BETTER?



Let's continue the conversation...

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With the support of OAC's
Forensic Architecture & Engineering
Building Enclosure Team

