Risk Management for the Building Enclosure

Bill Nash P.E. and Ben Townsend, P.E.

WDP & Associates, Inc.

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Good Day to You

Welcome to the Preliminary Presentation on Risks to the Enclosure

But Firstly

Thank You!


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SEALTIGHT®
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FOR THE BUILT ENVIRONMENT


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ARCHITECT'S
NEWSPAPER

What was the population of the planet when you were born?

What is the population of the planet now?

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POPULATION OF THE ENTIRE WORLD

1950	2,525,778,669
1960	3,026,002,942
1970	3,691,172,616
1980	4,449,048,798
1990	5,320,816,667
2000	6,127,700,428
2010	6,916,183,933
2015	7,324,782,225
2020	7,716,749,042
2030	8,424,937,474
2040	9,038,687,151
2050	9,550,944,891

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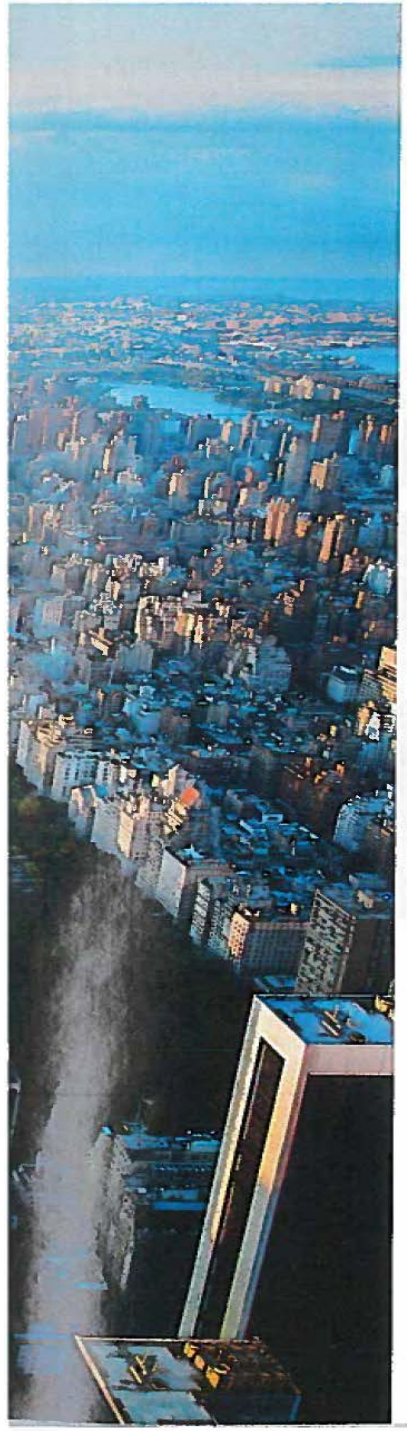

BUILDING SAFETY

DIFFERENT BY DESIGN

The look and function of modern buildings are being shaped by a host of influences, from emerging technologies to a push for environmental sustainability. But these bold new structures can also present designers, enforcers, and first responders with unique fire and life safety challenges. BY JESSE ROMAN

NFPA.ORG/OUTLIERS

Read "Fire Safety Challenges of Tall Wooden Buildings," a 2013 paper produced by the Fire Protection Research Foundation.

Read "Building Code Guidelines for Tiny Homes," a new white paper produced by NFPA's Building Code Development Committee.

JDS DEVELOPMENT GROUP

Tall & Skinny
Bold new building designs include pencil skyscrapers such as 111 West 57th Street in New York City, currently under construction. The residential tower will include 82 stories and rise to a height of more than 1,400 feet, with a footprint of just 60 feet by 60 feet.

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DIFFERENT BY DESIGN

Tall Wood Buildings

How big is the fire risk, and how should the structures be protected?

Since the dawn of humanity, we've used wood primarily for two things: to build structures and start fires. Separately, these attributes are invaluable; together, they have resulted in some of humanity's deadliest fires. For that reason, model building codes in most countries have traditionally limited the height of wood buildings to fewer than six stories.

Over the last decade, though, attitudes toward taller wood buildings have begun to shift. Recent advancements in engineered wood products, coupled with environmental pressure to build more sustainably, have resulted in the construction of large wood-timber buildings at heights once unimaginable.

The latest example is Brock Commons, an 18-story, 174-foot-tall dormitory tower, currently the world's tallest wooden-frame building, slated to open in May at the University of British Columbia. A 12-story timber-framed building in Portland, Oregon, isn't far behind, and neither is a 10-story wooden building in Manhattan. A seven-story wood office building in Minneapolis opened in November.

In Europe and Australia the trend is further along, with numerous tall wooden buildings being built since the early 2000s and many more underway. Projects and designs are getting bolder all the time. An architectural firm has unveiled plans for a 34-story "woodscraper" in Stockholm, while architects in Vancouver have discussed a similar-sized building there. Some architects have even called this moment the beginning of the Timber Age.

TINDER BOXES?

While most architects and builders excitedly tout wood's strength and versatility, as well as its ease of assembly and reduced construction times, critics are concerned that we are just building bigger and bigger tinder boxes.

"I'm in front of building approval committees every month and I'm constantly hearing, 'this can't be done,'" said David Barber, a fire protection engineer with Arup who has worked on a number of tall wooden building projects and co-authored the 2013 paper "Fire Safety Challenges of Tall Wooden Buildings" for the Fire Protection Research Foundation (FPRF).

Barber said that a number of proposed tall wooden building projects he's worked on have been scuttled over fire safety concerns. He contends that, while wooden buildings do behave differently than traditional steel and

Tall Timber
Brock Commons (facing page), a new dormitory at the University of British Columbia, is currently the tallest wooden building in the world at 174 feet. It was constructed in just 70 days once the prefabricated components arrived on site. Above, the interior of the T3 office building in Minneapolis (right), which opened in November. The largest mass timber building in the U.S., it was built using more than 1,100 nail-laminated timber panels, which were assembled in Winnipeg, Manitoba, and shipped to the site.

concrete buildings in a fire, adequate fire safety can be easily achieved.

Several recent high-profile fires in apartment complexes under construction—built using lightweight engineered wood components—have added to concerns among building officials and the fire service about tall wooden buildings (see "Burned Again," page 18). Barber is quick to point out, however, that taller wooden buildings do not use lightweight engineered wood components, but rather heavier elements such as cross-laminated timber, or CLT, which tests have shown possess greater fire resistance than lightweight materials.

Even so, for some officials tasked with keeping people safe, huge wooden structures are reason for caution regardless of what type of wood is used. "I'm sorry, but I'm very reluctant to endorse anything made out of sawdust and glue," said former New Jersey fire marshal and firefighter Jack J. Murphy, who is also chairman of the Fire Safety Directors Association of Greater New York and a member of NFPA's High-Rise Building Safety Advisory Committee. "My mentality is, if we are having a hard time tackling some of these low-rise wood-building fires, how are we going to deal with something taller? They have a lot of selling to do to make us feel comfortable."

There are several types of heavy timber products on the market now, but CLT is arguably the most popular. A CLT panel consists of three to seven layers of timber boards crisscrossed and bonded together for maximum strength. A typical panel can run 10 feet wide, 60 feet long, and almost two feet thick. The size and thickness of the panels, Barber argues, gives engineered heavy-timber products a natural fire resistance. When the wood burns, it naturally builds up a layer of char on its outer surface, forming an insulated barrier from the heat and fire. By designing the wooden timbers thick enough, "we can engineer the building to naturally resist fire and carry the loads," Barber said.

In many cases, the wood building's interior is finished and encapsulated with fire-rated gypsum board, which adds an extra layer of protection. However, it has become an increasingly popular design trend to leave the timbers partially exposed, which makes fire officials like Murphy nervous. "It's all wood and I think there is a lot of reluctance with that, especially in Manhattan where some of these building footprints are four feet away from neighboring buildings," he said. "In some of these cases, the outside of the building is wood, and the inside is wood, and so outside-in burns are a concern, especially in a densely populated area."

Barber admits that the interior wood exposure in tall wooden buildings can increase the fire duration because the wood is adding fuel to itself. "But most buildings of any height are protected with sprinklers, so something would have to go very wrong for the fire risk to increase in any significant way," he said.

Finding out how much the exposed heavy timber in a residential dwelling impacts fire growth is a key objective of an FPRF project currently underway. "Fire Safety Challenges of Tall Wooden Buildings Phase 2" involves full-scale tests of timber rooms with exposed surfaces with the goal of quantifying how fires in rooms with exposed timber differ in temperature, fire spread, toxicity, and other factors, compared to rooms with timber fully covered in gypsum board. The testing is being conducted this spring and the results should be released this summer.

Barber believes that heavy timber wooden buildings will continue to grow in popularity as officials become more comfortable and familiar with their fire safety and as the public continues to value wood's advantages as a sustainable resource. It's not a trend that will subside anytime soon. "As more of these buildings are constructed and people see that this is not as scary as they think, there will be many others," Barber said. "It's just a matter of time."

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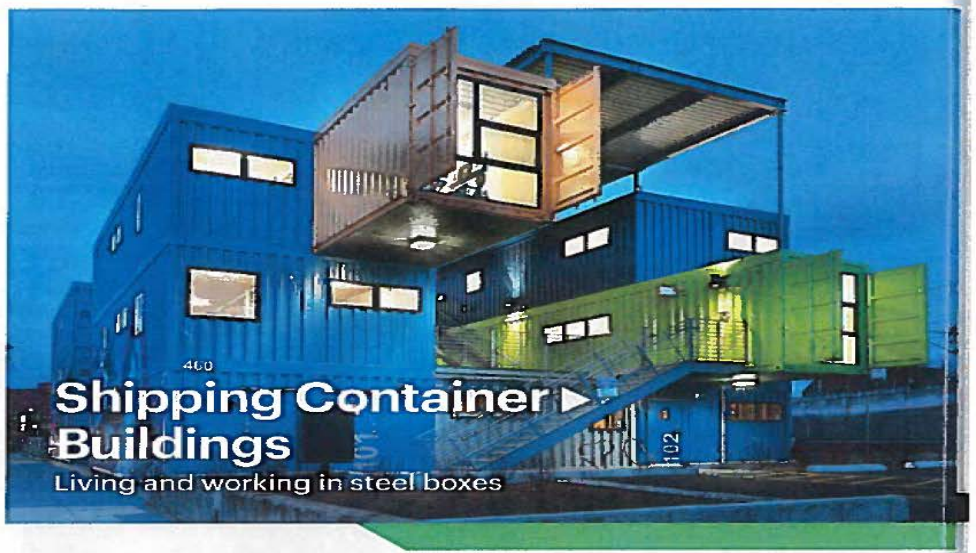
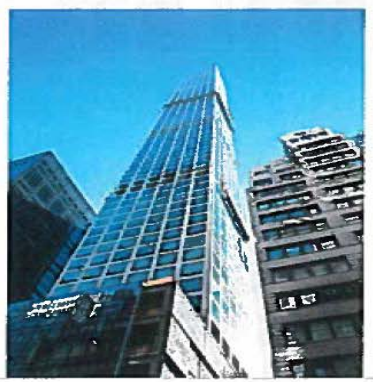


Shipping Container Buildings

Living and working in steel boxes



ONE WORLD TRADE CENTER
200 ft x 200 ft
Height: 1,776 ft

432 PARK AVE.
94 ft x 94 ft
Height: 1,396 ft

111 W. 57th ST.
80 ft x 60 ft
Height: 1,438 ft

Pencil Skyscrapers

First responder concerns over tall and skinny buildings

Short on space but brimming with demand, real estate developers in recent years have transformed the neighborhood near the southern end of Manhattan's Central Park into a steel garden of impossibly skinny, soaring towers. At 1,396 feet and 85 stories, 432 Park, which opened in December 2015, is the tallest residential building in the Western hemisphere, with a footprint of just 94 feet by 94 feet; the total area of about 8,800 square feet is roughly a tenth of that occupied by the shorter Empire State building. Even skinnier, the nearby 82-story tower under construction at 111 West 57th Street will be just 60 feet by 80 feet and more than 1,400 feet tall, with a width-to-height-ratio, also known as an aspect ratio, of 1:23— making it the skinniest building in the world. It will, however, lose its title if a proposed 60-story building, with a footprint of just 50 feet by 54 feet, is built on 37th Street.

Jack J. Murphy, a former firefighter, fire marshal, and current chairman of the New York City High-Rise Fire Safety Directors Association, has inspected some of these buildings and says they present unique challenges for firefighters. For one, the buildings' small footprints mean very narrow scissor stairwells that can have five or more turns between floors. "What would that do to my hose stretch?" Murphy said. The compact size also means tight quarters for operation and medical staging in an emergency.

Meanwhile, in some pencil buildings—a term used for buildings with aspect ratios greater than 1:10—floors housing the buildings' mechanicals are left entirely open to the exterior to allow the wind to pass through, increasing stability. If a door was left open on these floors during a fire, "the wind could cause the fire to come shooting up there like a blowtorch," Murphy said. In addition, at least one building he's inspected had louvers in each apartment to admit air from the outside, which could also affect fire conditions. "This is why it's critical for fire departments to get out into the field and do recon and intelligence ahead of an event so they know what they're dealing with," he said.

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Are We Ready for Another Big One?

Preparing for Community Resilience

In This Issue

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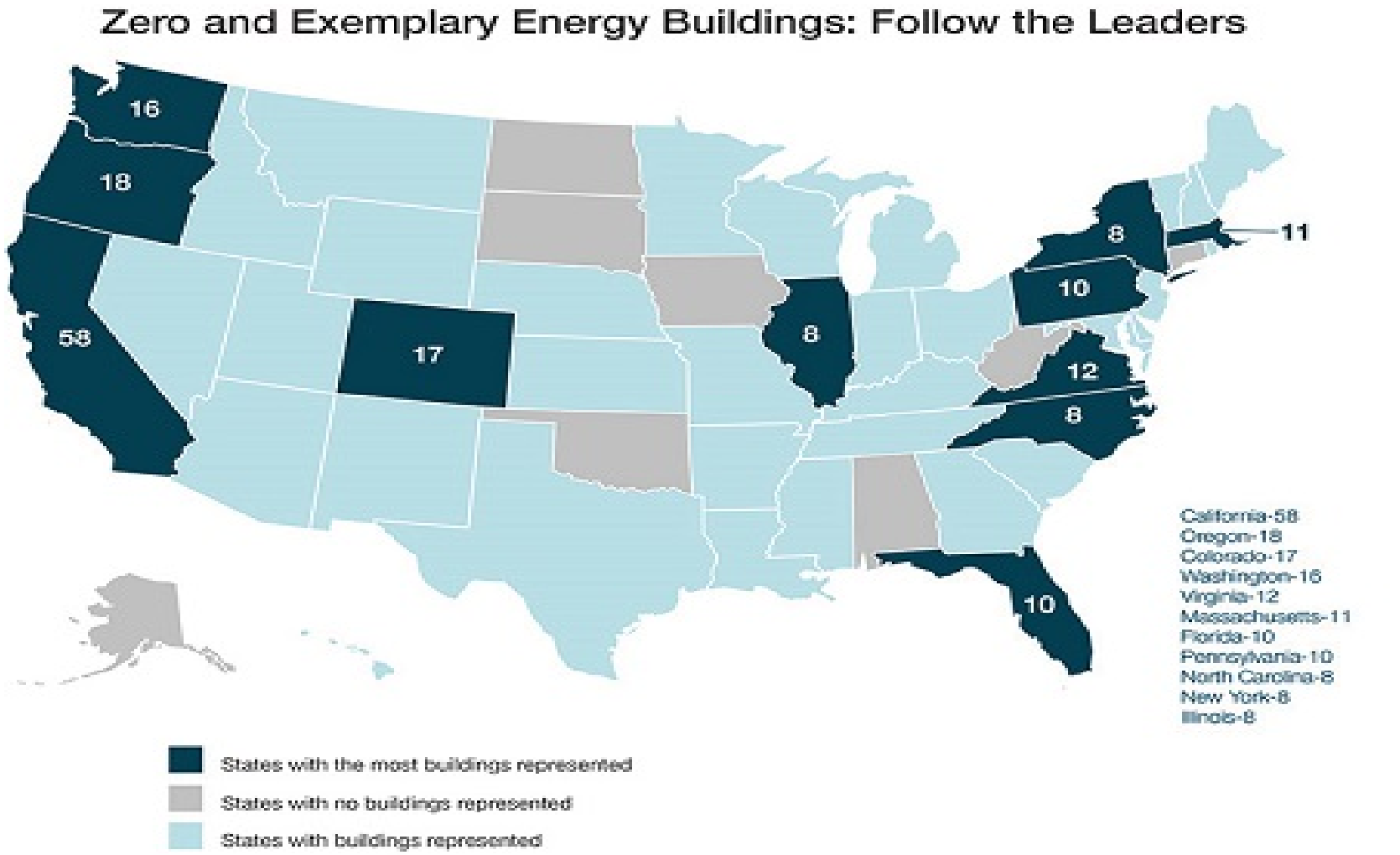
Zero Net Energy Buildings



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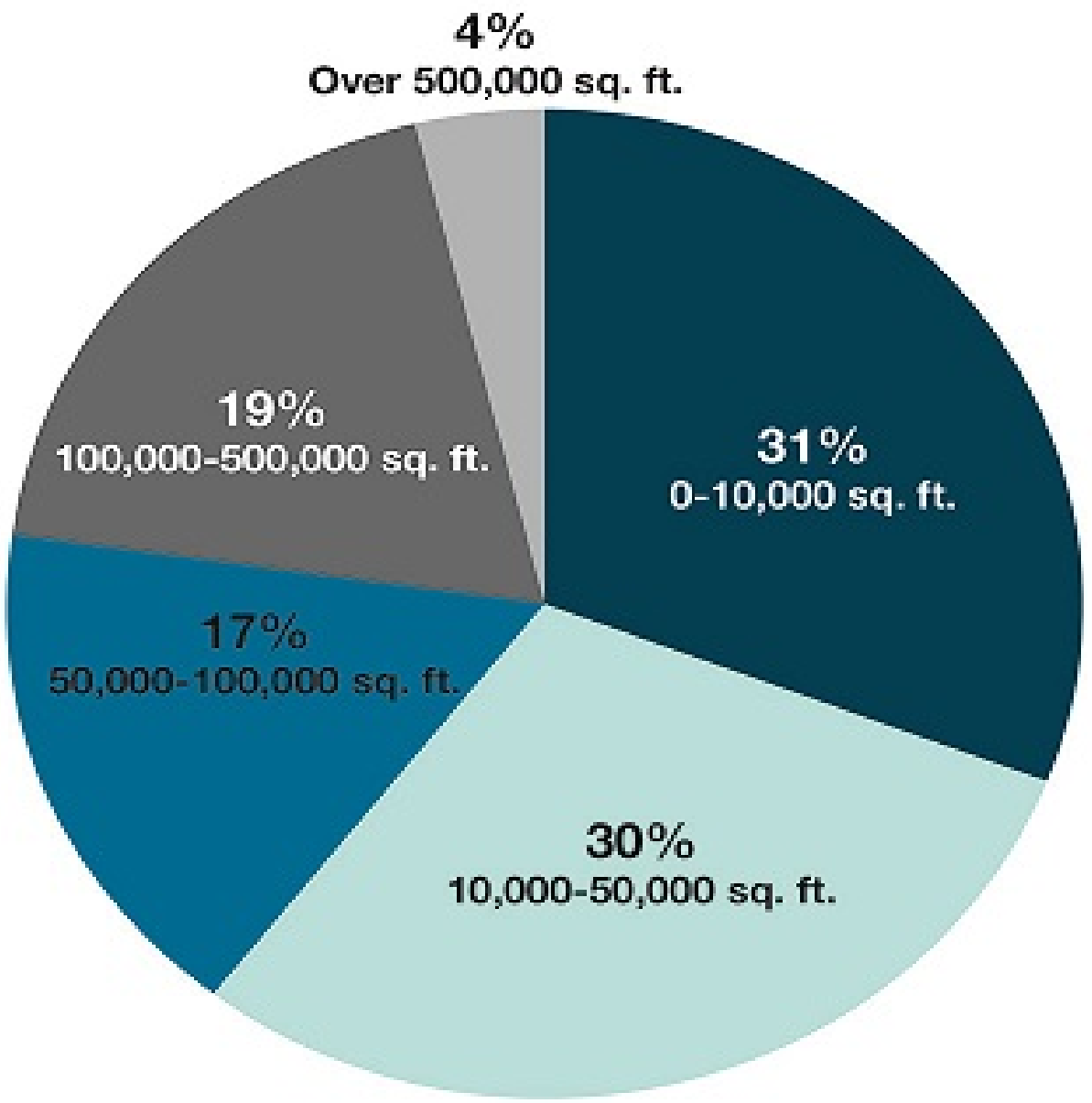
Square footage of buildings currently in the Getting to Zero Database



Courtesy of New Buildings Institute | newbuildings.org/getting-to-zero-buildings-database

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MOSAIC CENTRE ACHIEVES NET ZERO IN EDMONTON'S SEVERE CLIMATE

THE MOSAIC CENTRE WITH CURTAIN WALL VENT ADAPTORS BY CASCADIA WINDOWS & DOORS LTD. VISIBLE ON THE SOUTH AND EAST ELEVATION. [PHOTO: COOPER + O'HARA].

Cascadia's fibreglass curtainwall Vent Adapter improves envelope performance

CASCADIA
WINDOWS & DOORS

DETAIL OF THE CURTAIN WALL VENT ADAPTOR.

Located at the edge of a commercial strip of a rapidly urbanizing area on the outskirts of Edmonton, the Mosaic Centre office building is pursuing both LEED Platinum and Living Building Challenge certification. The net zero energy requirement of the Living Building Challenge is a particularly ambitious target given Edmonton's severe climate.

To maximize passive solar for net zero energy design, the location of the building on its site was determined by considering the overshadowing potential of different development scenarios on adjacent sites. In addition, the building is oriented on an east-west axis for best solar exposure.

This orientation, and the access to daylight it affords to south-facing spaces guided the interior organization of the building. Accordingly, the most densely occupied spaces are located on the south side where they receive the most light.

The curtain wall system is fibreglass-based with triple glazing and three low-e coatings. For natural ventilation, the system makers use of the Curtain Wall Vent Adaptor by Cascadia Windows & Doors Ltd. In Langley, BC.

The Fibreglass Curtain Wall Vent Adaptor

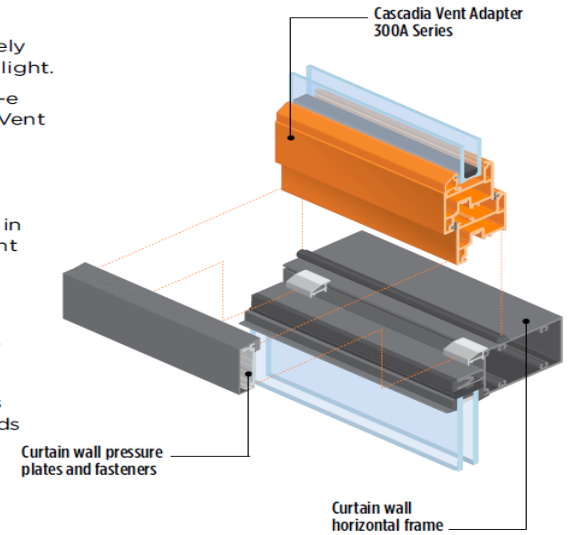
A fibreglass vent adaptor solves a compromise that has been traditionally present in aluminum curtainwall glazing systems at operable vents - a drop in the thermal thermal performance of the curtainwall due to the added amount of aluminum at the vent's sash and frame.

Insulated fibreglass frames have similar thermal performance as the best double-glazed IG units [centre of glass] available today, so when coupled with double glazing, the frame doesn't drag down the thermal performance. Triple glazing increases the performance even further.

Energy efficient, commercial-grade fibreglass vent adaptors allow designers and glaziers to meet the toughest new energy efficiency codes and standards that would otherwise severely limit the number and size of aluminum operable vents adaptors.

Cascadia's fibreglass vent adaptors permit as much venting as desired without lowering thermal performance.

Further details at: http://www.cascadiawindows.com/products/series/85.php



Exploded view of Cascadia Fibreglass Vent Adaptor

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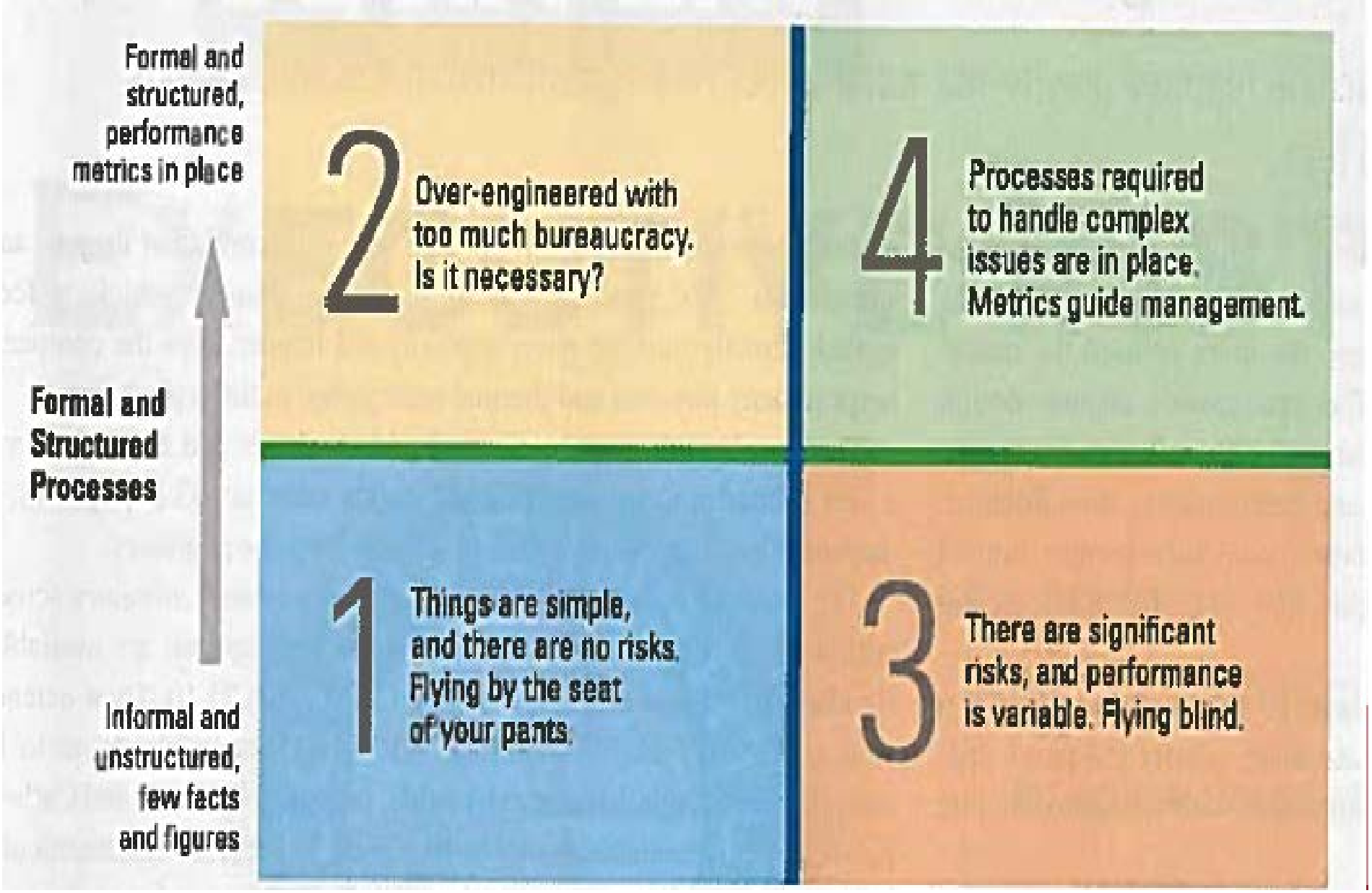

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**“Some people drink from the fountain of knowledge.
Others just gargle.“**

-- Robert Anthony,
American business professor

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The building enclosure poses multiple risks to the management of a construction project.
While there are proactive architectural, construction management, or construction firms that have implemented internal programs and processes to co-ordinate the air barrier / building enclosure, inclusive of construction document review, mock ups, and field performance testing, there remain those projects that construct ‘buildings with issues.’ These projects provide headline news of non-performance and litigation.

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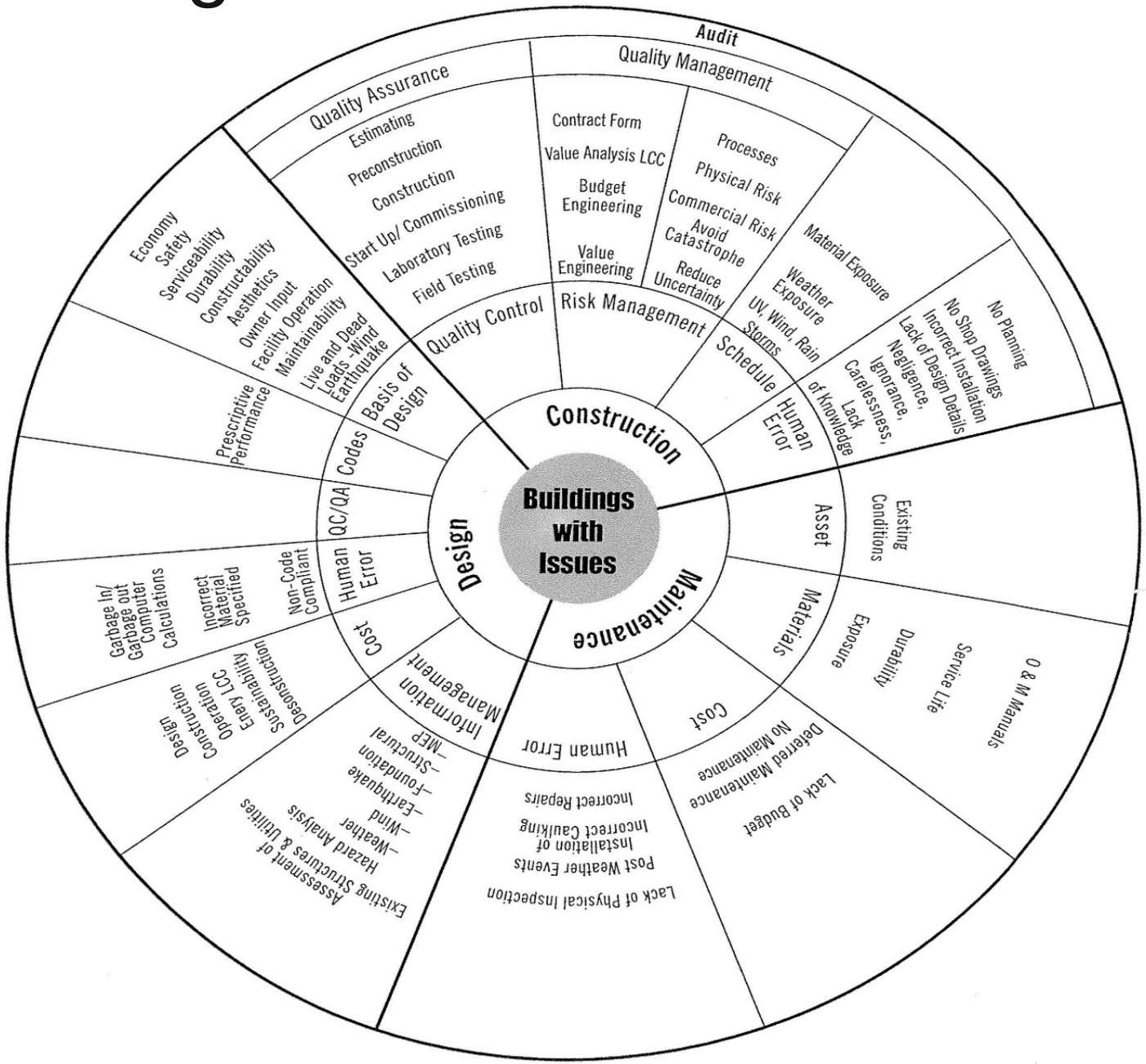
What might be the root causes of buildings with issues?

Buildings with Issues – Root Causes



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102 Story

2,248,355 SF

Design
2 weeks
Using previous design for the Reynolds Building in Winston Salem, NC

Construction
15 months to
Ribbon cutting
January 1930 to
May 1, 1931

5 Fatalities

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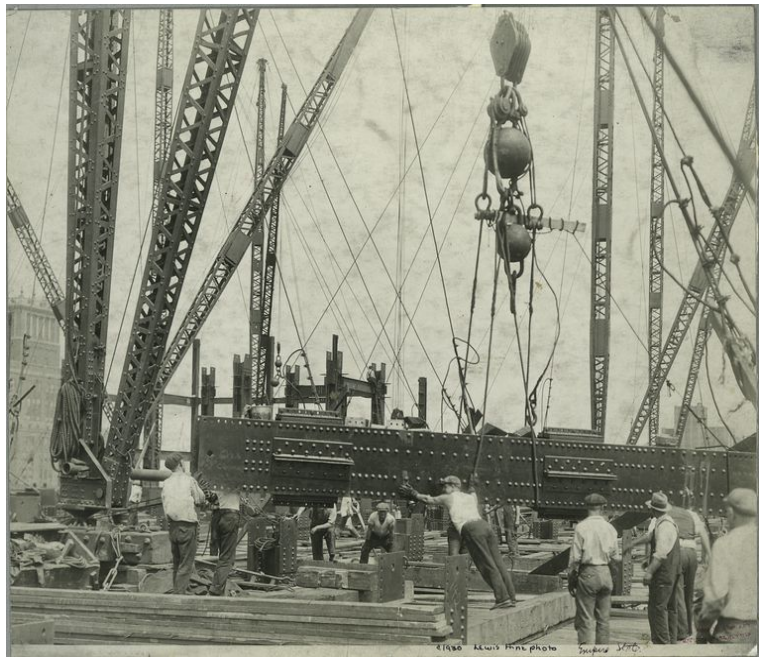

What is the most misused word in construction ?

QUALITY

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- Suggest to replace the use of the word Quality in construction
- Suggest to replace with the word – **PERFORMANCE**

PERFORMANCE

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You can not improve the enclosure unless you measure it's field performance

~~QUALITY~~

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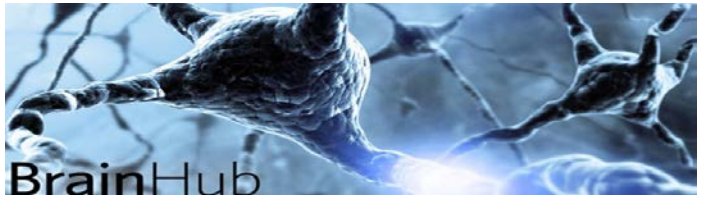
How is your brain on risk management?

Are you ‘cornfused’ by the alphabet soup of acronyms for the increasing glossary of terms, catchall phrases, methods and processes proposed by multiple presentations when it comes to choosing the most effective way to manage and delegate responsibility for project risks?

This presentation will provide discussion of one method to provide an integrated approach to ‘what works’.



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What type of alphabet soup will you integrate into your design and into your construction for a building ??

ACI	ACIH	ASCC	NEBB	WBDG
AISC	NFPA	ANSI	CHMC	ZNE
AAMA	EIMA	USGBC	SWRI	SPFA
ABAA	ASME	USDOE	AISI	IPD
AWS	AITC	NBI	SDI	BCA
ABC	ICRI	NIBS	SJI	AIA
ASHRAE	SWRI	NCRA	CRSI	ASCE
ASCE	NCMA	GA	UL	ANSI
ASTM	PCA	PTI	NECA	TMS
AGC	SMACNA	EDI	MBMA	CRSI
BIA	AWCI	WWPA	SSPC	PtD
AFPA	ICC	IBC	CAN/ULC	

Please call out the names of the Acronyms that you recognize

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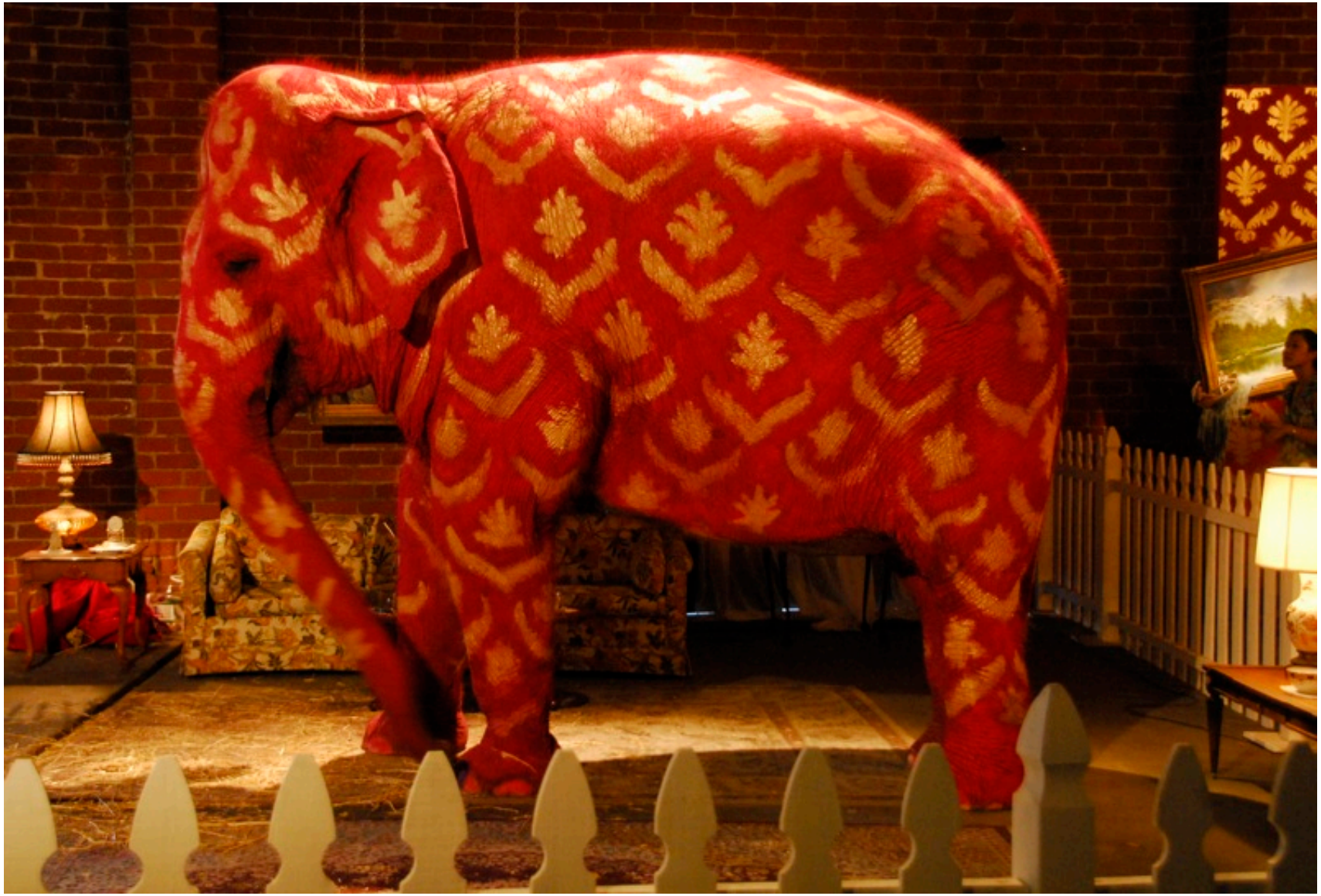
What is the most important issue in construction?



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Before OSHA was created 43 years ago, an estimated 14,000 workers were killed on the job every year. Today, workplaces are much safer and healthier, going from 38 fatal injuries a day to 12. But there is still much work to be done.

Construction Fatalities

Data series	2011	2012	2013	2014
Fatalities				
Number of fatalities	781	849	856	(P) 908

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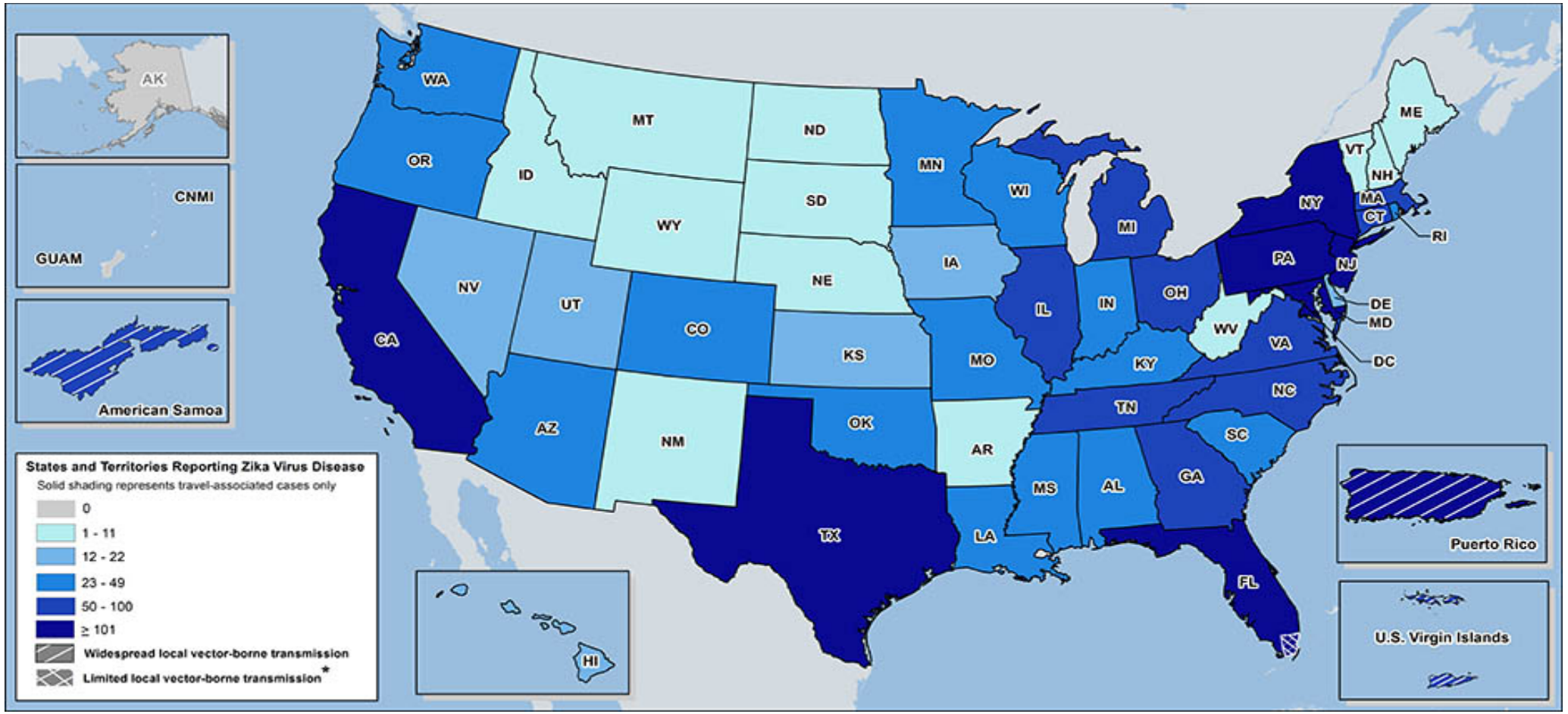
Travel-associated cases* No. (% of cases in states) (N=3,713)	Locally acquired cases† No. (% of cases in states) (N=105



Zika Cases Reported in the United State as of October 5, 2016
CDC newsletter

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THE CONSTRUCTION WEEKLY

ENR
Engineering News-Record

enr.com

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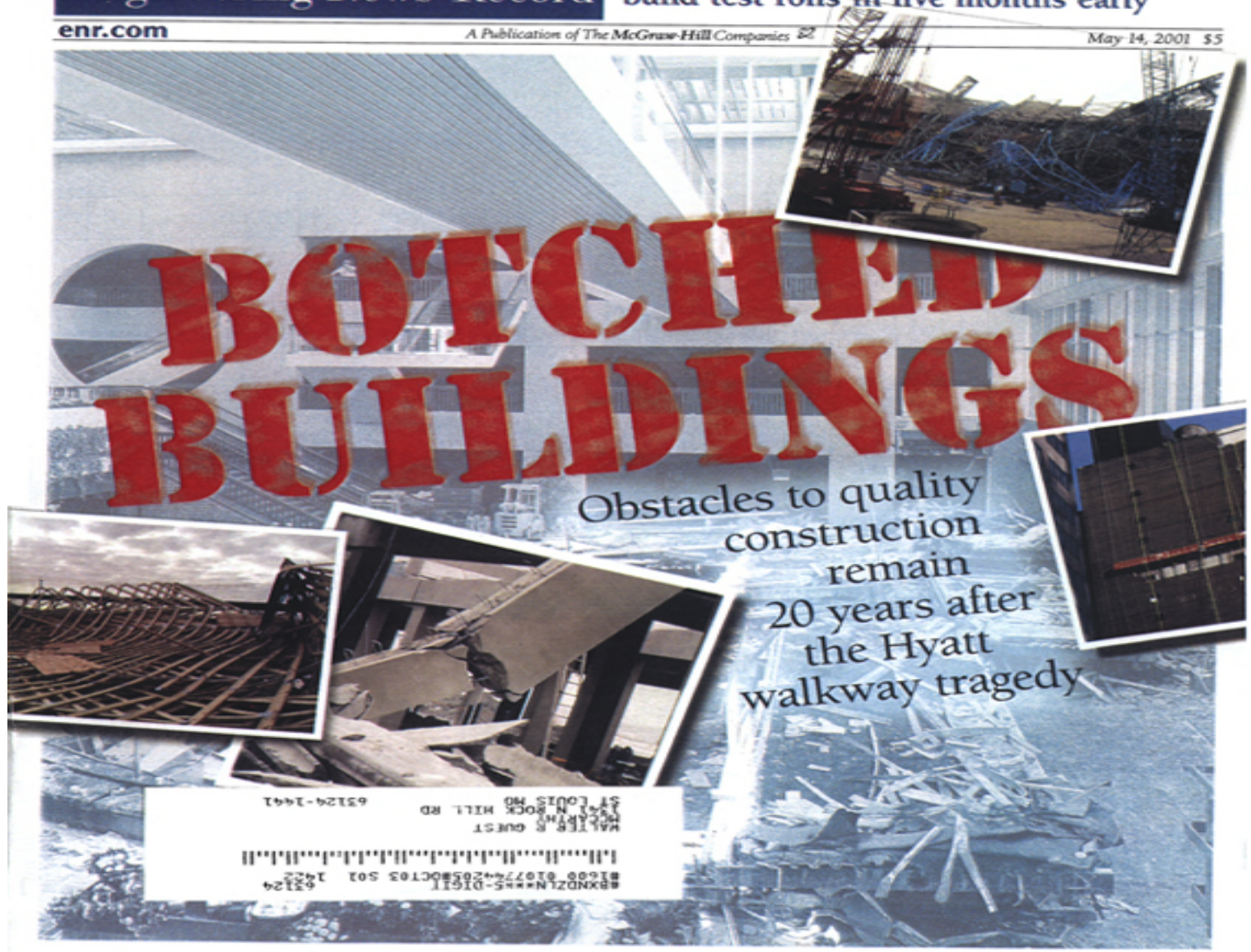
May 14, 2001 $5

► **UNIONS:** Building trades president wants to mend fences and bring the carpenters union back into AFL-CIO

► **HIGHWAYS:** Utah's $1.6-billion design-build test rolls in five months early

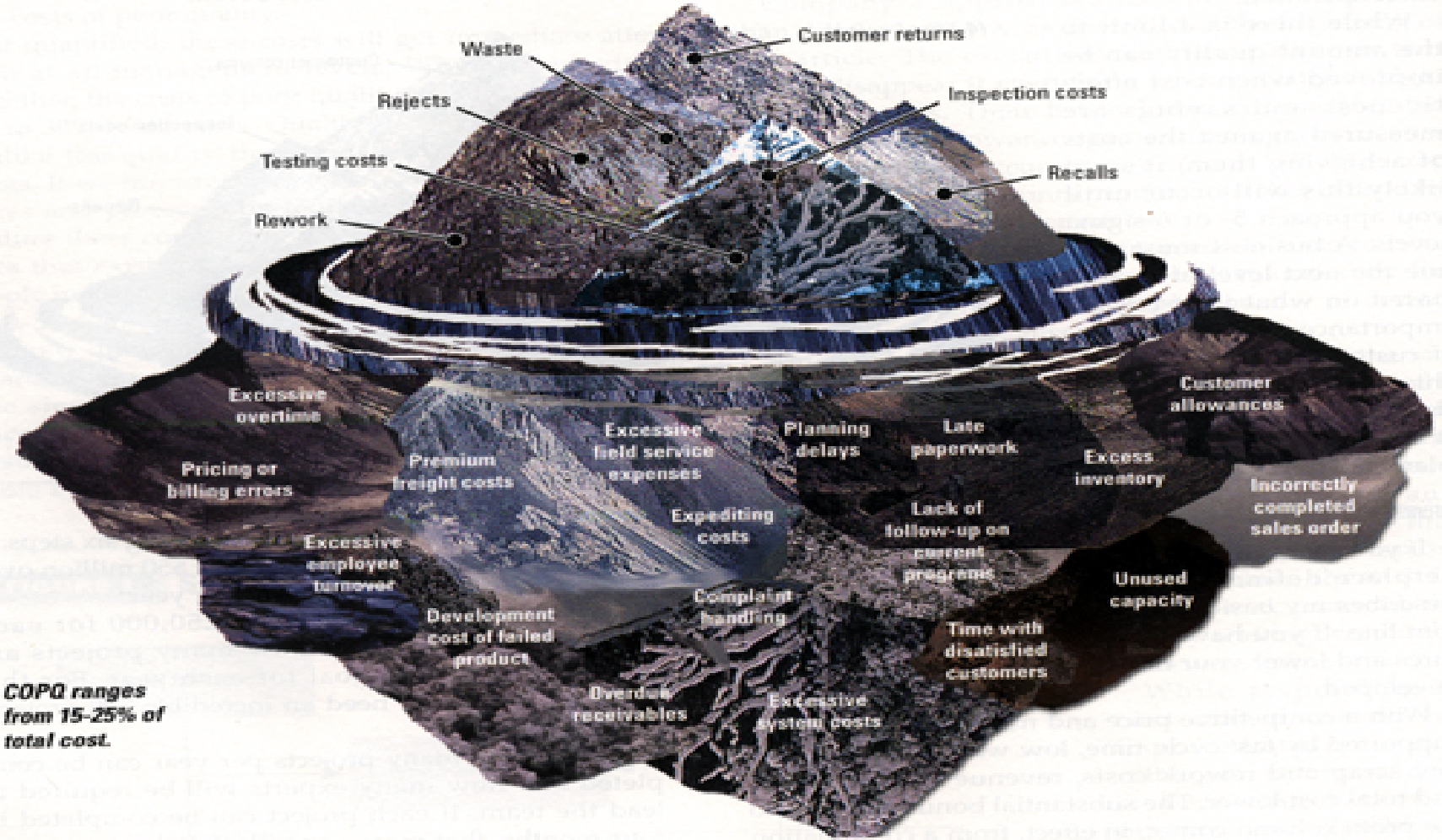


BOTCHED BUILDINGS

Obstacles to quality construction remain 20 years after the Hyatt walkway tragedy

FIGURE 3 Cost of Poor Quality (COPQ)

As a company gains a broader definition of poor quality, the hidden portion of the iceberg becomes apparent:



COPQ ranges from 15-25% of total cost.

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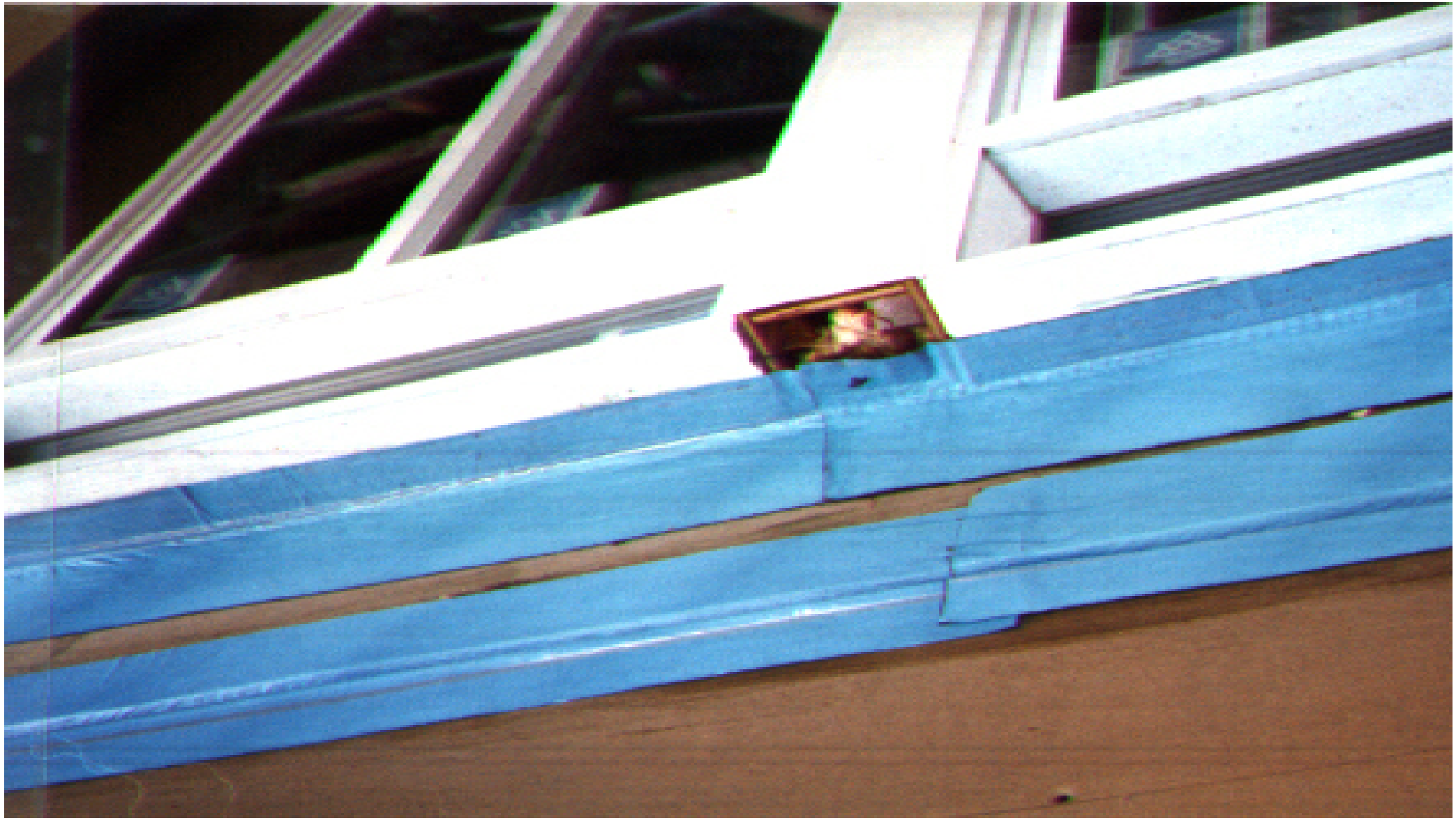

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WDP & Associates, Inc.

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CONTINUING EDUCATION
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DILBERT / By Scott Adams

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What is a Building Enclosure Coordination Program?

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Building Enclosure Coordination Program

- Used to reduce risk when constructing the air barrier and building enclosure
- Catch-all term

- Primarily implemented by the contractor
- the A/E and owner provide support

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BECP and Enclosure Commissioning (BECx)

- BECP & BECx : Same goal, approached from different direction
- BECx is 100% reliant on the buy-in from the Contractor – a BECP represents the contractor's engagement with BECx
- In the absence of BECx, the Contractor's BECP reduces enclosure risk for everyone
- ABAA QA program is complementary to both

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Building Enclosure Coordination Process

Construction Document Review

Clarify Roles and Responsibilities

Scheduling / Sequencing / Planning

Shop Drawing Review

Laboratory and Field Mock - Ups

Field Performance Testing

Non Compliance Process

10 Month Warranty Walk Through of the Enclosure)

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Cost and Benefit of a BECP

- Cost in time and effort for planning, coordinating, preparing
- Reward later in project through reduction in unexpected problems with the air barrier and enclosure – RISK minimized

- In the same way that ABAA QA and BECx are implemented by independent 3rd parties to reduce risk for everyone, a contractor's BECP also reduces risk for everyone
- But the contractor is in control of the process

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Ten Elements of a BECP

What steps a contractor should take, and how a designer can assist

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1: Specifications Define BECP

Common preexisting example:

Mechanical / electrical / plumbing coordination plan

The designer initiates and clarifies the BECP in specifications

Define:

- BECP
- The specific individual responsible for the coordination of the building enclosure interfaces with subcontractors and manufacturers

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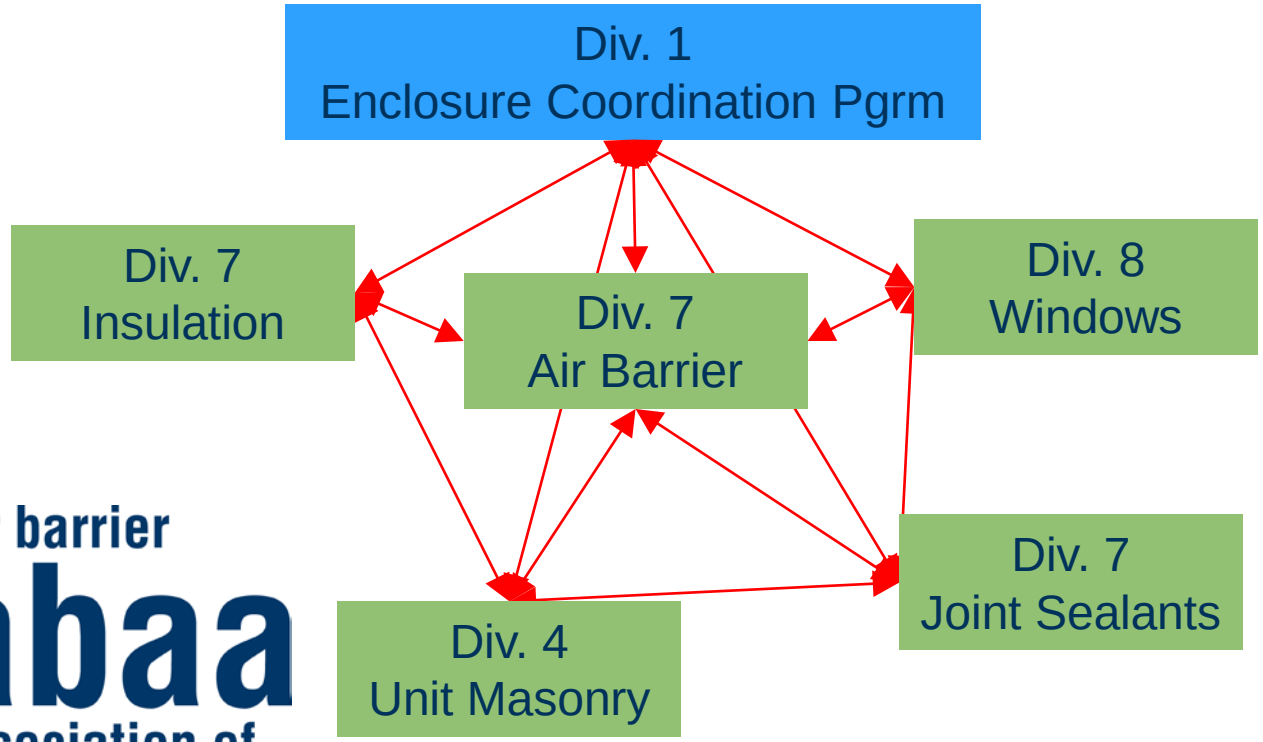
2: A/E Provides Integrated Specifications

The A/E assists by cross linking specifications



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Division 1 – provide sections for mockup, performance testing, site specific performance plan, construction & temporary protection, scheduling with tasks included for the building enclosure:

- Submittals, shop drawings, building enclosure trade installation activities, mock ups, lab testing, field performance testing
- Temporary protection of the installed enclosure materials
- Shop Drawings integrated to demonstrate the continuity of the air, water and thermal barriers
- Compatibility of materials regarding waterproofing, air barrier, roofing sealants, and fenestration

3: Responsibility Matrix

Utilize to perform a ‘Gap Analysis” of the specifications and provide a roadmap for the building enclosure first level QC, performance testing, documentation

The contractor is most aware of which trades should be responsible for which work items, so should prepare the responsibility matrix with A/E review

RESPONSIBILITIES PER SPECIFICATIONS				
Construction Manager	Owner	A/EoR	BECxA	Product Manufacturer
Air Barrier Subcontractor	Window Subcontractor	Unit Masonry Subcontractor	Metal Panel Subcontractor	Joint Sealant Subcontractor

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4: Performance Specifications

If performance specifications are used, the contractor needs to develop their own QC processes to meet those requirements

Example: if a whole building air tightness test is specified, the contractor should implement their own QC processes to make sure the building will pass, whether or not QC is specified

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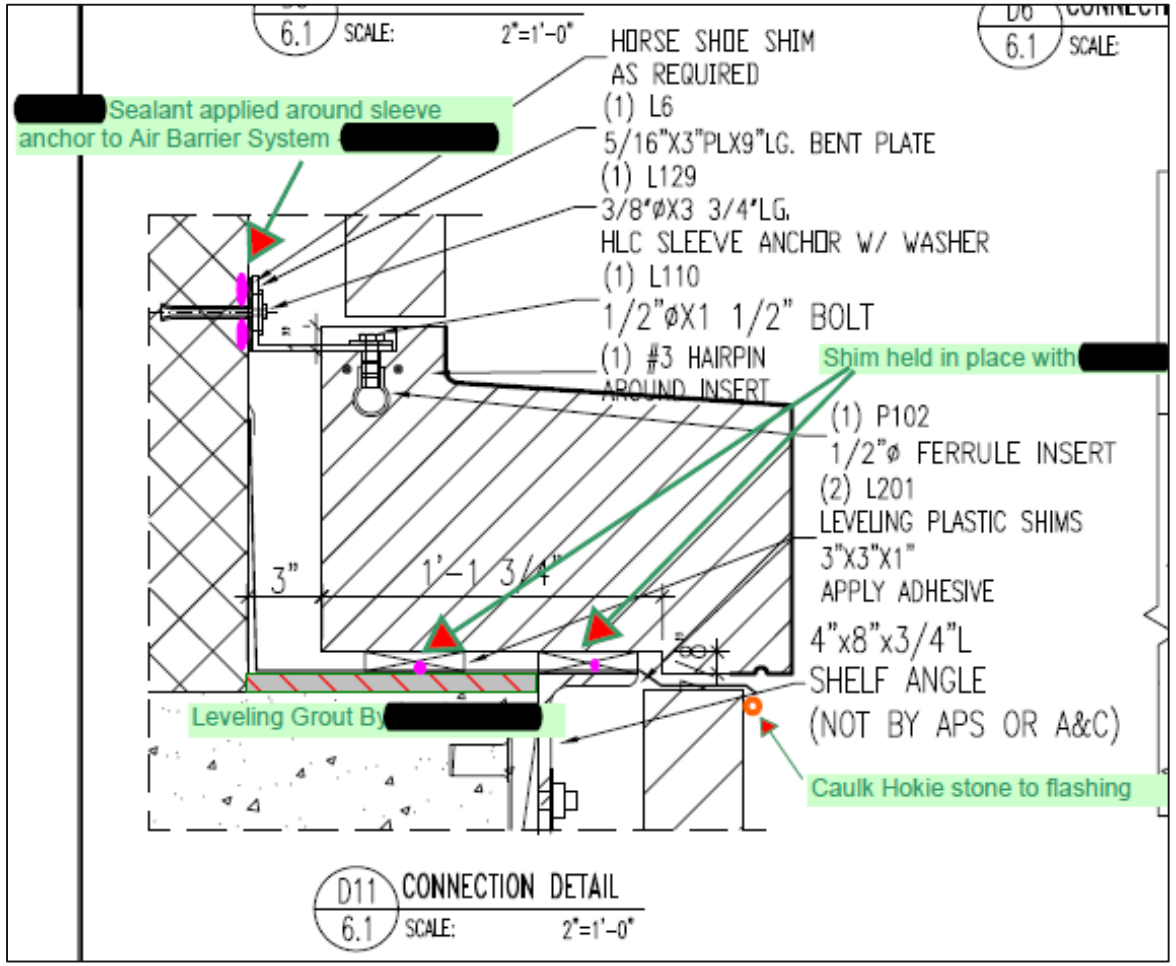
5: Coordinated Shop Drawings

The A/E should specify coordinated shop drawings

The contractor needs to carry through and review the submissions of all trades to check that they are truly coordinated, prior to submission of coordinated drawings to the A/E



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6: CM/GC Responsible for 1st level Performance Control Verification

The CM/GC should create and implement a non-conformance process to inspect, document, track and require formal submittals for approval prior to field repairs and requiring mock ups of field repair work

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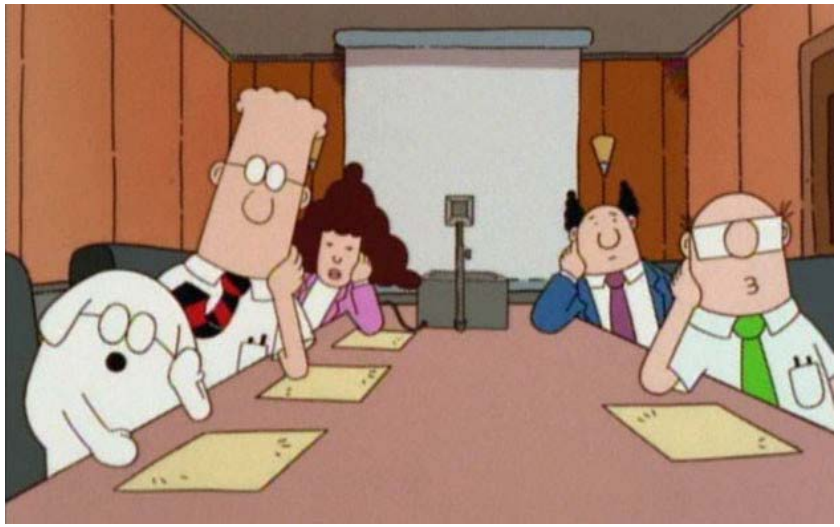
7: Pre-Construction Meetings

Schedule pre-construction meetings after the shop drawings are approved and a minimum of 4 weeks prior to the start of construction activity



Invite all parties who may come into contact with the air barrier or building enclosure:

- Joint sealant, window, unit masonry, roofing, cast stone, flashing, etc.
- Manufacturer’s reps
- Owner’s rep
- A/E
- Testing Agency
- Enclosure consultant or BECxA

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8: Site Constructed Mockups That Are Field Performance Tested

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8: Site Constructed Mock Ups That Are Field Performance Tested

If mockups are implemented on a project, follow through to gain as much use out of them as possible

Construct early to allow time to make changes

Use to:

- Coordinate trades
- Evaluate constructability of details
- Early performance verification
- Identify conflicts
- Provide a visual guide for training
- Confirm maintenance is possible

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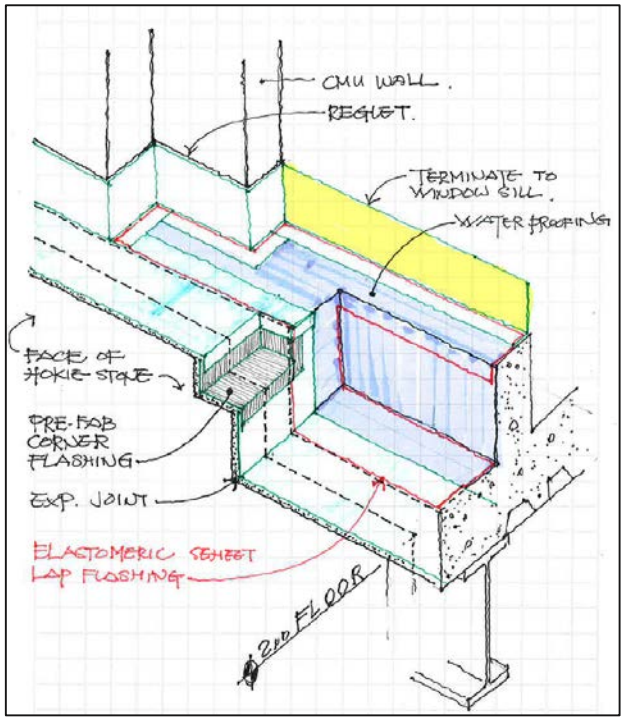
9: Documentation by the Contractor

Document the performance verification testing done and the results carefully



When changes are made, make sure the changes and repair procedures are documented

This is important not just for meeting the performance verification requirements of the specifications, but to limit the contractor's own liability in the future

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10: A 10 Month Warranty Walk Through for the Building Enclosure

The CM/GC should initiate warranty walkthrough inspections to make sure the individual trade warranty issues are addressed before warranties expire

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Specific Examples

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Checklists

Find the middle point between too complex and too simple

Be project specific – nobody wants to deal with a generic checklist where only half the items apply

Pros:

- Consolidate product and installation requirements in one place

Cons:

- Overreliance
- No checklist will be 100%

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Checklists – Example

SECTION 1 – PRE-CONSTRUCTION PROCEDURES:

Description	Complete	Initial
Submittals:		
[Product data]	Yes / NA	
[Samples]	Yes / NA	
[Compatibility Certificates]	Yes / NA	
[Installer Certifications]	Yes / NA	
…	Yes / NA	
[Other required submittals per specification]	Yes / NA	
	Yes / NA	
Shop Drawings:		
[Location and configuration of enclosure system]	Yes / NA	
[Details for areas of concern, i.e. transitions]	Yes / NA	
…	Yes / NA	
[Other relevant shop drawing requirements]	Yes / NA	
	Yes / NA	
Mockup Review Items:		
[Surface preparation]	Yes / NA	
[Protection]	Yes / NA	
…	Yes / NA	
[Other relevant mockup requirements]	Yes / NA	
	Yes / NA	
Preinstallation Conference	Yes / NA	
Calibration dates for field testing equipment checked	Yes / NA	

COMMENTS:

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Checklists – Example

SECTION 1 – PRE-CONSTRUCTION PROCEDURES:

Description	Complete	Initial
Submittals:		
Product data, storage, and installation instruction for liquid air barrier membrane, self-adhering flashing/transition membrane, termination sealant, primer, and any other accessories	Yes / NA	
Samples: 12x12 inch samples of liquid-applied air barrier and transition/flashing membrane	Yes / NA	
Product Certificates for compatibility between air barrier components and other materials, including but are not limited to: sheathing panels, below-grade waterproofing (including primers, flashing sheets, bonding adhesive, lap seal), silicone joint sealant	Yes / NA	
Installer Certifications – ABAA License documentation	Yes / NA	
Manufacturer's Qualifications	Yes / NA	
Product Test Reports – from qualified independent testing agency, for current formulation of air barrier materials	Yes / NA	
Manufacturer's acceptance criteria for adhesion values for each substrate	Yes / NA	
Shop Drawings:		
Location and extent of air barrier	Yes / NA	
Indicate the continuity of air barrier surface from roofing to below-grade waterproofing, including the anticipated configuration of work by other trades which the Contractor anticipates will be incorporated as a barrier to air infiltration (sheet metal, windows, roofing, etc)	Yes / NA	
Details for substrate joints and cracks	Yes / NA	
Details for transitions and tie-in to adjacent building construction, including but not limited to: structural steel at the loading bay canopy, below-grade waterproofing, vertical building expansion joint assemblies, flashing, windows	Yes / NA	
Details for sealing penetration in the air barrier from metal panel and coping supports and fasteners	Yes / NA	
The Air Barrier Subcontractor confirmed to have ABAA registration	Yes / NA	
Each installer is ABAA licensed	Yes / NA	
100 sq. ft. building mockup completed	Yes / NA	
Mockup Review Items:		
Surface preparation	Yes / NA	
Crack and joint treatment	Yes / NA	
Corner detailing	Yes / NA	
Thickness and texture of liquid-applied membrane	Yes / NA	
Tie-in with adjoining construction	Yes / NA	
Penetration details	Yes / NA	
Adhesion to other building materials if relevant (i.e. sheet metal flashing, below-grade waterproofing, and roofing materials)	Yes / NA	
Protection	Yes / NA	
Preinstallation Conference	Yes / NA	

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Checklists – Example

SECTION 2 – BUILDING ENCLOSURE INSTALLATION:

Description	Complete	Initial
[Installation instructions maintained on site]	Yes / NA	
[Daily field log by installer maintained on site]	Yes / NA	
[Daily field performance testing performed]	Yes / NA	
[Copy of daily field progress log distributed daily to Owner's representative]	Yes / NA	
[Manufacturer technical representative scheduled to perform site visits and reports]	Yes / NA	
…	Yes / NA	
[Other specific enclosure system installation requirements]	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	
	Yes / NA	

COMMENTS:

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Checklists – Example

SECTION 2 – BUILDING ENCLOSURE INSTALLATION:

Description	Complete	Initial
Installation instructions maintained on site	Yes / NA	
Daily field log by installer maintained on site	Yes / NA	
Daily field performance testing performed – adhesion is in accordance with manufacturer acceptance criteria	Yes / NA	
Copy of daily field progress log distributed daily to Owner's Representative	Yes / NA	
Material stored dry, out of sunlight, and per manufacturer's instructions	Yes / NA	
Air barrier equipment maintenance logs maintained by installer	Yes / NA	
Adjacent surfaces masked from overspray or spillage as needed	Yes / NA	
Substrate is dry	Yes / NA	
Substrate cleaned of grease, oil, bitumen, paints, dirt, excess mortar, or other coating contaminants	Yes / NA	
Provide a smooth transition from one substrate plane to another using stainless steel sheet metal to provide continuous support for the air barrier	Yes / NA	
Primed areas covered the same day	Yes / NA	
All edges and seams of the transition membrane sealed with sealant	Yes / NA	
Punctures and tears repaired	Yes / NA	
Transition membrane lapped min. 3 inch each substrate	Yes / NA	
Penetrations sealed per manufacturer's instructions	Yes / NA	
Air barrier applied only when relative humidity is less than 85 percent and air temperature is 5 deg F above dew point	Yes / NA	
Air barrier not applied in rain, fog, snow, or mist, or when these conditions are eminent	Yes / NA	
Manufacturer technical representative scheduled to perform site visits and reports, including the first application of the liquid-applied membrane	Yes / NA	
Thickness of liquid-applied membrane checked by installer during installation	Yes / NA	
Adhesion testing performed for detail and transition membranes, including transitions to flashing, waterproofing	Yes / NA	

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Responsibility Matrix and Gap Analysis

List all the tasks relating to performance verification and inspection in one place

Look for gaps between the scope

Develop as early as possible

Pre-bid: a gap analysis tool, so all testing work assigned to a specific party, without duplication

Post-bid: communication tool to focus attention

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Responsibility Matrix and Gap Analysis

Building Enclosure System	Mockup Required Per Specifications	Specification Sections	Test / Inspection Procedure Description	Mockup, Pre-Construction, or Post-Construction	Test / Inspection Standards	Test Criteria	Remarks

RESPONSIBILITIES PER SPECIFICATIONS				
CM/ Subcontractor	Owner	A/EoR	ITA/ITL	Product Manufacturer

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Responsibility Matrix and Gap Analysis

Building Enclosure System	Mockup Required Per Specificat	Specification Sections	Test / Inspection Procedure Description	Mockup, Pre-Construction, or Post-Construction	Test / Inspection Standards	Test Criteria	Remarks
Fluid Applied Air Barrier Membranes	Yes - 100 sq. ft., including tie-in with adjoining construction	072726 1.5 A. 1.	As part of the ABAA Quality Assurance Program, independent ABAA auditor provides one or more inspection and report	At ABAA-defined intervals during construction			**ABAA auditor required**
		019119 3.2	Field air leakage test for air barrier transitions to adjacent systems, field of AB, penetrations - **6 locations smoke test and 3 locations tested by bubble gun @ 20 tests each**	**During or after construction?**	ASTM E1186	No visible sign of air leakage	
		019119 3.2	Air barrier and transition membrane adhesion testing to substrate	6 locations throughout construction	ASTM C1521, Method A	Per manufacturer adhesion test data	**ASTM C 1521 is intended for testing sealant joints. ABAA guide specifications recommend testing fluid- and sheet-applied air barrier material adhesion by ASTM D 4541. As part of the ABAA certification program, subcontractor is also required to perform adhesion testing**
		019119 3.2	Whole building air barrier testing	@ 100% building enclosure completion	ASTM E1827 or ASTM E779	0.25 CFM @ 75 Pa	**Testing to be performed when building enclosure is complete, but before interior finishes are installed on exterior walls**

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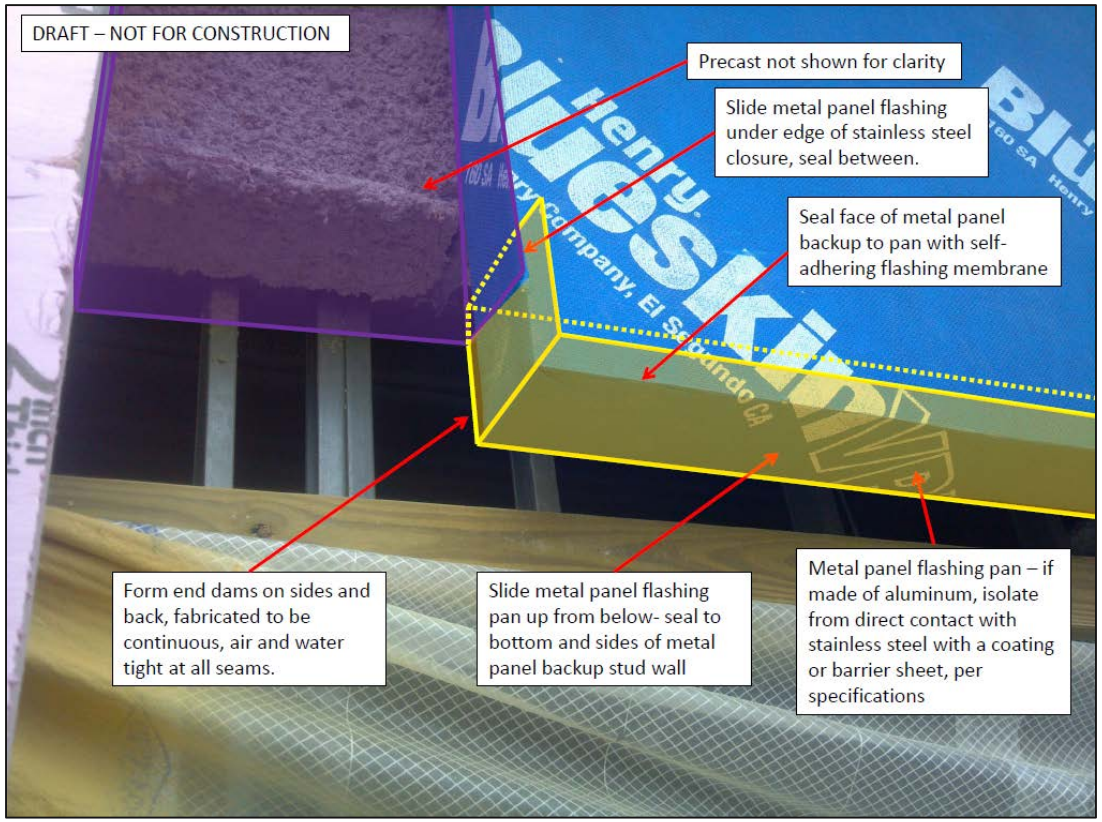
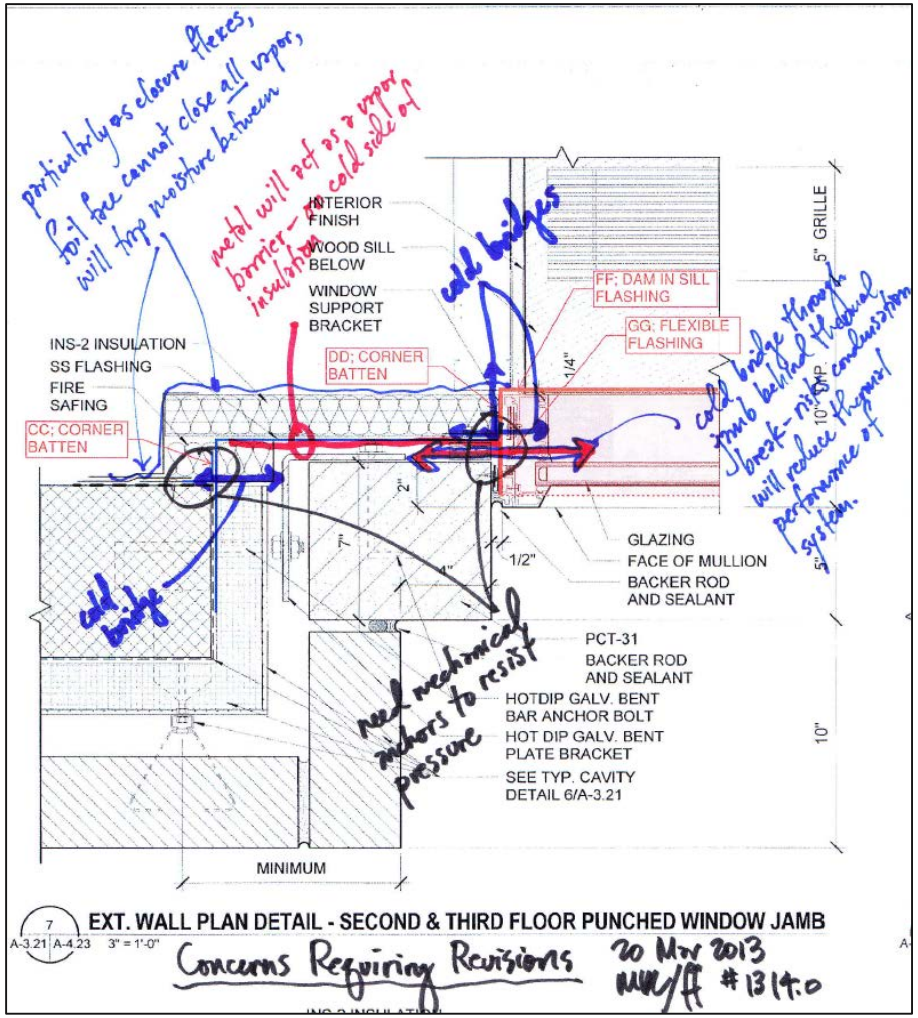
Documenting Changes





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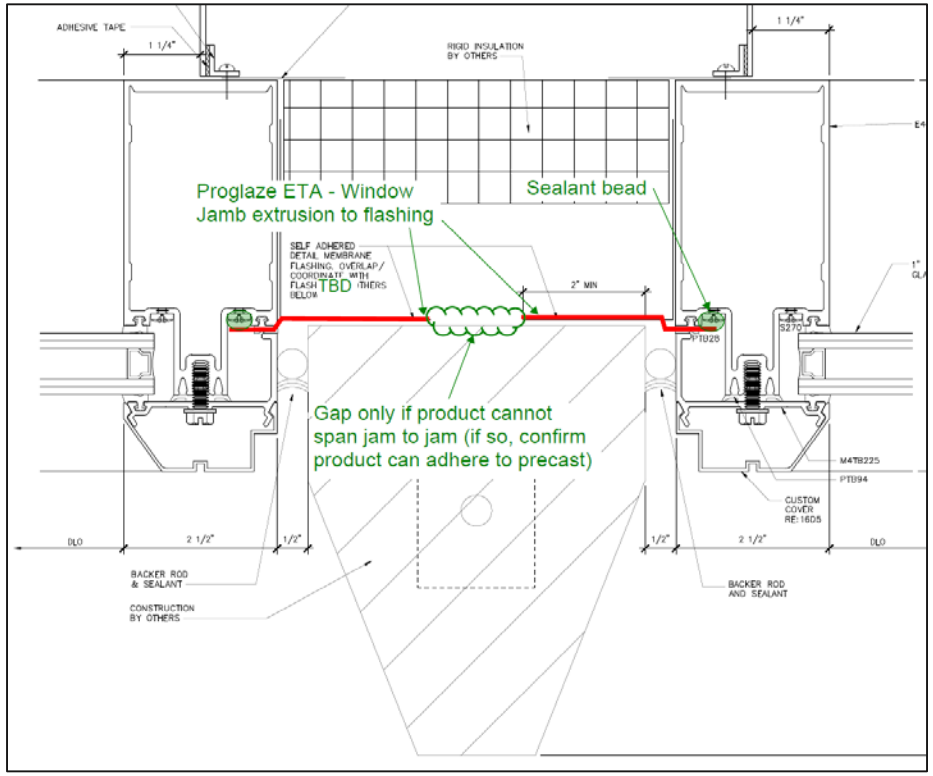
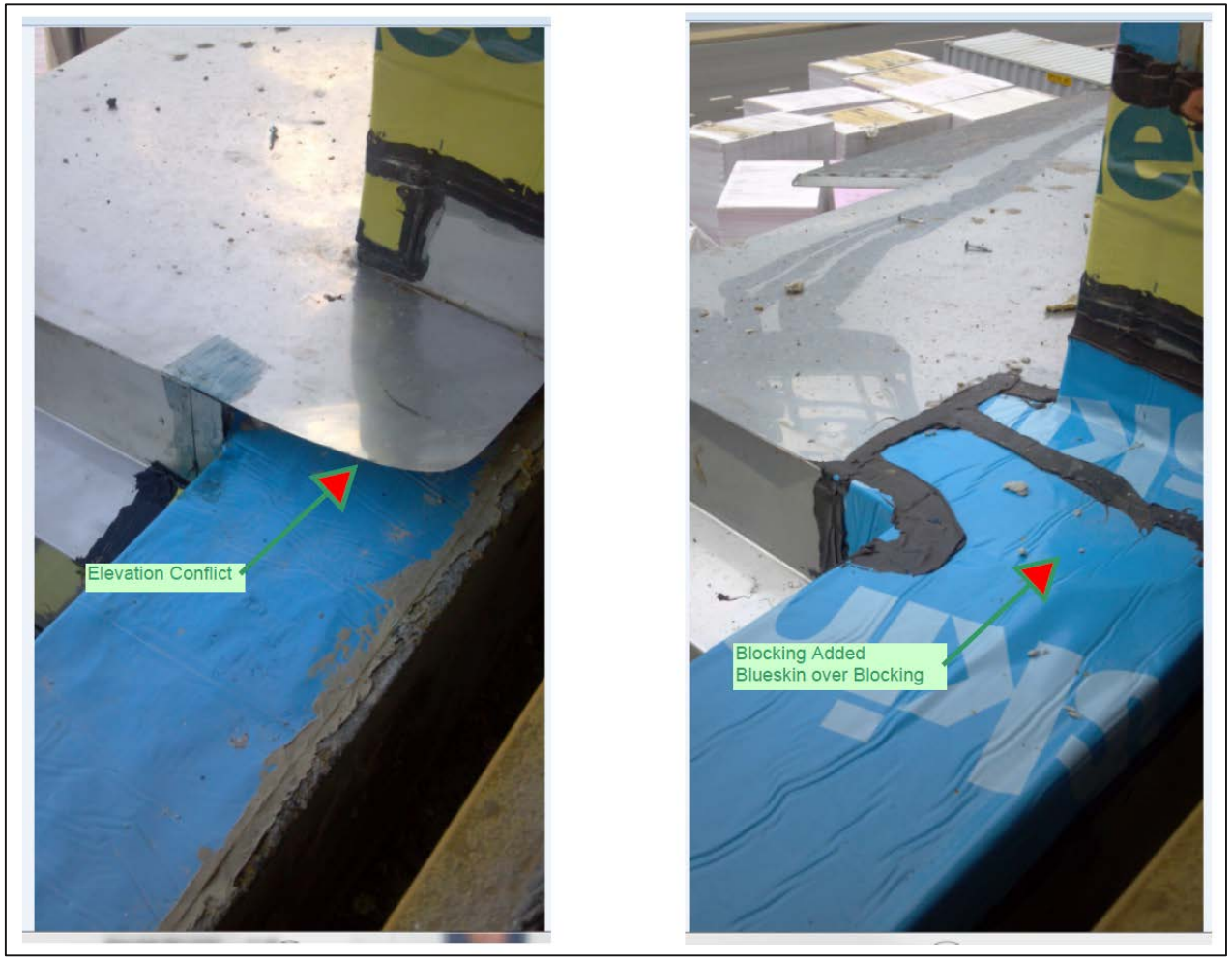
Documenting Changes





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Documenting Changes

#	Report Date & Observer	Systems Impacted	Issue	Action / Status / Resolution	Reference	Possible Resolution Path
51	1/28/2013 BWT	Air barrier, flashing transition to cast stone	[Design Issue] Plan detail needed showing how the entry at the west elevation near column line 3 is closed at the jamb for water and air infiltration. Clarification also needed for how that flashing closure will terminate at the bottom, and how water from the joint between the precast head and precast jamb will be captured.	[Contractor] submitted RFI 599 for flashing detail. RFI 843 response depicts flashing at the base of the jambs. Update: see [Contractor] Sketch #31 dated 1/7/14	RFI 599; RFI 843; [contractor] SK31	RESOLVED

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Coordination Through Preconstruction Meetings and Shop Drawings

Include as many related trades as feasible

Example: the intersection of air barrier, plumbing, and mason trades

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Bill Nash
Ben Townsend

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Thank You!


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