

# Resilient New Buildings

*Low Carbon, **Performance-Based** and  
Multi-Hazard Designs in a Changing Climate*

## John Sherstobitoff

Principal – Seismic & Structures – Ausenco

Chair - Standing Committee Earthquake Design, National Building Code

Chair - Task Group - Performance Based Design / Resilience

Chair – Working Group – Seismic Isolation, Supplemental Energy Dissipation

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in the built environment  
British Columbia April 16-17th, 2018



# Resilient?



# Somewhat



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# Resilient?



# YES



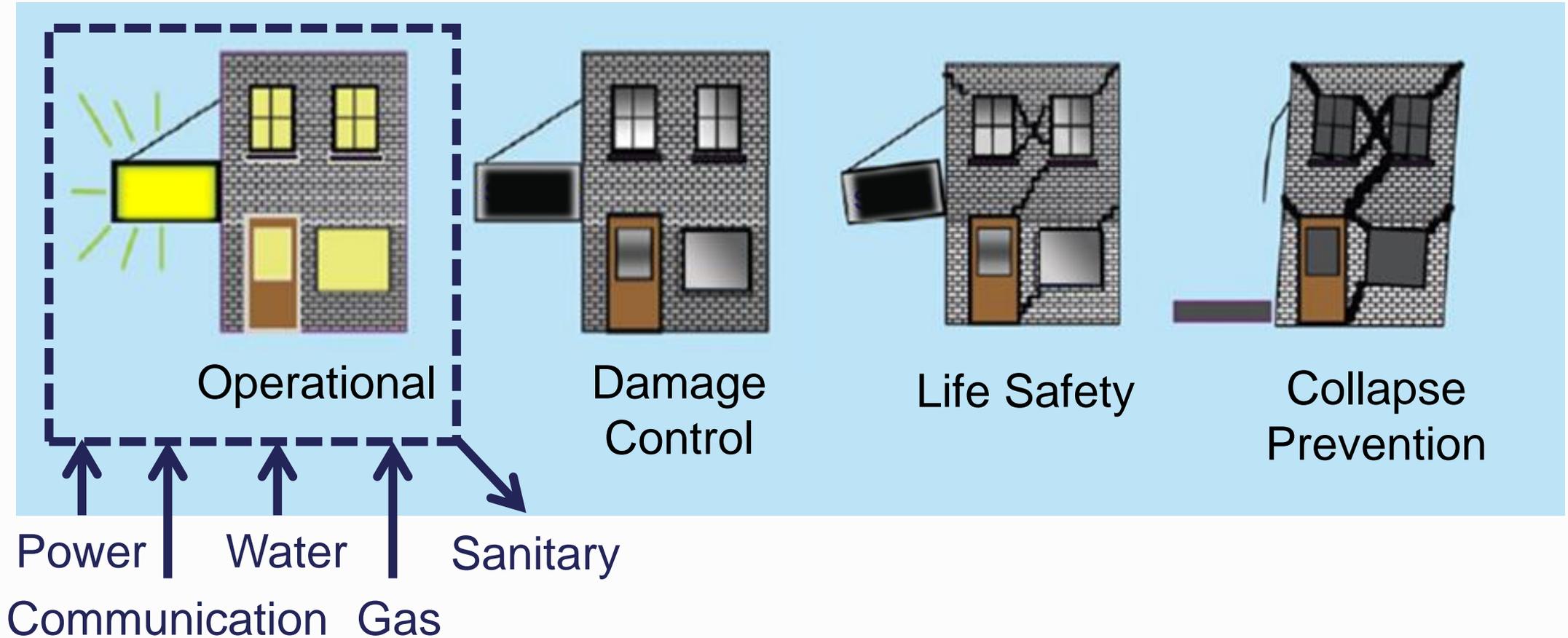
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# Resilience



# Building Codes Today – Objective Based

## Normal buildings (offices, residential)

“... prevent ... loss of life”

“... resist major earthquakes without collapse...extensive damage”

## Post-earthquake buildings (hospitals, fire stations)

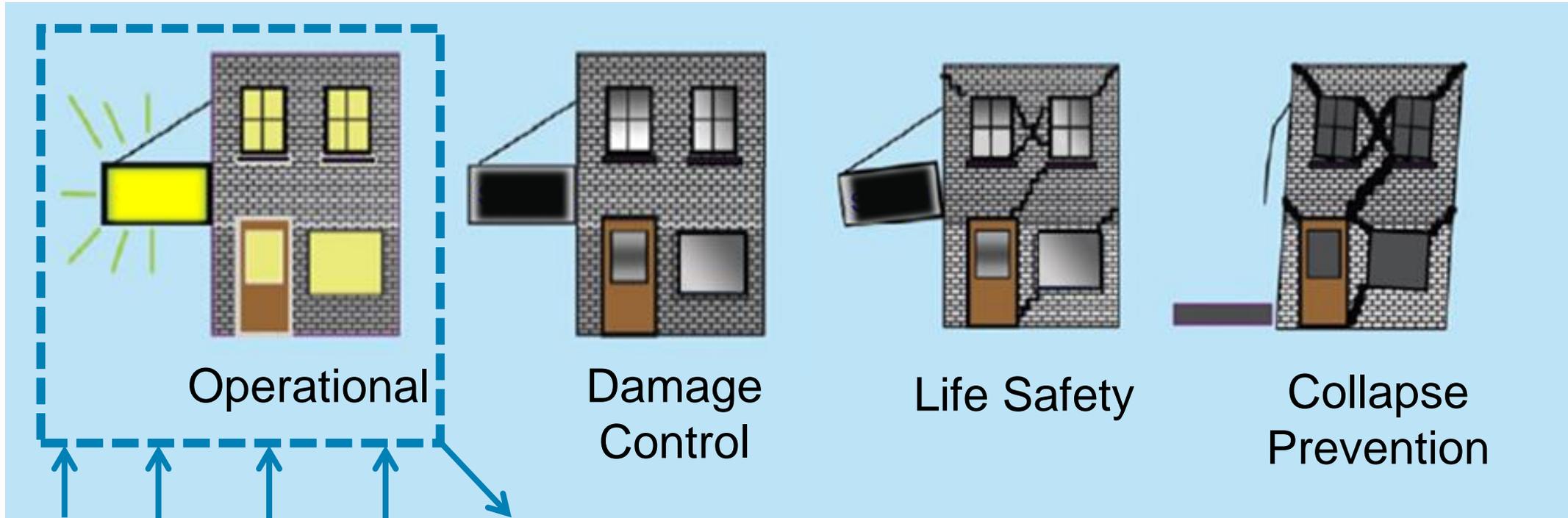
“... will not necessarily ensure operational readiness”

## High importance buildings (schools, community centres)

... somewhere in between the above two

# Resilience

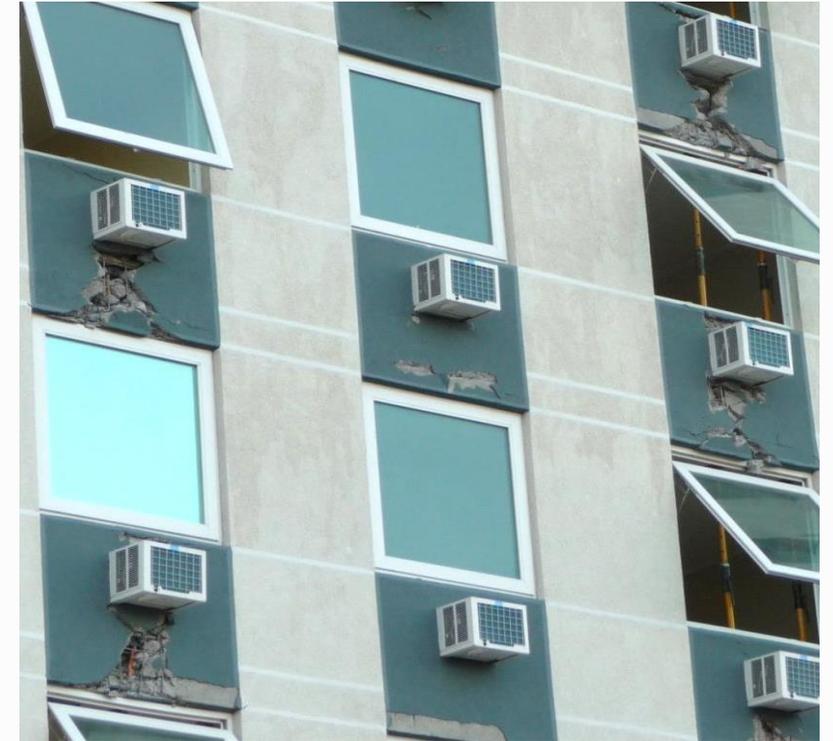
High Importance  
Post-disaster Normal



Power  
Communication  
Water  
Gas  
Sanitary

**Performance Varies  
44 structural Systems**

# Conventional New Building Design Earthquake Energy Dissipation by Ductility – controlled damage



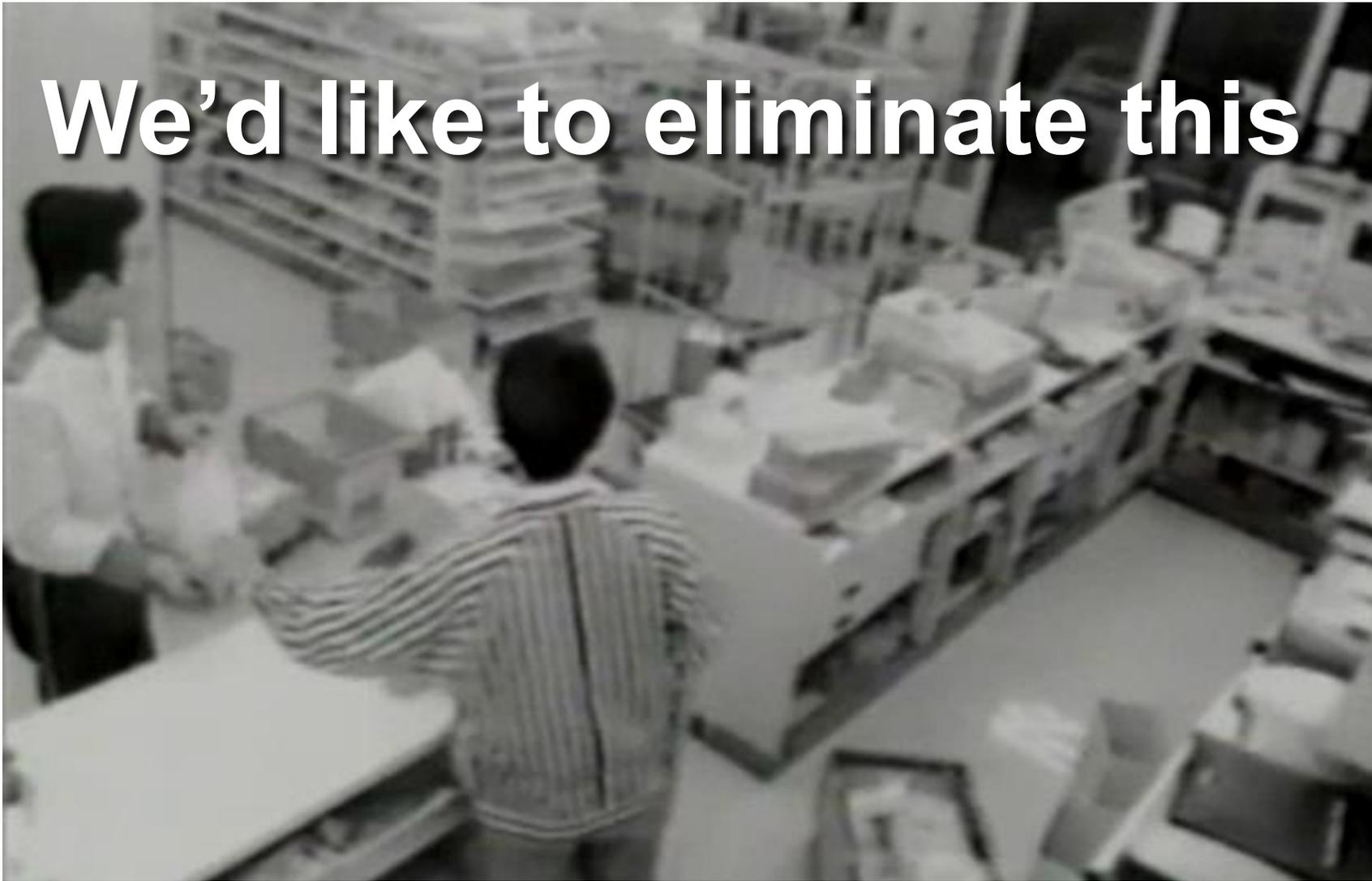
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# We'd like to eliminate this



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And move to this



Base Isolated Hospital, Japan, Tohoku EQ

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# Do we have the tools and technology?



**Structure Undamaged**



**Base Isolated  
buildings for  
20 years in  
15 countries**



*Now in NBCC 2015*

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# Do we have the tools and technology?



**Viscous Walls**



**Viscous Dampers**

**Structure Undamaged**

***Now in NBCC 2015***

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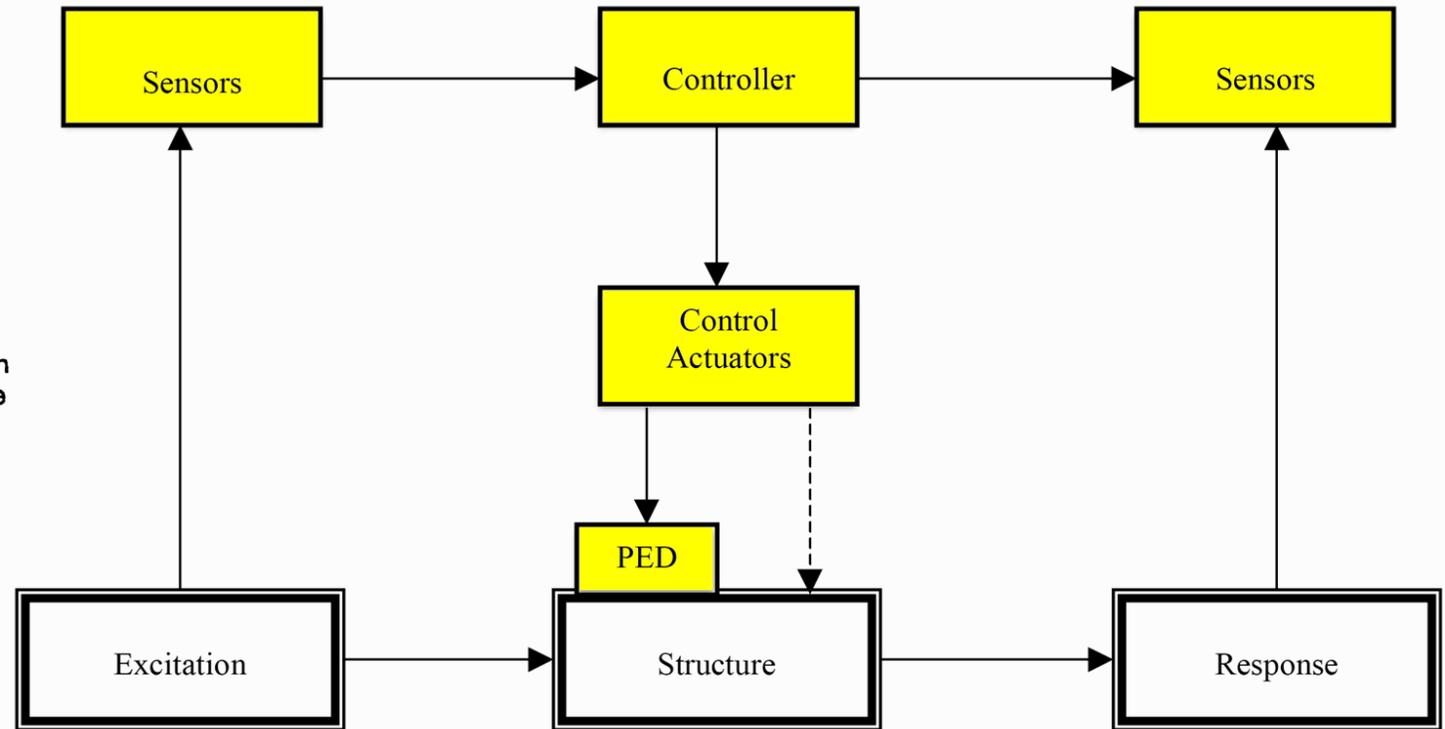
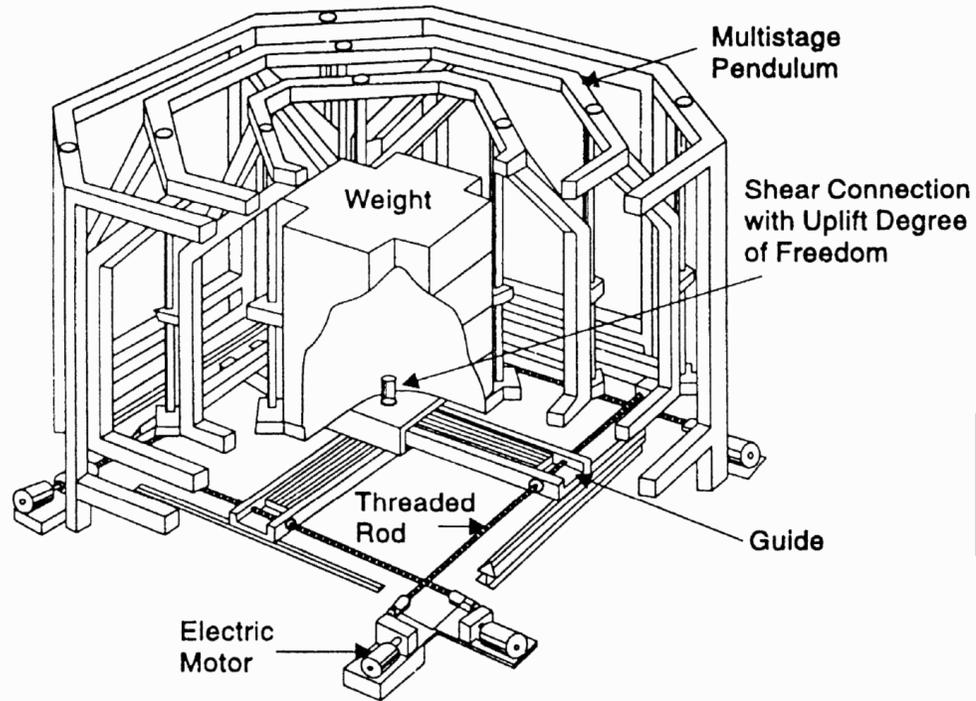


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# New Directions

“Smart, active buildings”



Structure with Hybrid Control

# Can we do better for new buildings?

Fully resilient for:  
< 1% cost large buildings  
< 5% cost small buildings

*Would you pay \$10,000 more  
for your new \$1M condo?*

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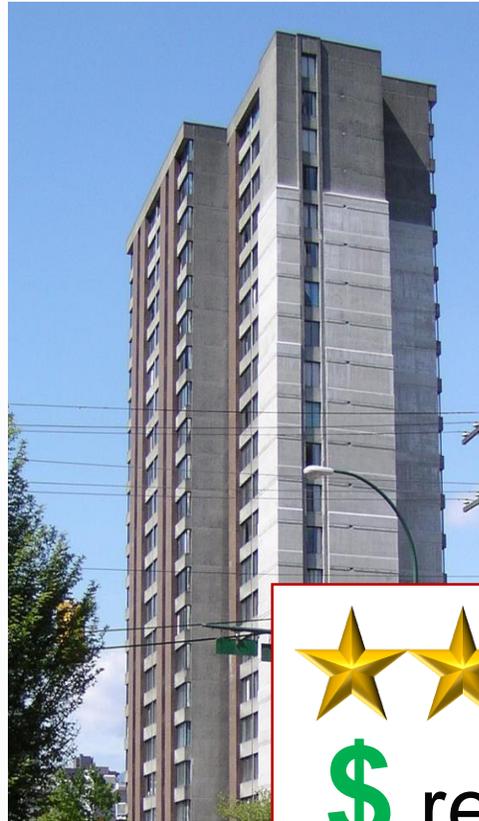
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# Can the market be a driver?



★ ★ ★  
\$ rent, sell



★ ★ ★ ★ ★  
\$ rent, sell

## Resilience Ratings



Safety	★ ★ ★
Damage	★ ★ ★ ★ ★
Recovery	★ ★ ★

# Building Codes

Perhaps public perception that buildings designed per Code are earthquake proof, **resilient**, undamaged

... by meeting the minimum code legal requirements ... **they are not** ...

It is time to move towards a ... **performance based** ... risk based ... resilient buildings code.

NBCC 2020 Task Group on Performance Based Design  
PBD Matrix

Ground Motion Exceedance Probability (Return Period)	Fully Operational (Essentially elastic)	Operational (Damage Control)	Life Safety / Collapse Prevention?
20% in 50 years (225 years)	■		
10% in 50 years (475 years)	■	■	
5% in 50 years (1,000 years)		■	■
2% in 50 years (2,475 years)		■	■

*Ordinary Buildings* (green line)  
*High-Importance Buildings* (orange line)  
*Post-Disaster Buildings* (red line)

# It is time...

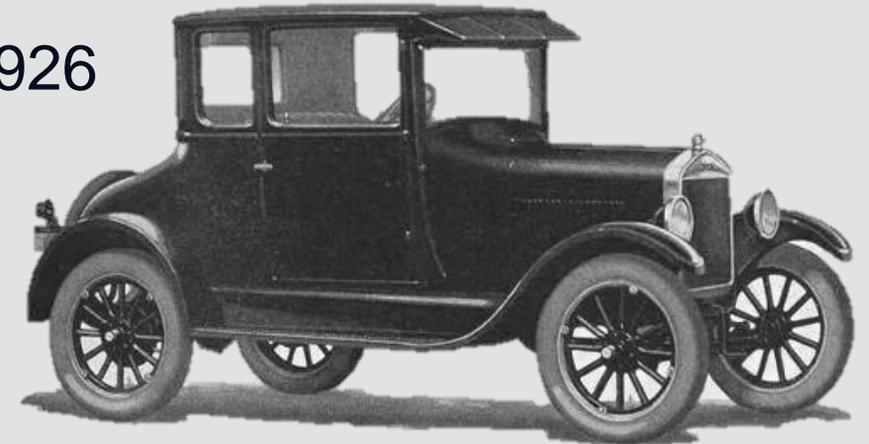
1893 ... pneumatic tires to “soften” the hard ride on bumpy roads  
... similar to base isolation for buildings?

1926 ... shock absorbers to “absorb the unpredictable and unwanted energy of bumpy roads”  
... similar to dampers for buildings?

1893



1926



# Who can drive the acceleration towards resilient new buildings?

- Codes - National , Provincial, Municipal
- Designers
- Contractors
- Real Estate (resilience ratings)
- Informed, proactive building owners
  
- All of us !

Resilience is the new sustainability  
We are approaching a “resilience economy”  
Consumer awareness will lead to demand  
Who will be the first Recovery and Response private owner in BC?

Lisa Stevens, BC Construction Association

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Construction is the second least efficient industry of all industries measured.

The inherent risk associated with this inefficiency drives costs up therefore when change in design demands occurs, the industry traditionally responds with higher cost.

We need to take an entirely new approach to project delivery so that HOW we build will provide us the means to WHAT we build.

Tom Plumb, Kinetic Construction

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# A glimpse today...

## We really want to hear your ideas

### Session T4 Tuesday 1:30 - 3:00pm

**Tuna Onur**

Moderator; hazard/risk specialist

**Tom Plumb**

Kinetic Construction

**Jamie Gray-Donald**

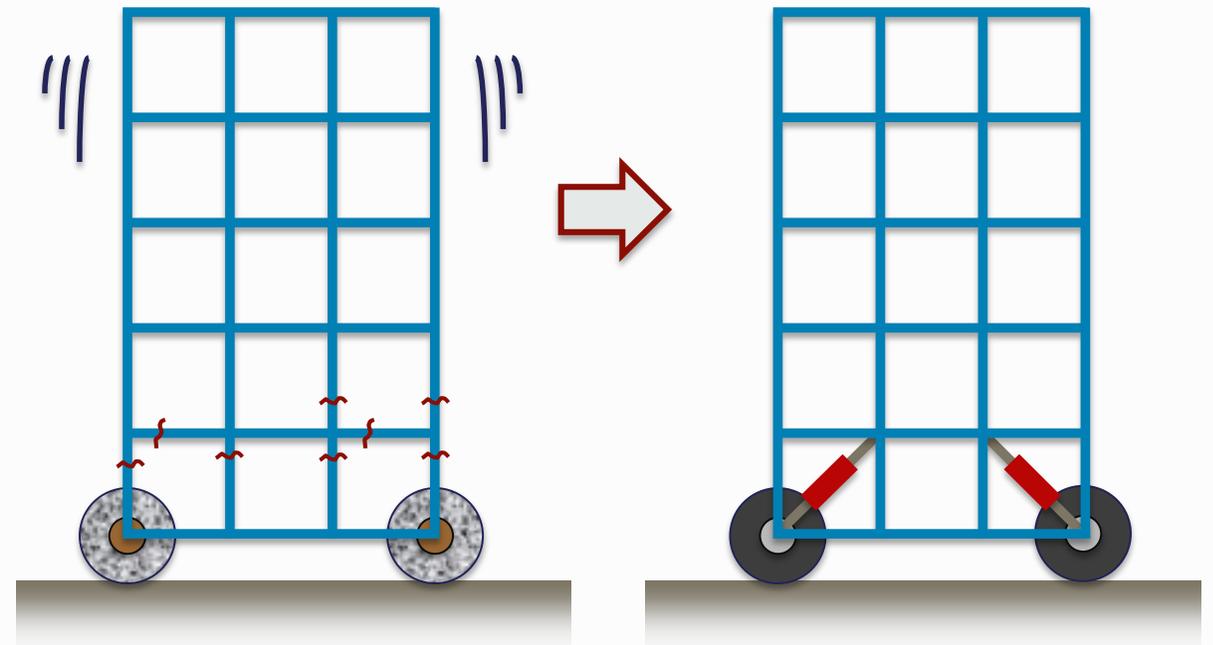
Quad Real Properties

**Lisa Stevens**

BC Construction Association

**Angie Woo**

Fraser Health



*Welcome to*

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