

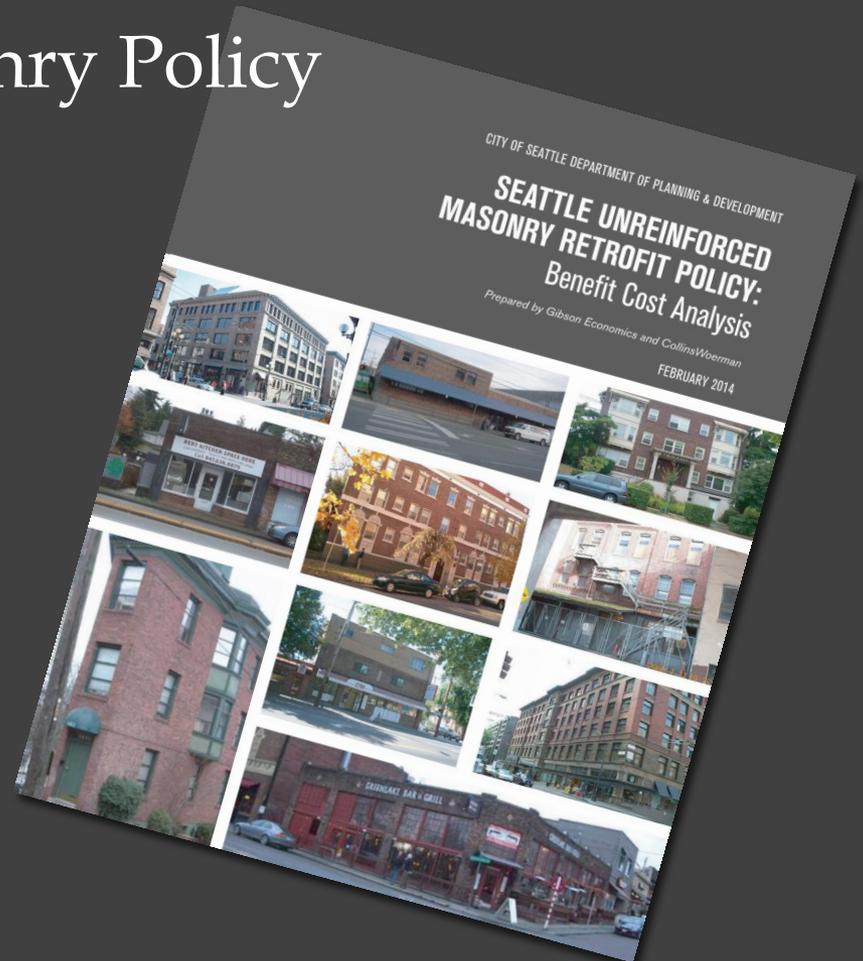
# BENEFIT COST ANALYSIS

Seattle Unreinforced Masonry Policy

March 13, 2014

John Gibson

Steve Moddemeyer





# URMs and neighborhood character

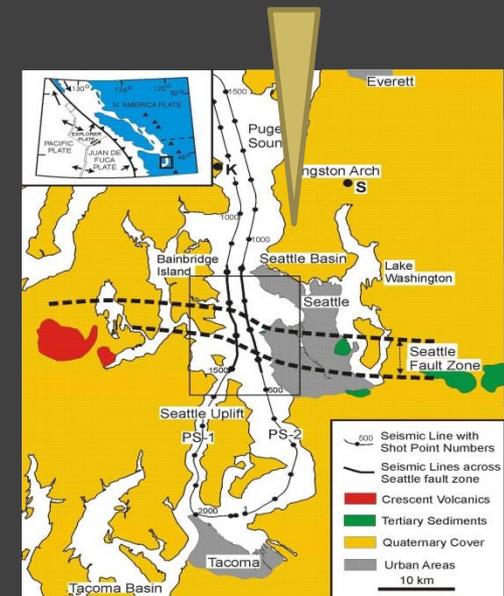
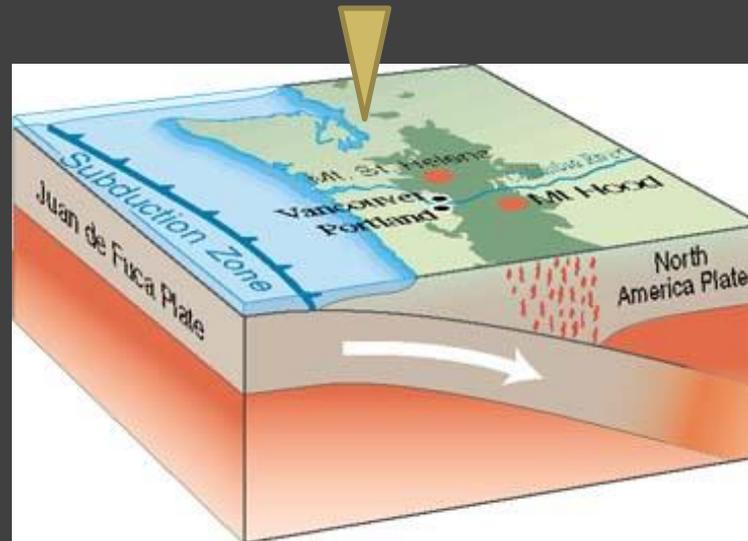
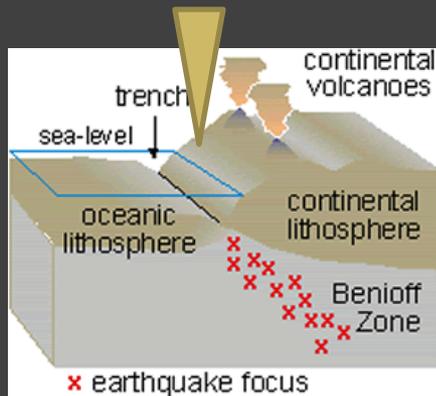


# To do list

- ▣ Refined the list of 929 potential URMs
- ▣ Cleaned up the potential URM list
  - Removed duplicates
- ▣ Geo-located all 929 with latitude/longitude
- ▣ Identified three earthquake types and severity
- ▣ Developed new Bolts Plus fragility curve
- ▣ Separated 929 buildings into categories
  - 1-2 stories
  - 2+ stories
  - Liquefaction zones
  - Historic districts
- ▣ Identified key impacts, costs, benefits
- ▣ Established a series of data ranges for sensitivity testing
  - Cost ranges for retrofits
  - Cost for money
- ▣ Ran HAZUS model 135 times to develop results
- ▣ Ran benefit cost of retrofits
- ▣ Ran benefit cost of policy
- ▣ Evaluated potential incentives
- ▣ Briefings, task memos, report

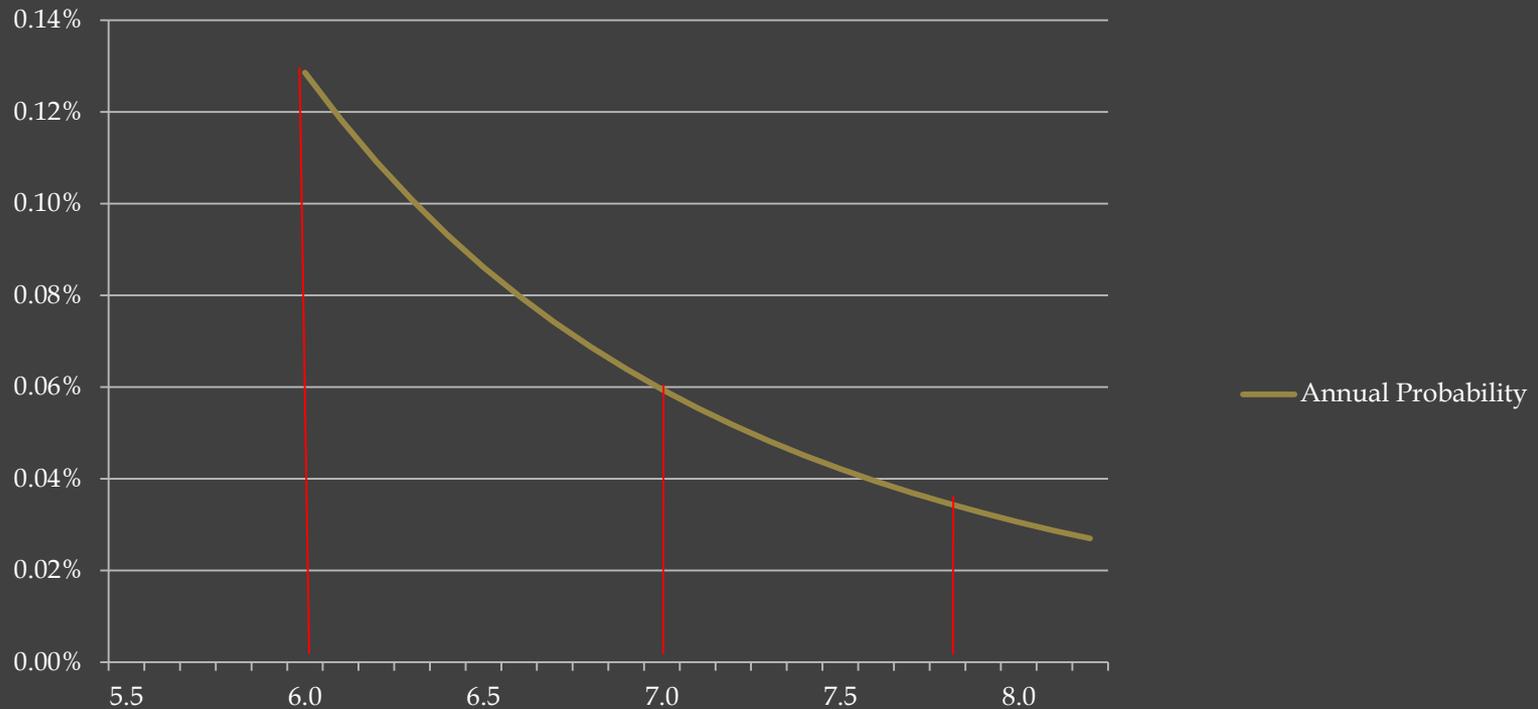
# Seattle's three kinds of earthquakes

- ▣ Benioff zone earthquake M6.8 (Nisqually)
- ▣ Subduction zone earthquake M 9.0
- ▣ Seattle Fault M6.7



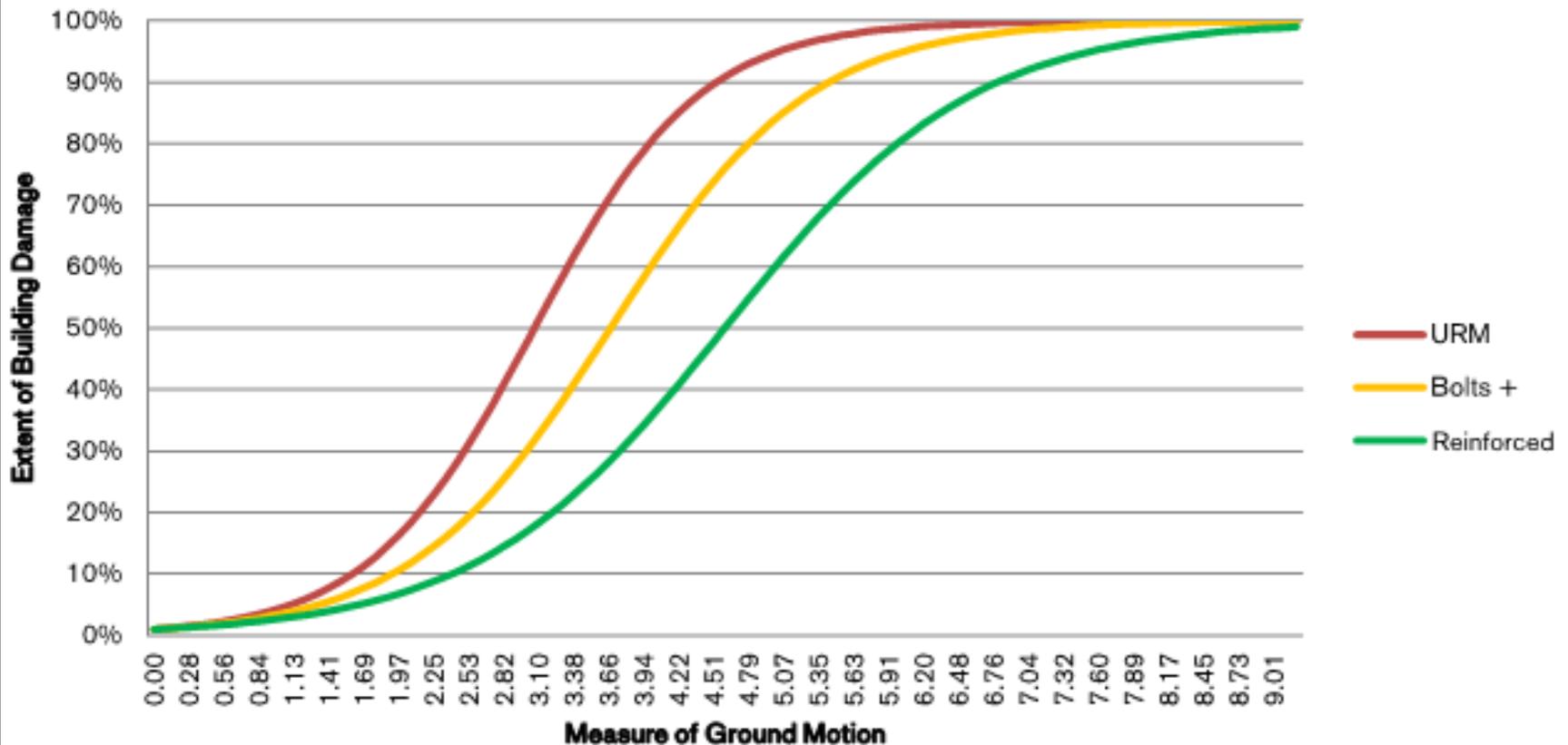
# Select Three Representative Seattle Earthquakes

## Earthquake Probability by Severity



# Established a “Bolts Plus” fragility curve

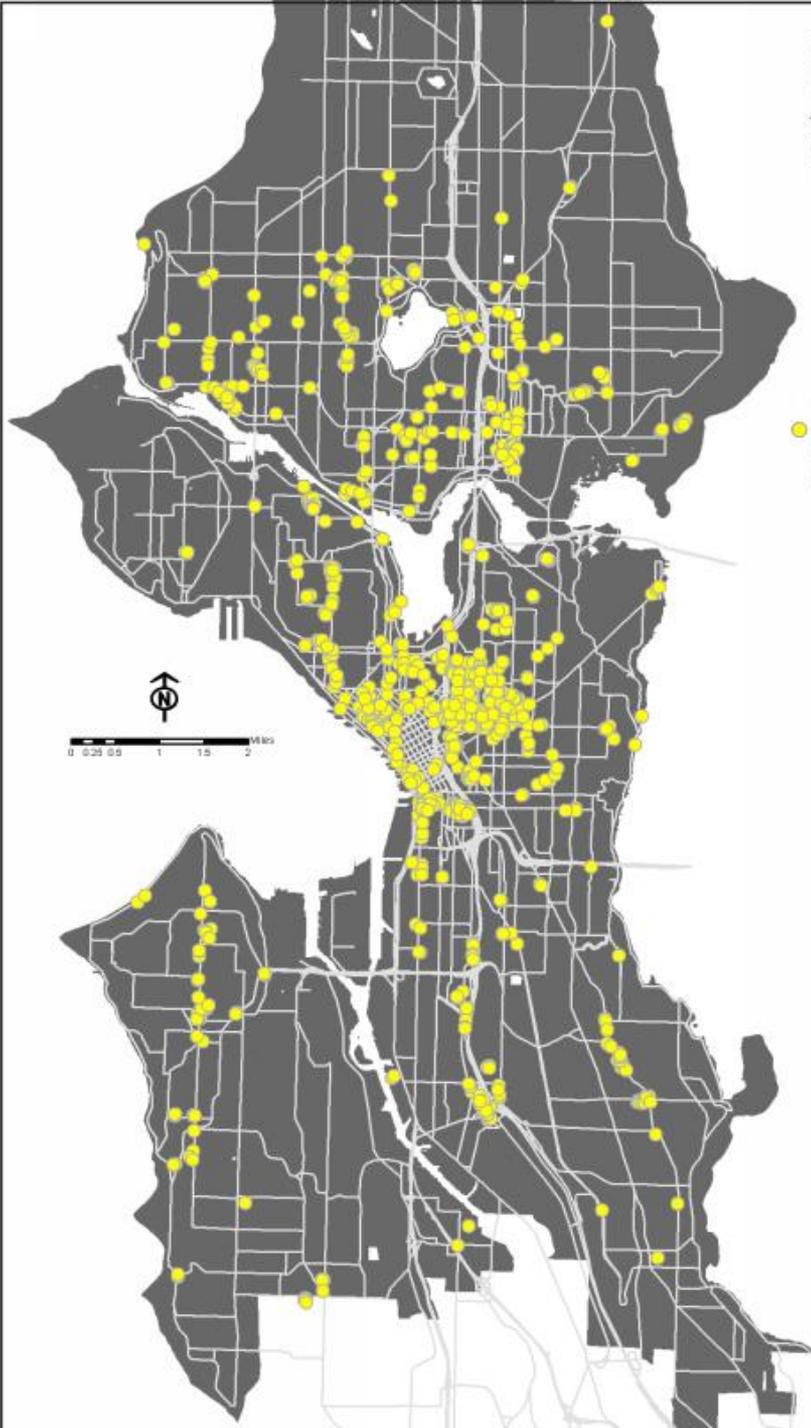
Figure 1. Fragility Curves: Damage from Ground Motion, for Various URM Retrofits



# HAZUS Runs

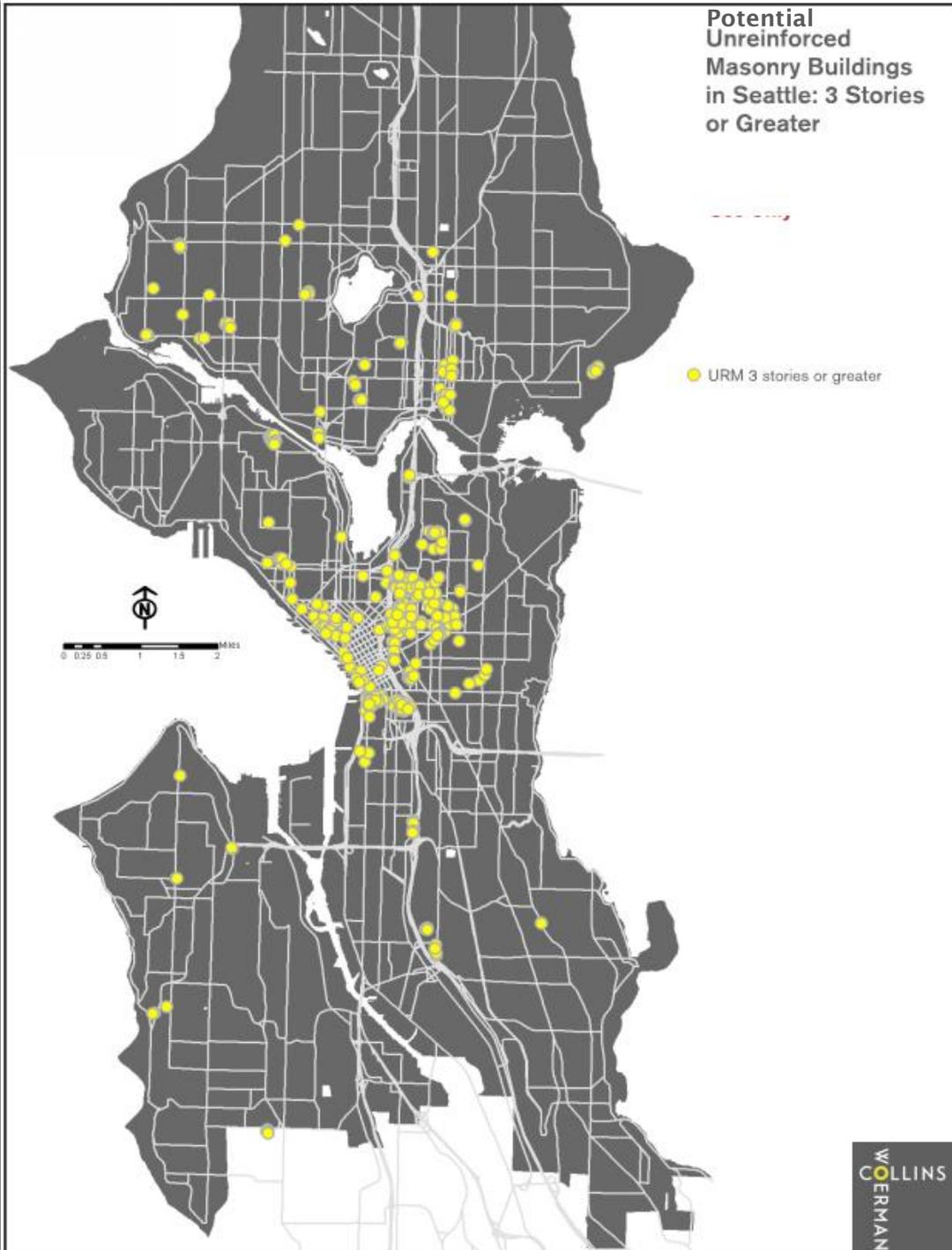
		Before Bolts+ retrofit	After Bolts+ retrofit	Reinforced Masonry
Liquefaction soils	Low Rise	HAZUS results in % damage and loss of life	LHAZUS results in % damage and loss of life	HAZUS results in % damage and loss of life
	Mid Rise	HAZUS results in % damage and loss of life	HAZUS results in % damage and loss of life	HAZUS results in % damage and loss of life
Non-Liquefaction soils	Low Rise	HAZUS results in % damage and loss of life	HAZUS results in % damage and loss of life	HAZUS results in % damage and loss of life
	Mid-Rise	HAZUS results in % damage and loss of life	LHAZUS results in % damage and loss of life	LHAZUS results in % damage and loss of life

# Location of Potential Unreinforced Masonry Buildings in Seattle Identified in this Study

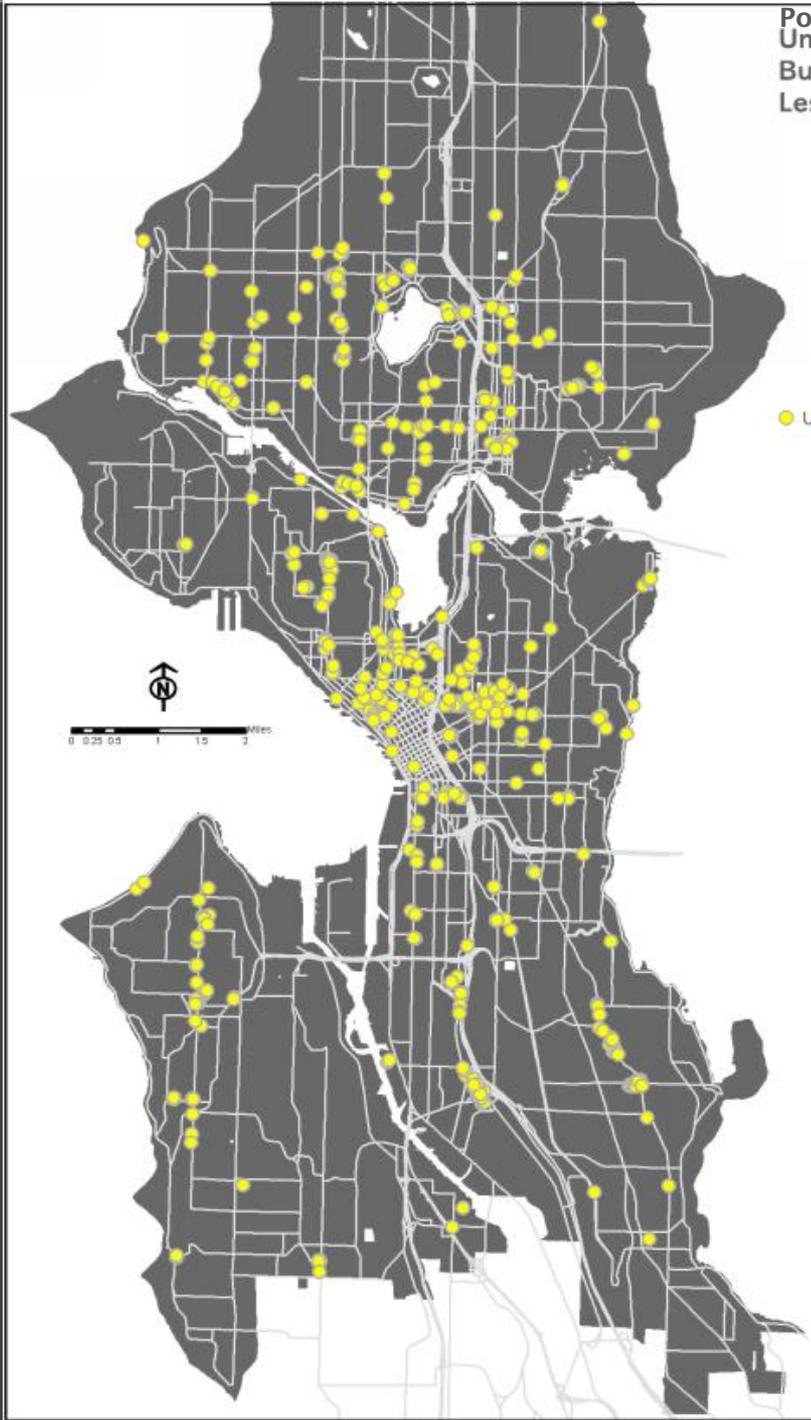


● URMs identified in the DPD database used for this study

# Potential Unreinforced Masonry Buildings in Seattle: 3 Stories or Greater



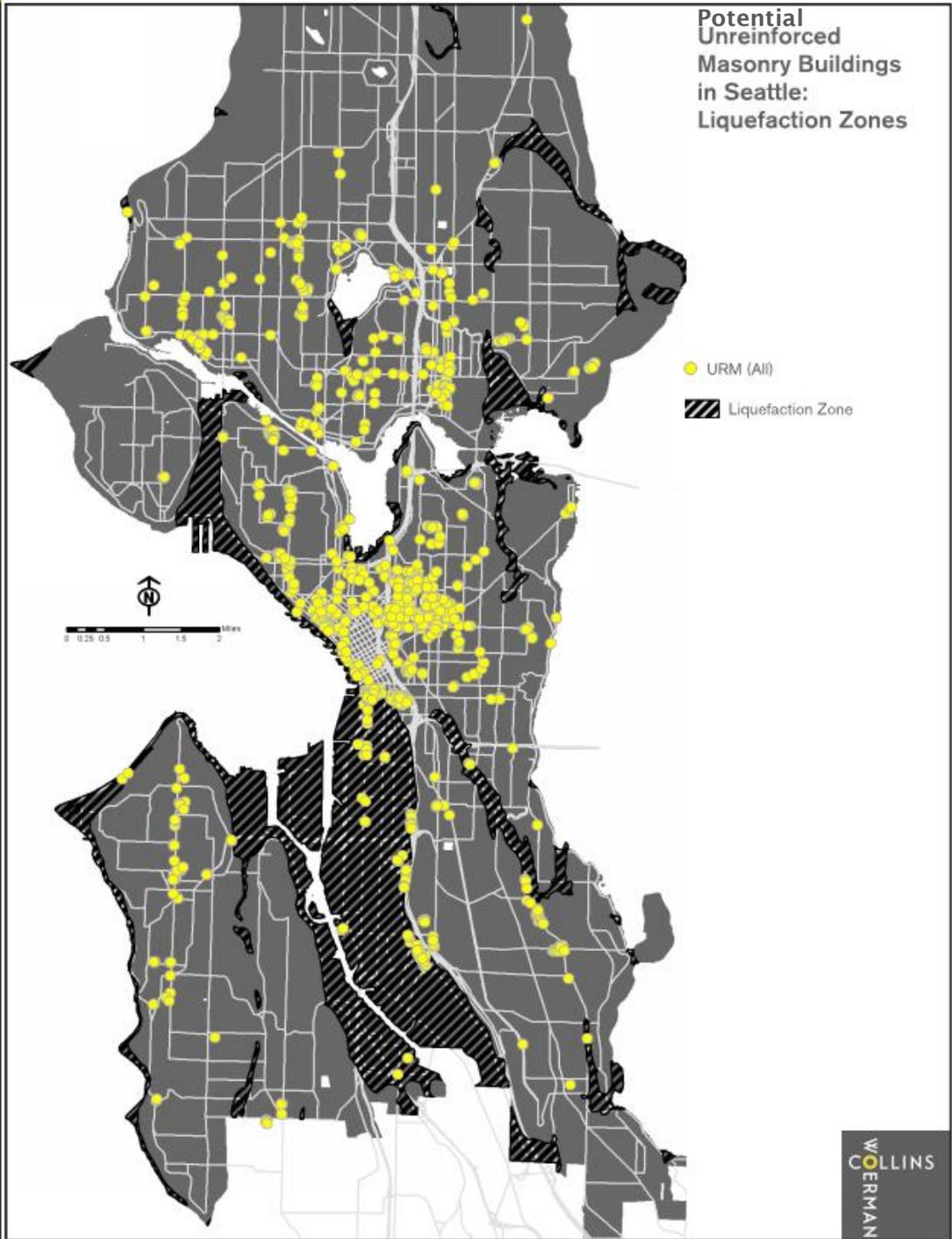
Potential  
Unreinforced Masonry  
Buildings in Seattle:  
Less than 3 Stories



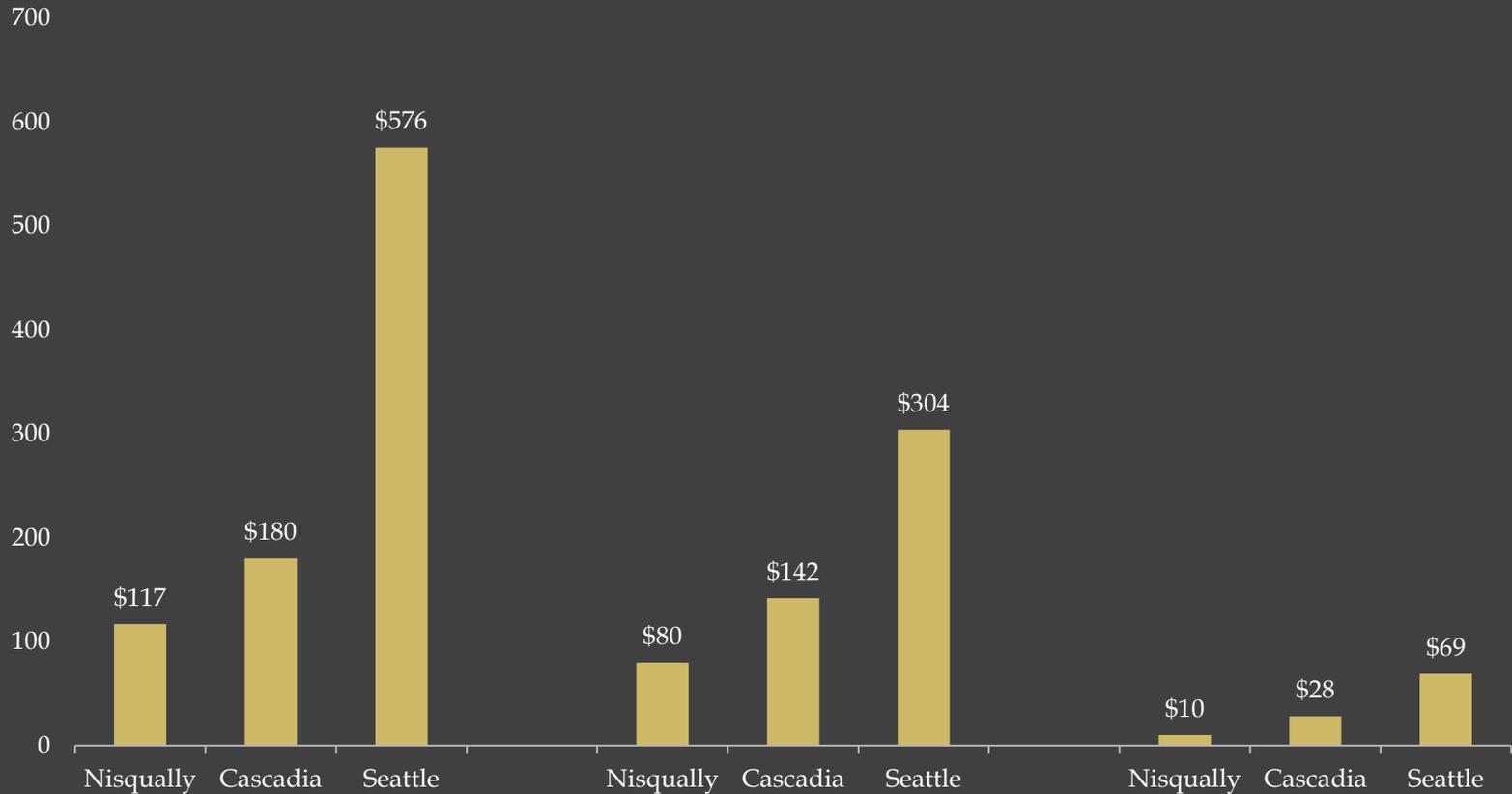
● URM 1-2 stories



# Potential Unreinforced Masonry Buildings in Seattle: Liquefaction Zones



# BUILDING DAMAGE

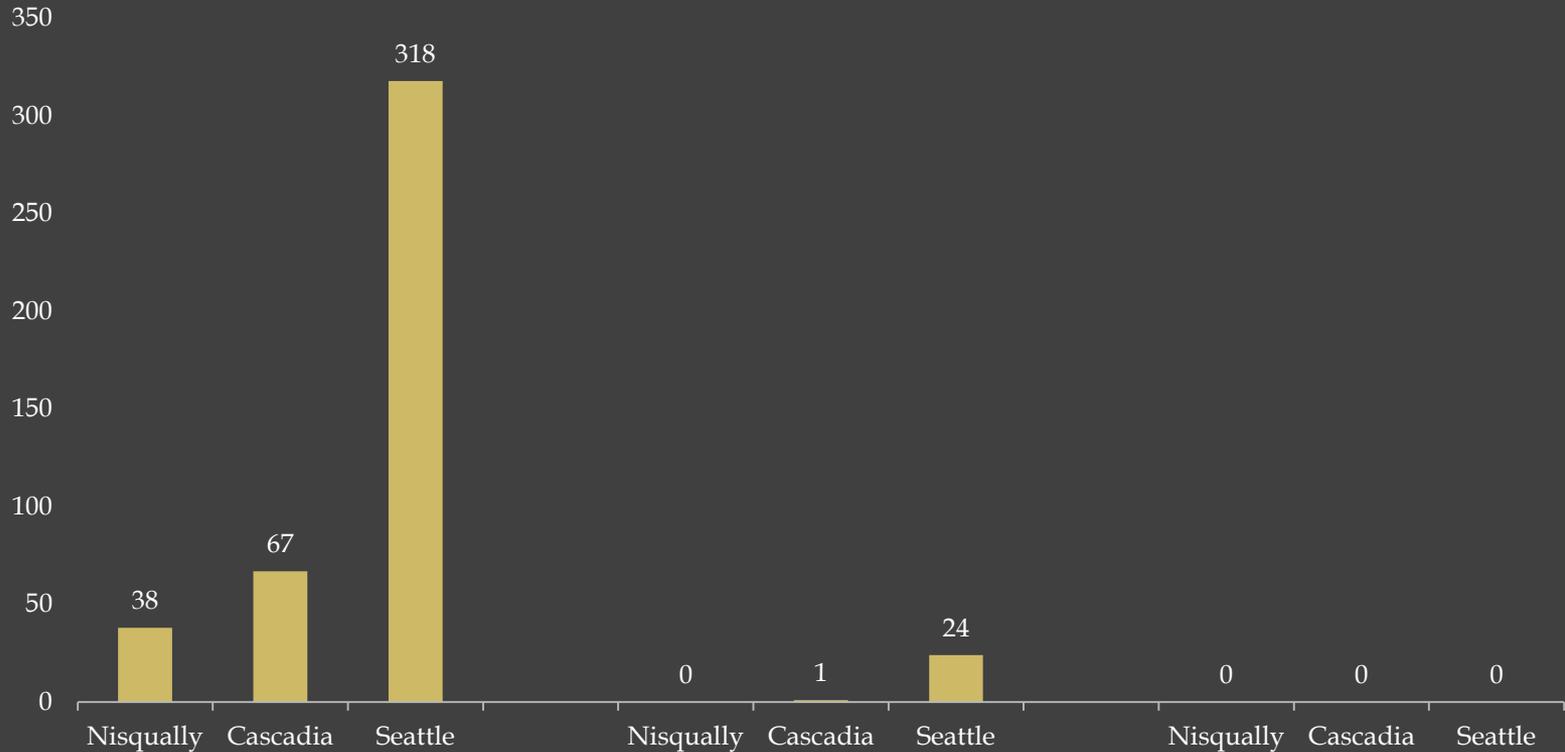


STATUS QUO

BOLTS PLUS

REINFORCED  
MASONRY

# HOSPITALIZATIONS

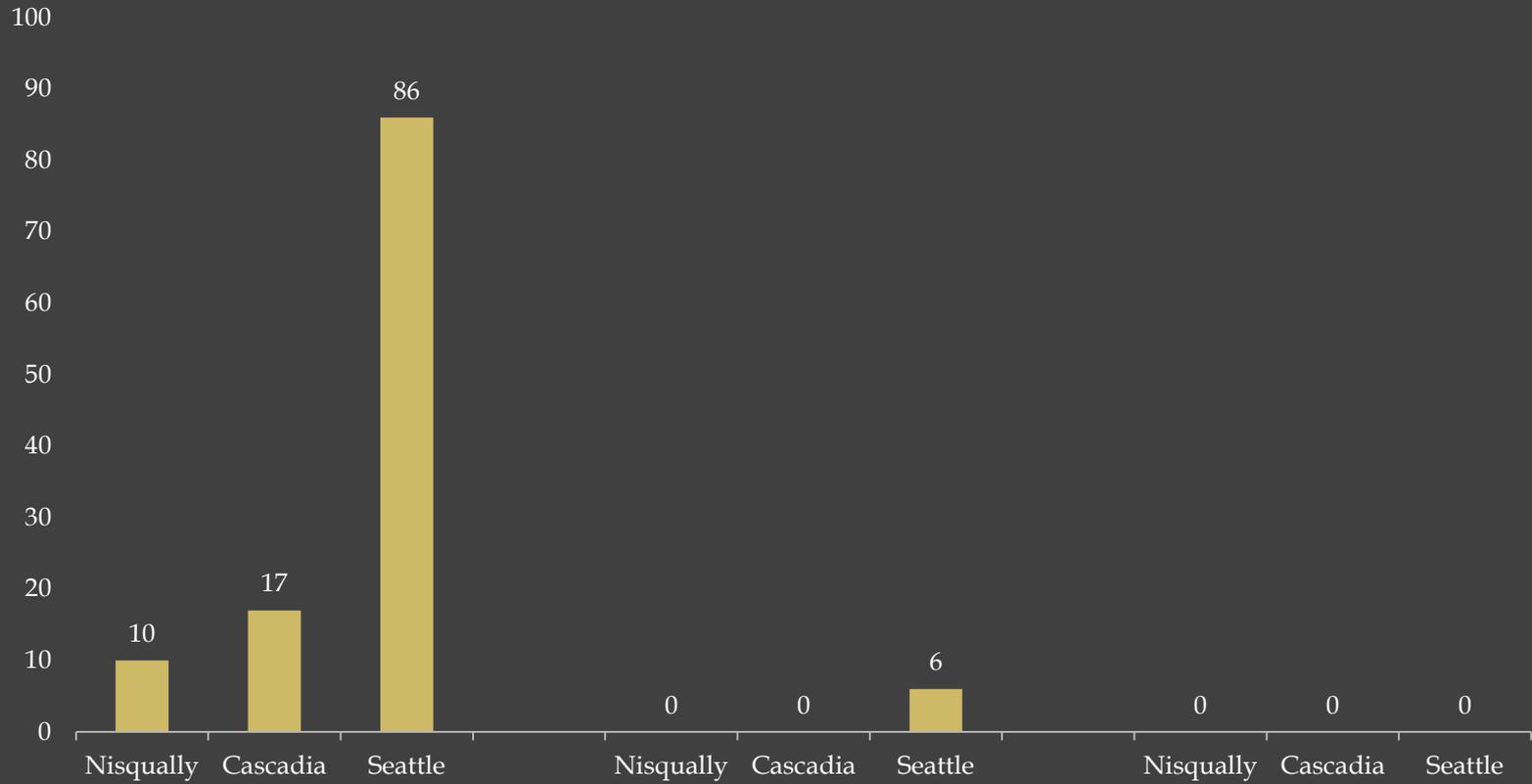


STATUS QUO

BOLTS PLUS

REINFORCED  
MASONRY

# DEATHS



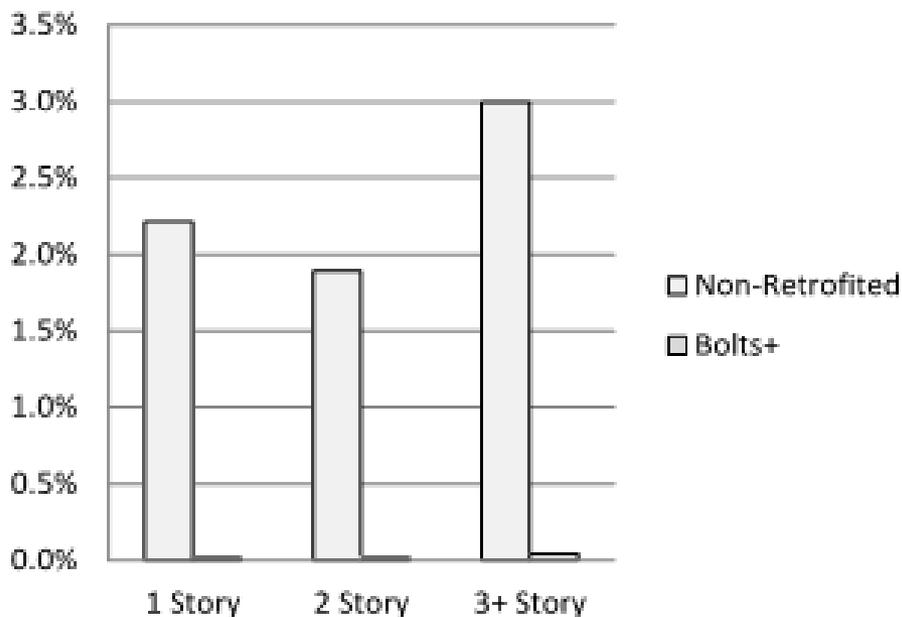
STATUS QUO

BOLTS PLUS

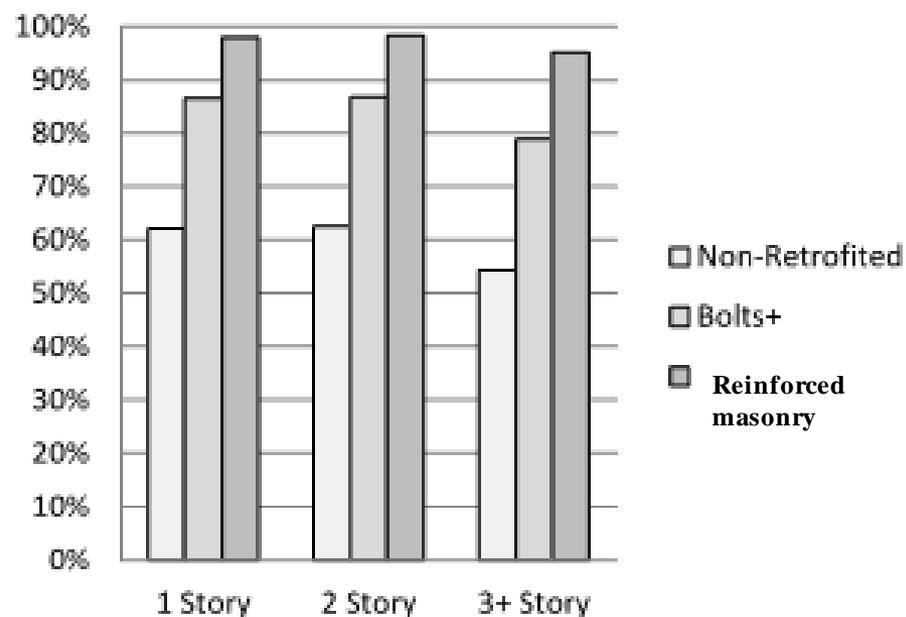
REINFORCED  
MASONRY

# Benioff Zone Earthquake 6.8 (Nisqually-type)

Percentage of URM Buildings Totally Destroyed, Nisqually Fault 6.8

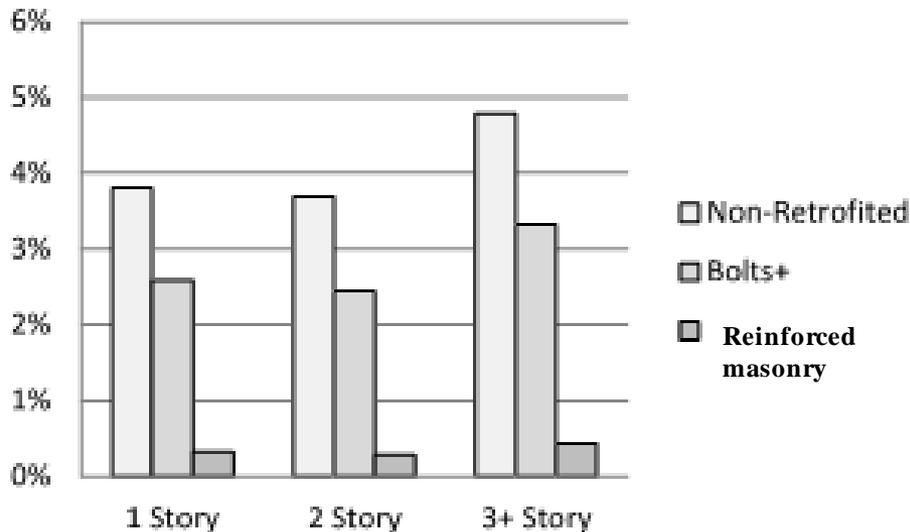


Percentage of URM Buildings with No Structural Damage, Nisqually Fault 6.8

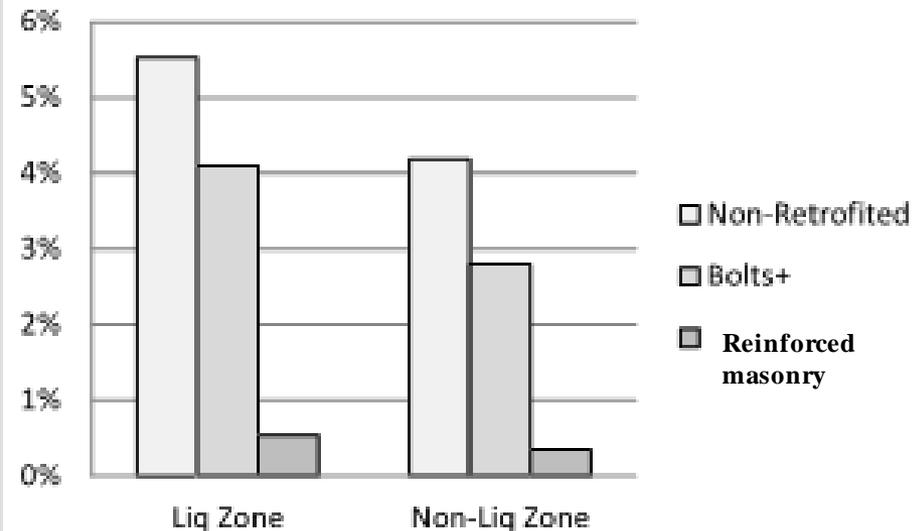


# Benioff Zone Earthquake 6.8 (Nisqually-type)

Building-Plus-Contents Value Damage Ratios by  
Building Height, Nisqually Fault 6.8

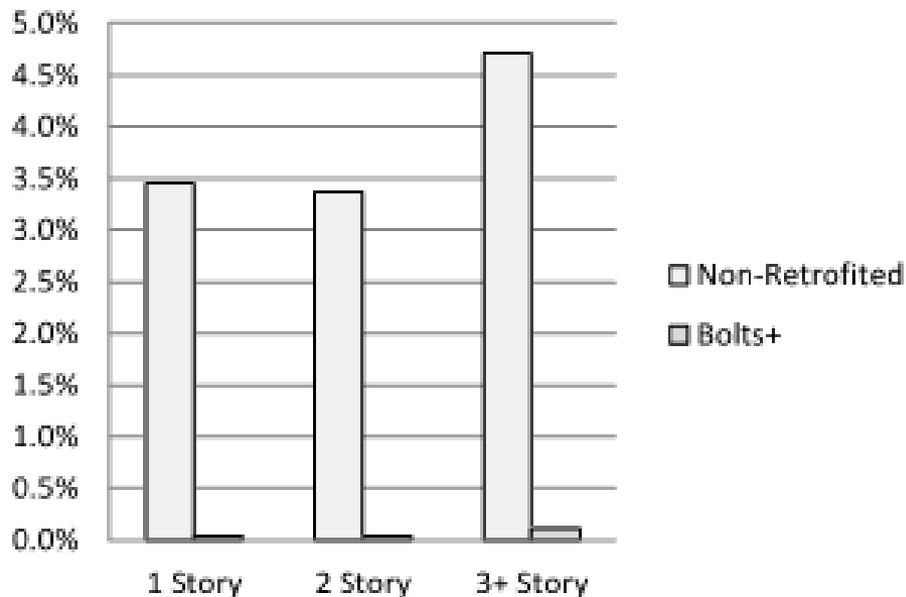


Building-Plus-Contents Value Damage Ratios by  
Underlying Soil, Nisqually Fault 6.8

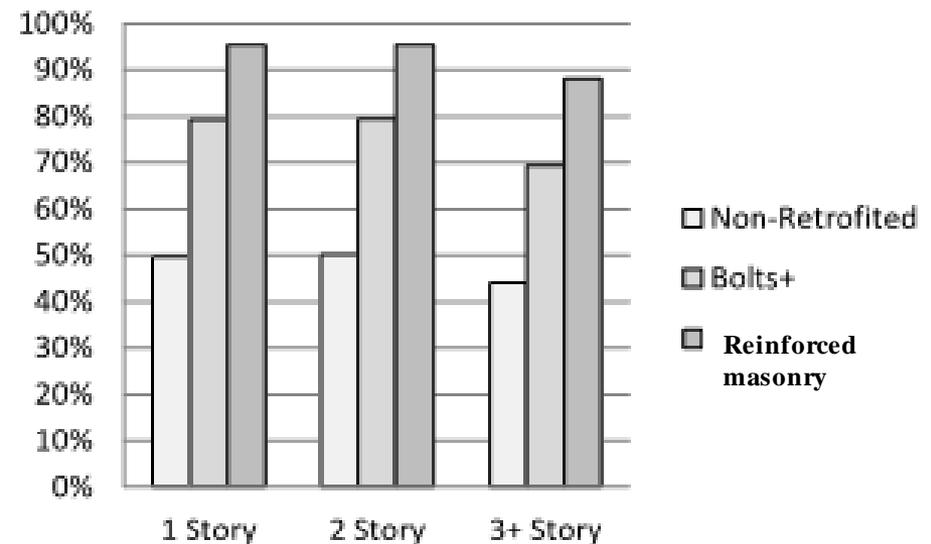


# Cascadia Subduction Zone 9.0

Percentage of URM Buildings Totally Destroyed, Cascadia Subduction Zone 9.0

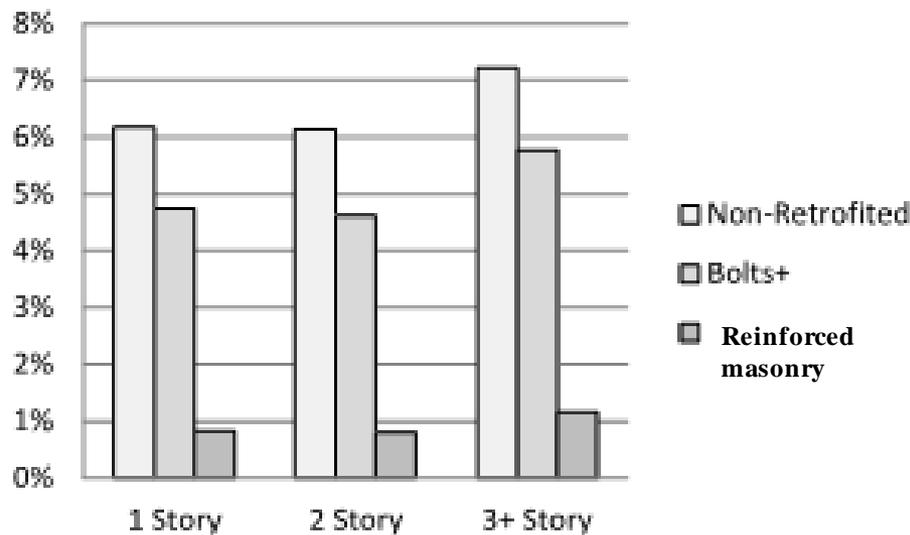


Percentage of URM Buildings with No Structural Damage, Cascadia Subduction Zone 9.0

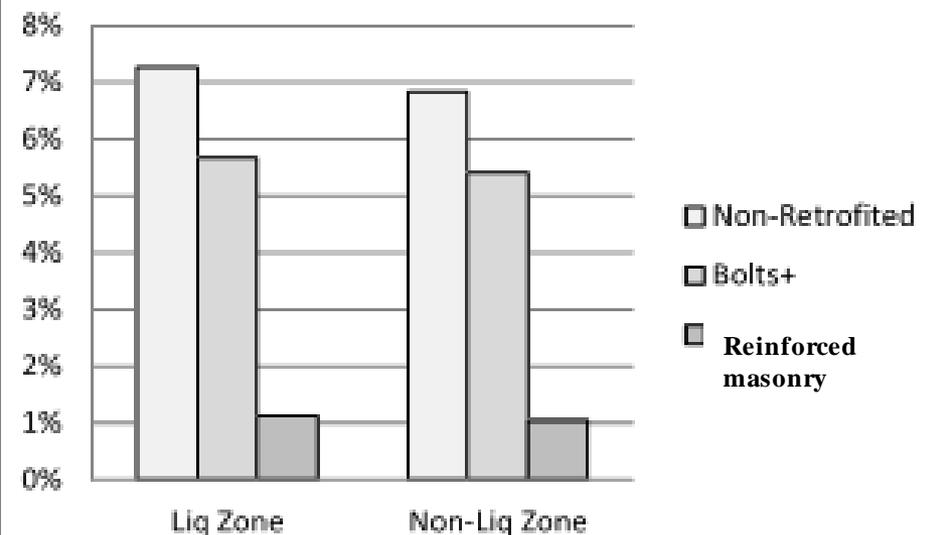


# Cascadia Subduction Zone 9.0

Building-Plus-Contents Value Damage Ratios by Building Height, Cascadia Subduction Zone 9.0

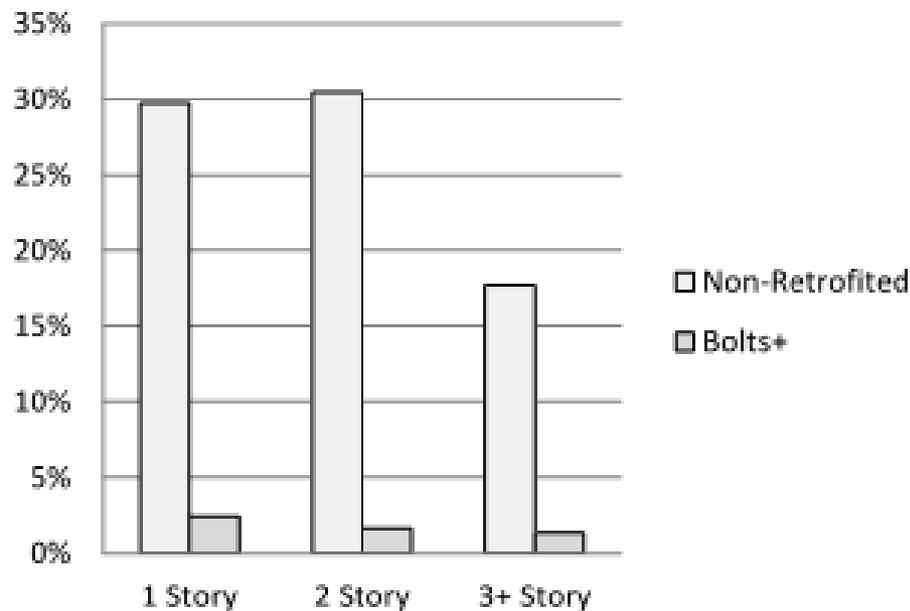


Building-Plus-Contents Value Damage Ratios by Underlying Soil, Cascadia Subduction Zone 9.0

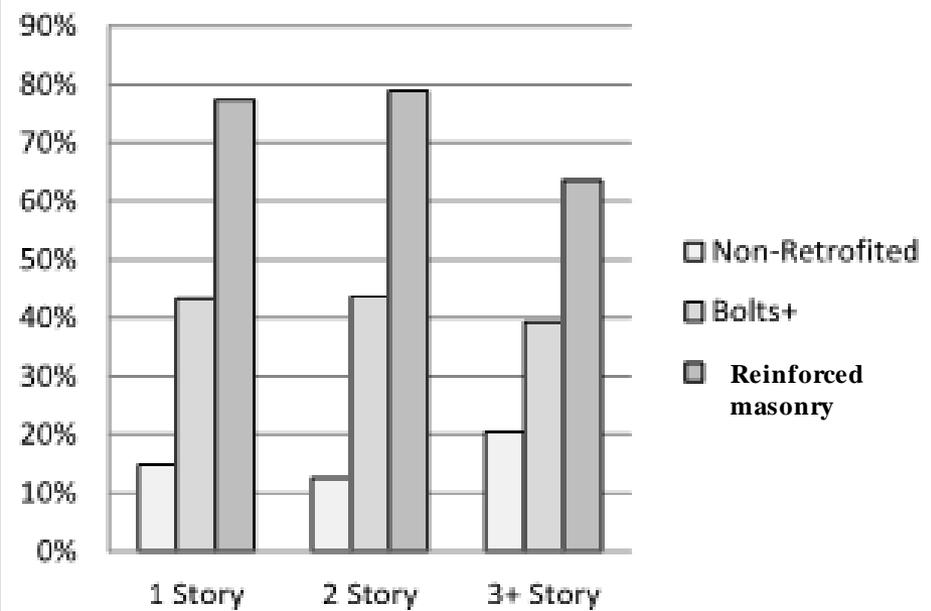


# Seattle Fault 6.7

Percentage of URM Buildings Totally Destroyed, Seattle Fault 6.7

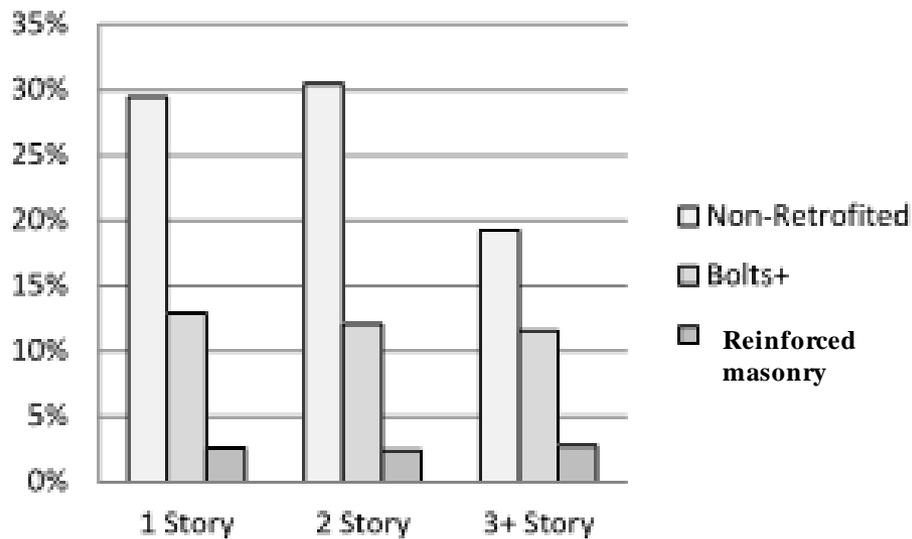


Percentage of URM Buildings with No Structural Damage, Seattle Fault 6.7

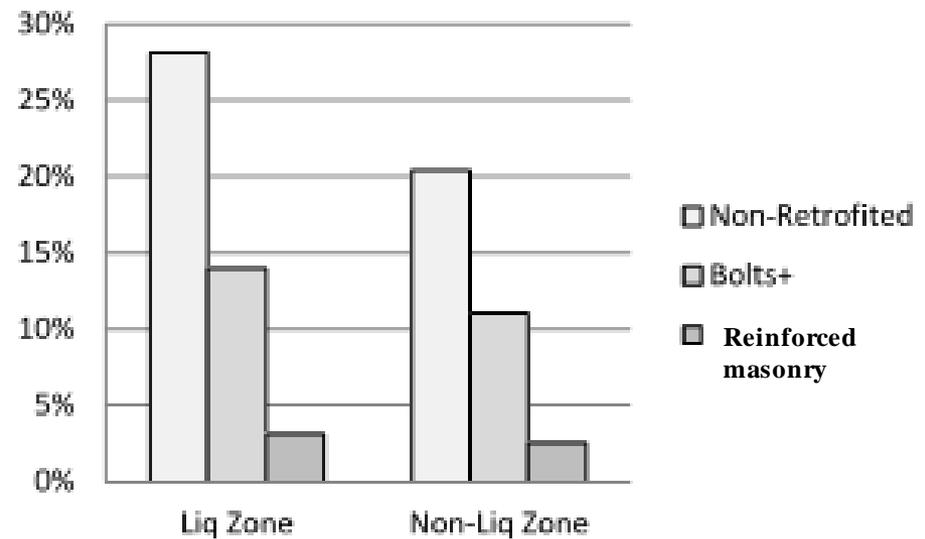


# Seattle Fault 6.7

Building-Plus-Contents Value Damage Ratios by Building Height, Seattle Fault 6.7



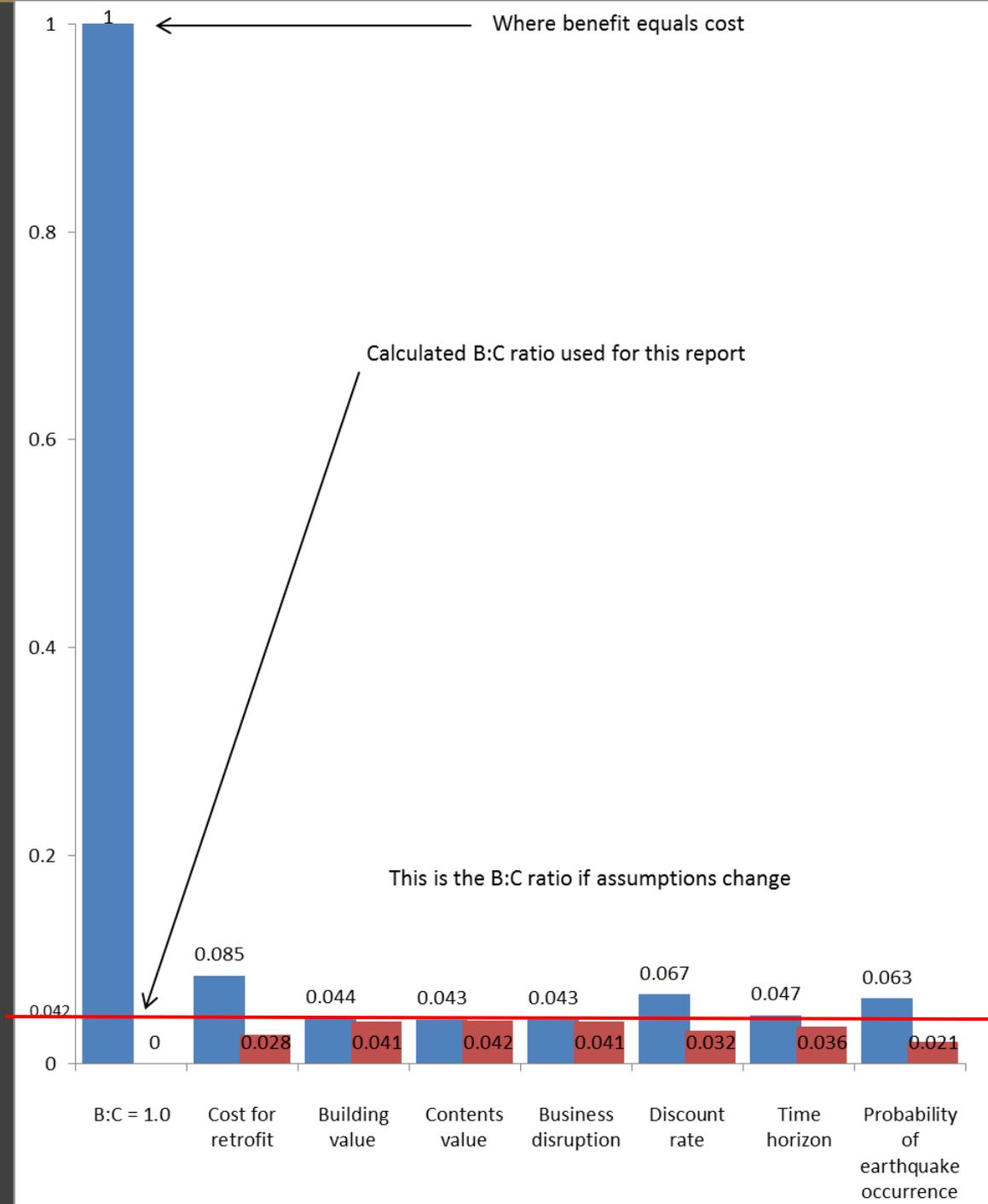
Building-Plus-Contents Value Damage Ratios by Underlying Soil, Seattle Fault 6.7



# Benefit-Cost Ratios, Baseline Assumptions

Real Discount Rate:	<b>7.0%</b>
Benefit Period, yrs:	<b>30</b>

Bolts+	Building & Contents	<u>Cost/SF</u>	<u>Cost (\$m)</u>	<u>Ben/yr (\$m)</u>	<u>PV (\$m)</u>	<u>B:C Ratio</u>
			<b>\$40</b>	\$808.8	\$1.09	\$13.49
	+ Other Economics			\$0.16	\$2.02	<b>0.019</b> <=
	+ Reduced Casualties			\$1.51	\$18.71	<b>0.042</b> <=





LOW SF



HISTORIC DISTRICT



HISTORIC DISTRICT



COMMERCIAL



COMMERCIAL



HISTORIC DISTRICT



COMMERCIAL



HISTORIC DISTRICT



LOW SF



MULTIFAMILY



HISTORIC DISTRICT



MULTIFAMILY



MIXED USE

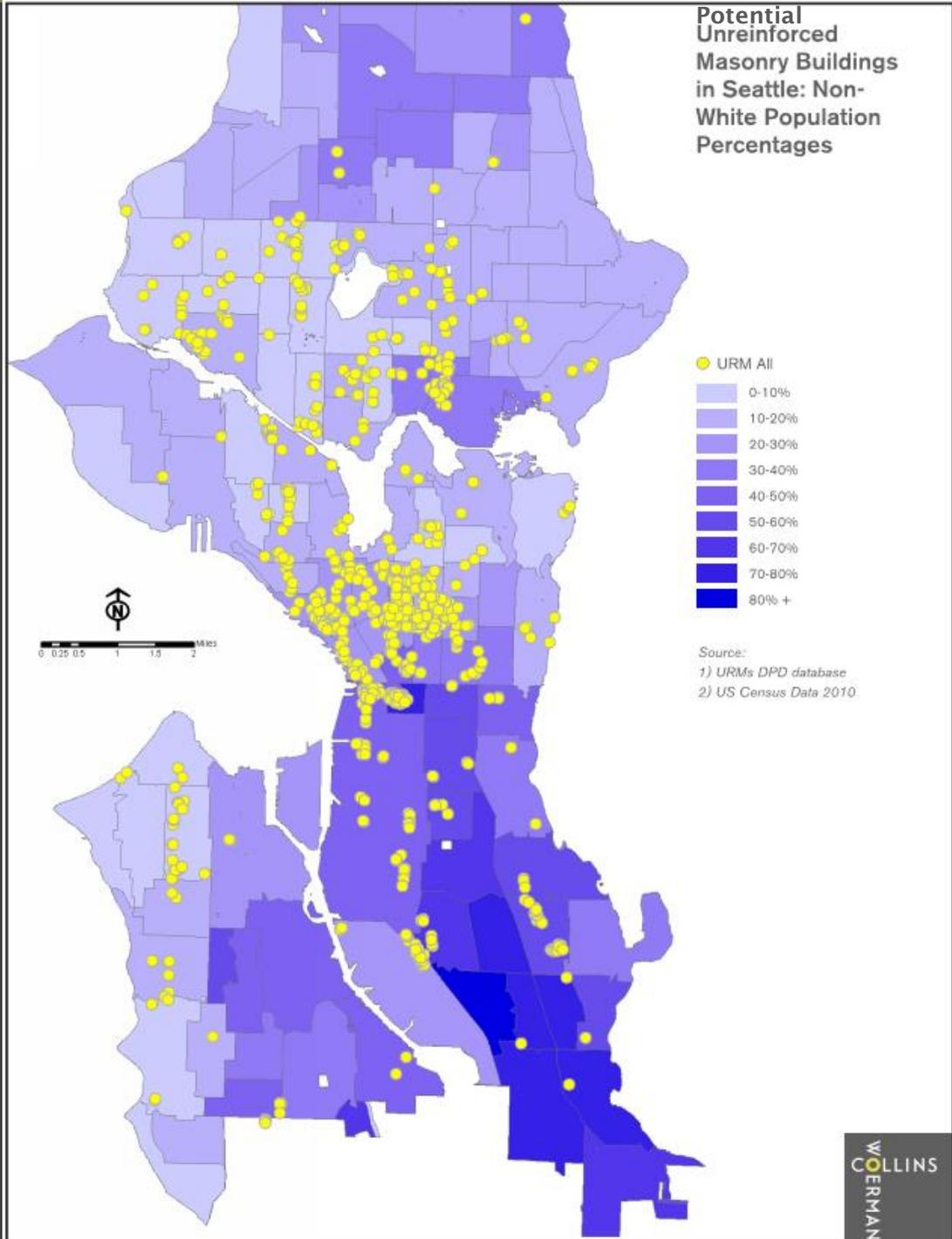


HIGH SF

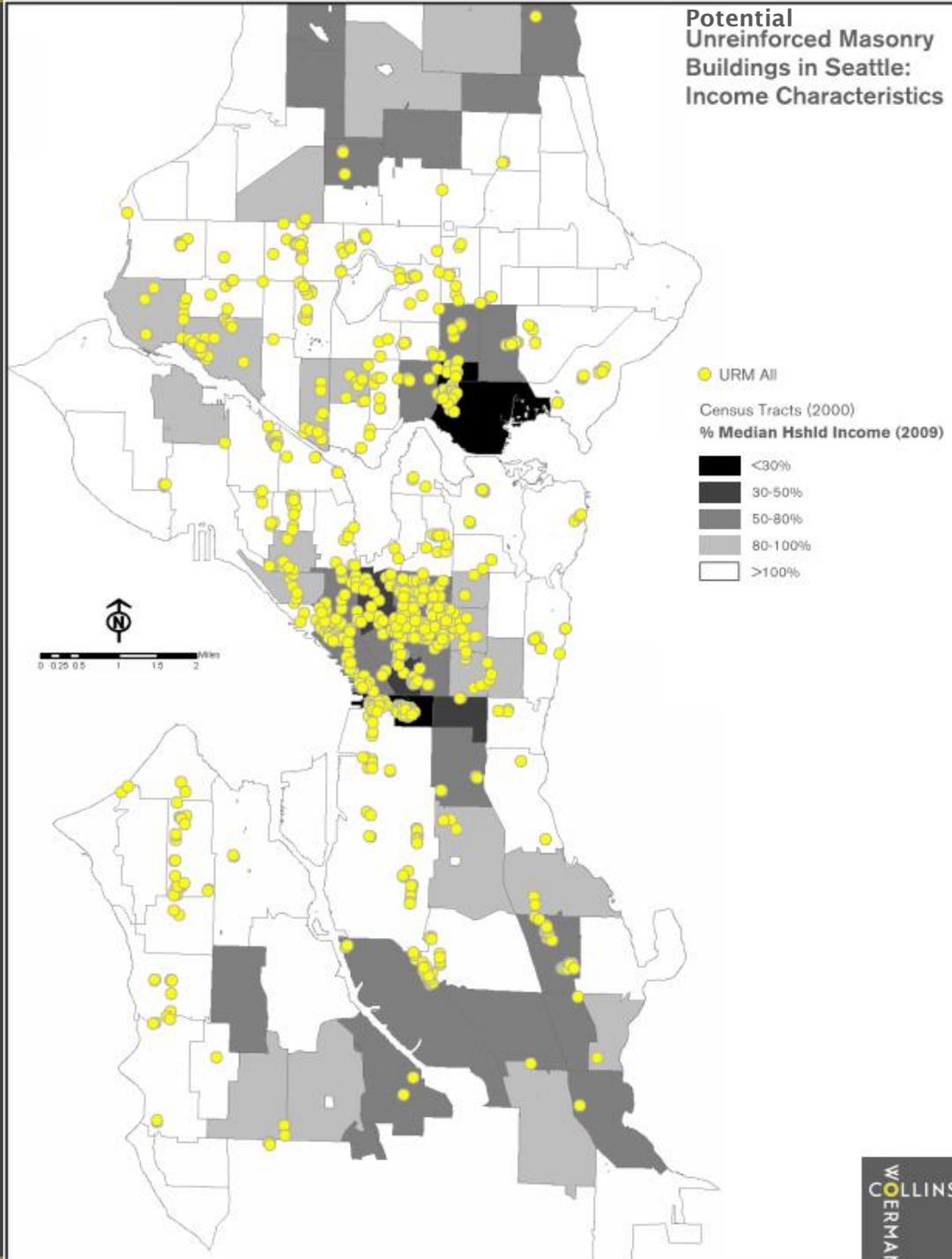


COMMERCIAL

# Potential Unreinforced Masonry Buildings in Seattle: Non-White Population Percentages



# Potential Unreinforced Masonry Buildings in Seattle: Income Characteristics





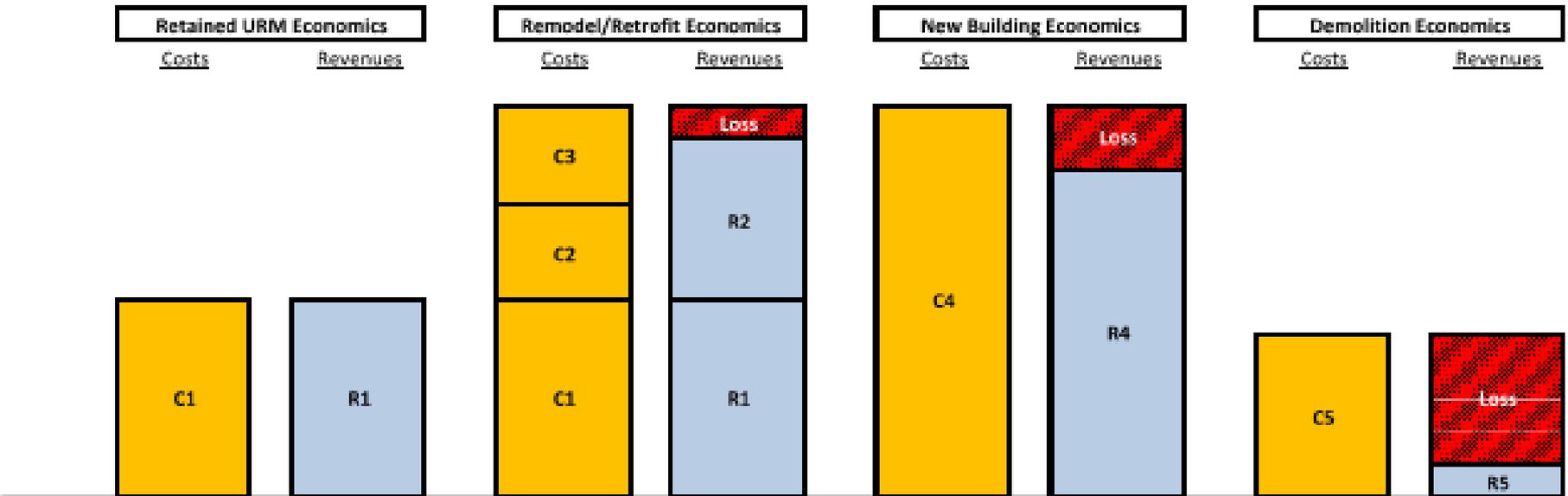
*Photo by Benjamin Vander Steen*

# How might URM building owner respond to mandatory retrofits?

- ▣ Retrofit URM
  - Typical: attractive location
- ▣ Demolish URM and build new building
  - Typical: unexceptional building, attractive location
- ▣ Demolish and leave site vacant
  - Typical: building in poor condition, unexceptional location
- ▣ Defer action and disregard code
  - Typical: all the above especially when difference between URM and second-best option is greatest

# Owner choices: remodels/retrofits

Figure 1. High Potential for Market Recovery of Mandatory Code Cost - URM with Significant Market Opportunities Through Remodel/Retrofit, Less with New Building



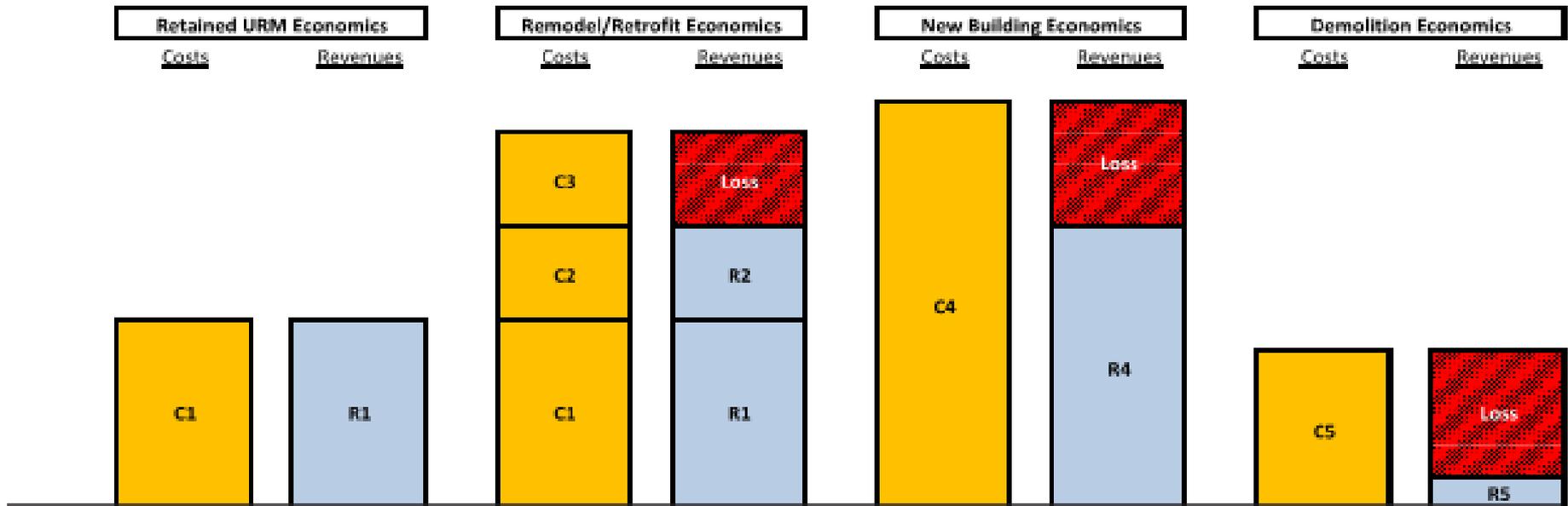
## Net Income:

Owner Option	Rev - Cost	Net Income/Loss
Retain URM	$(R1 - C1)$	\$0 m.
Remodel/Retrofit	$(R1+R2-C1-C2-C3)$	(\$1) m. <= Second best choice
New Building	$(R4 - C4)$	(\$2) m.
Demolish	$(R5 - C5)$	(\$4) m.

Code	Cost (C) or Revenue (R) Component
C1	Cost of existing URM
R1	Lease revenues from existing URM
C2	Cost to seismically retrofit URM
C3	Cost beyond retrofit to perform substantial alterations
R2	Increased lease revenues from substantial alterations
C4	Cost of a new replacement building
R4	Lease revenues from a new replacement building
C5	Investment cost of retaining parcel without building
R5	Revenues from surface use (e.g., parking)

# Owner choices: remodels/retrofits

Figure 2. Low Potential for Market Recovery of Mandatory Code Cost - URM with Little or No Market Opportunities Through Remodel/Retrofit, Less with New Building



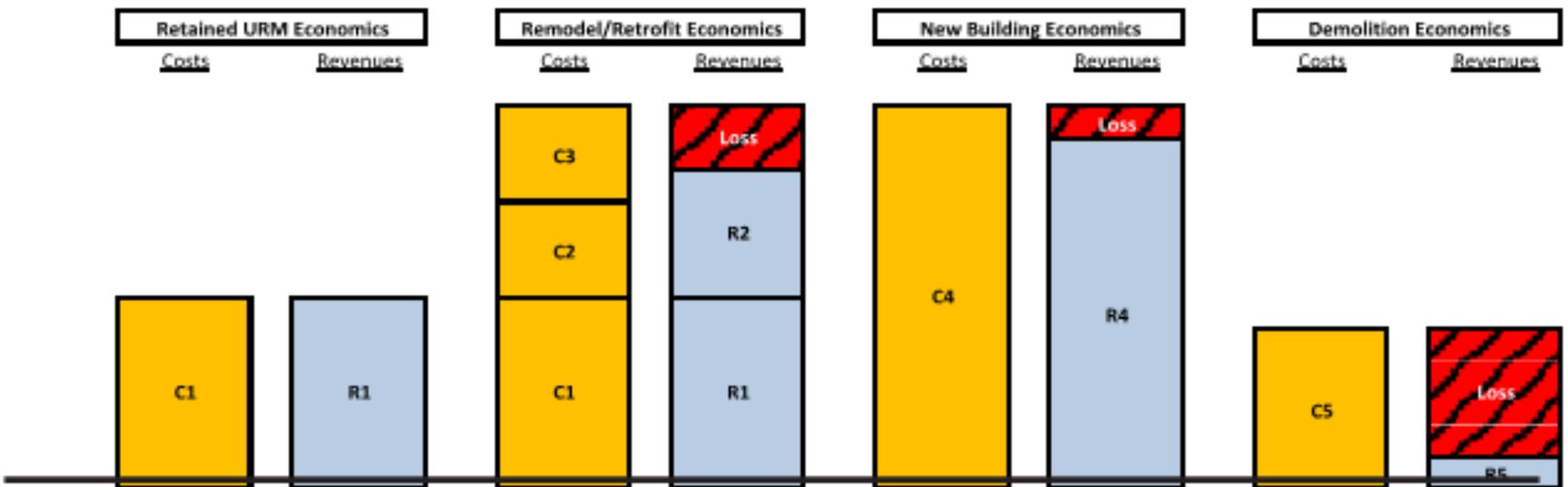
**Net Income:**

Owner Option	Rev - Cost	Net Income/Loss
Retain URM	(R1 - C1)	\$0 m.
Remodel/Retrofit	(R1+R2-C1-C2-C3)	(\$3) m.    <= Second best choice
New Building	(R4 - C4)	(\$4) m.
Demolish	(R5 - C5)	(\$4) m.

Code	Cost (C) or Revenue (R) Component
C1	Cost of existing URM
R1	Lease revenues from existing URM
C2	Cost to seismically retrofit URM
C3	Cost beyond retrofit to perform substantial alterations
R2	Increased lease revenues from substantial alterations
C4	Cost of a new replacement building
R4	Lease revenues from a new replacement building
C5	Investment cost of retaining parcel without building
R5	Revenues from surface use (e.g., parking)

# Owner choices: demolishes and builds new

Figure 3. High Potential for Market Recovery of Mandatory Code Cost - URM with Significant Market Opportunities Through New Building, Less with Remodel/Retrofit



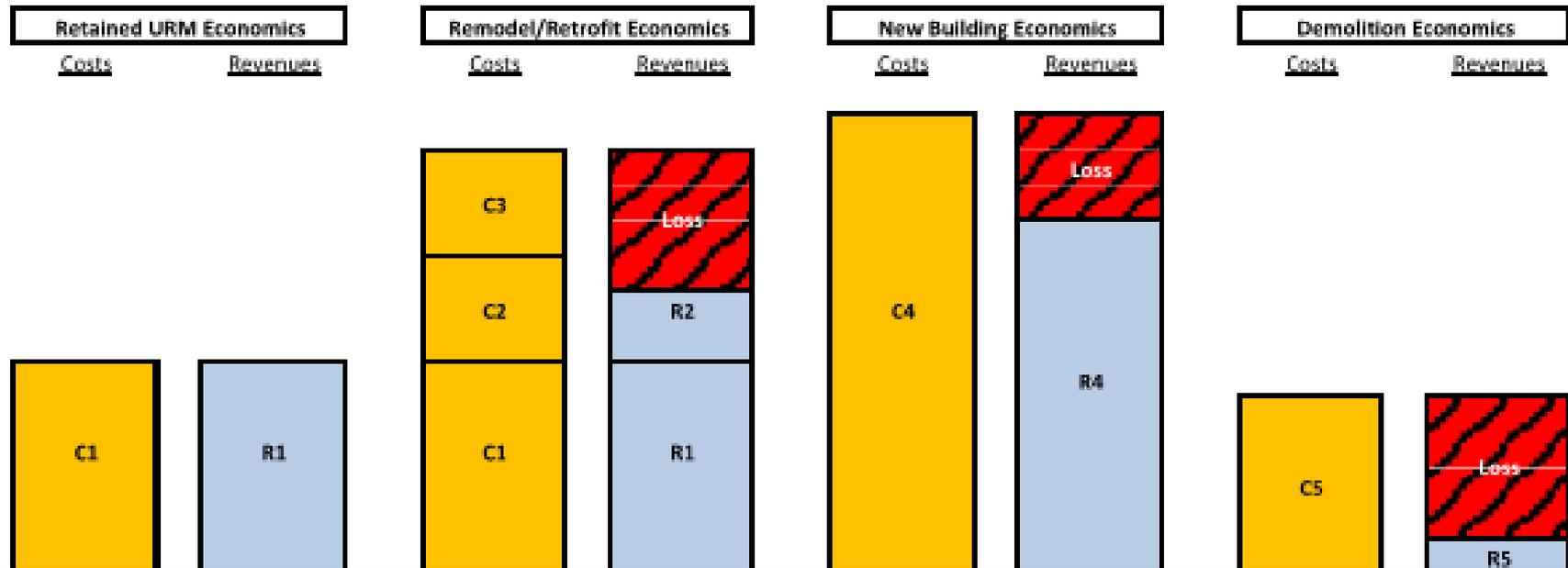
**Net Income:**

Owner Option	Rev - Cost	Net Income/Loss
Retain URM	$(R1 - C1)$	\$0 m.
Remodel/Retrofit	$(R1+R2-C1-C2-C3)$	(\$2) m.
New Building	$(R4 - C4)$	(\$1) m. <= Second best choice
Demolish	$(R5 - C5)$	(\$1) m.

Code	Cost (C) or Revenue (R) Component
C1	Cost of existing URM
R1	Lease revenues from existing URM
C2	Cost to seismically retrofit URM
C3	Cost beyond retrofit to perform substantial alterations
R2	Increased lease revenues from substantial alterations
C4	Cost of a new replacement building
R4	Lease revenues from a new replacement building
C5	Investment cost of retaining parcel without building
R5	Revenues from surface use (e.g., parking)

# Owner choices: demolishes and builds new

Figure 4. Low Potential for Market Recovery of Mandatory Code Cost - URM with Moderate Market Opportunities Through New Construction, Less with Remodel/Retrofit



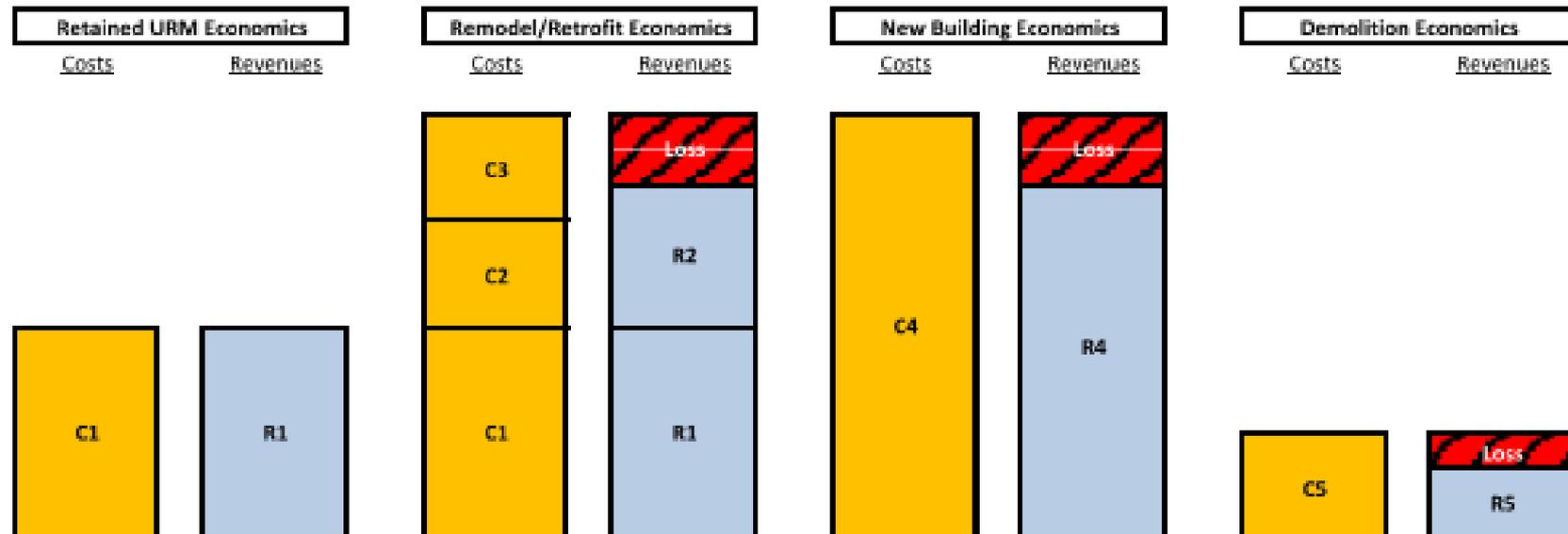
**Net Income:**

Owner Option	Rev - Cost	Net Income/Loss
Retain URM	$(R1 - C1)$	\$0 m.
Remodel/Retrofit	$(R1+R2-C1-C2-C3)$	(\$4) m.
New Building	$(R4 - C4)$	(\$3) m. ← Second best choice
Demolish	$(R5 - C5)$	(\$4) m.

Code	Cost [C] or Revenue [R] Component
C1	Cost of existing URM
R1	Lease revenues from existing URM
C2	Cost to seismically retrofit URM
C3	Cost beyond retrofit to perform substantial alterations
R2	Increased lease revenues from substantial alterations
C4	Cost of a new replacement building
R4	Lease revenues from a new replacement building
C5	Investment cost of retaining parcel without building
R5	Revenues from surface use (e.g., parking)

# Owner choices: demolish and leave vacant

Figure 5. High Potential for Market Recovery of Mandatory Code Cost - URM on High Traffic Site but Limited Opportunities Through Retrofit or New Building



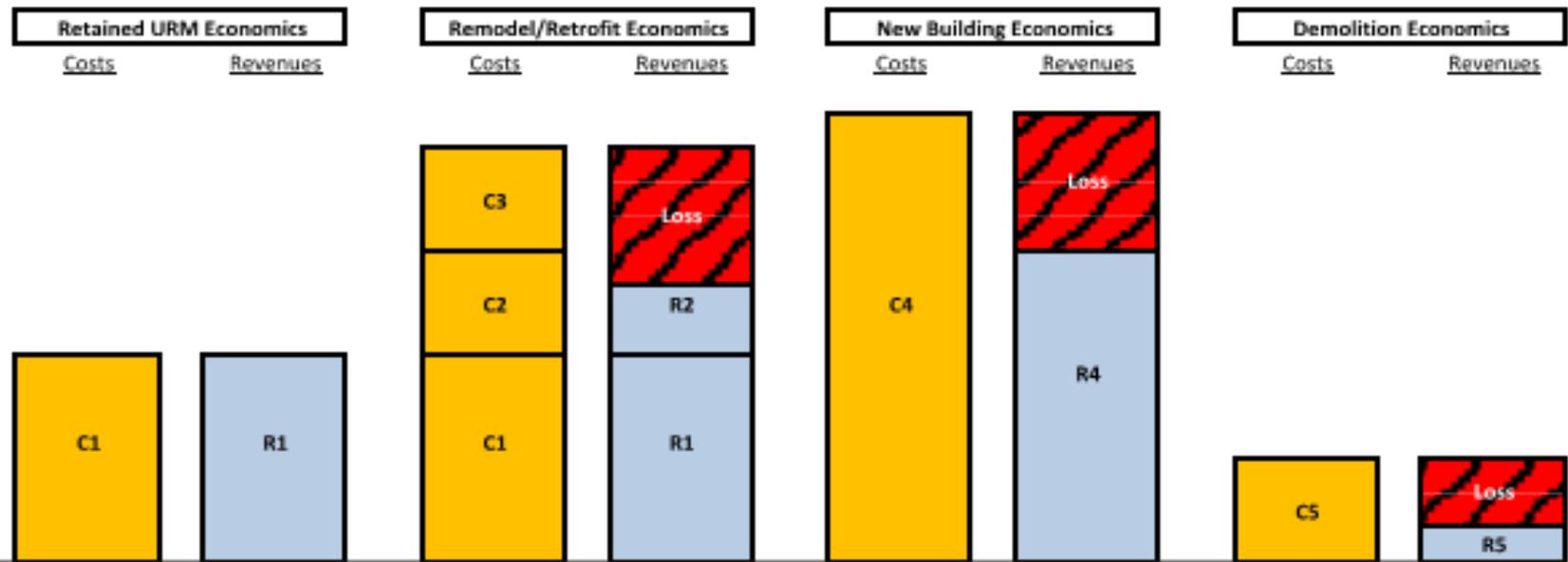
**Net Income:**

Owner Option	Rev - Cost	Net Income/Loss
Retain URM	$(R1 - C1)$	\$0 m.
Remodel/Retrofit	$(R1+R2-C1-C2-C3)$	(\$2) m.
New Building	$(R4 - C4)$	(\$2) m.
Demolish	$(R5 - C5)$	(\$1) m. ← Second best choice

Code	Cost (C) or Revenue (R) Component
C1	Cost of existing URM
R1	Lease revenues from existing URM
C2	Cost to seismically retrofit URM
C3	Cost beyond retrofit to perform substantial alterations
R2	Increased lease revenues from substantial alterations
C4	Cost of a new replacement building
R4	Lease revenues from a new replacement building
C5	Investment cost of retaining parcel without building
R5	Revenues from surface use (e.g., parking)

# Owner choices: demolish and leave vacant

Figure 6. Low Potential for Market Recovery of Mandatory Code Cost - Tear-Down Less Costly than Either Retrofit or New Building



**Net Income:**

Owner Option	Rev - Cost	Net Income/Loss
Retain URM	$(R1 - C1)$	\$0 m.
Remodel/Retrofit	$(R1+R2-C1-C2-C3)$	(\$4) m.
New Building	$(R4 - C4)$	(\$4) m.
Demolish	$(R5 - C5)$	(\$2) m. <= Second best choice

Code	Cost (C) or Revenue (R) Component
C1	Cost of existing URM
R1	Lease revenues from existing URM
C2	Cost to seismically retrofit URM
C3	Cost beyond retrofit to perform substantial alterations
R2	Increased lease revenues from substantial alterations
C4	Cost of a new replacement building
R4	Lease revenues from a new replacement building
C5	Investment cost of retaining parcel without building
R5	Revenues from surface use (e.g., parking)

# Financing options

- ▣ Small palette because of competition from other uses and state constitutional limits

# Levies

Type of Levy	Extent of Levy	Desirable or Appropriate for URM?	Legal?
<b>Regular property tax levy (e.g., to secure general obligation bonds)</b>	City-Wide	No - Regular levies are limited to certain public purposes, which do not presently include URM retrofits for private buildings; also subject to overall limits that cannot be exceeded by statute.	No - Probably not feasible without a change to state law
<b>Excess / Special Levy</b>	City-Wide	No - requires a supermajority for approval; subject to strict time limits	Not determined
<b>Benefit assessment district</b>	Only within the district (i.e., those receiving the benefit)	No - presently limited to certain types of taxing districts only. URM's not included.	No - Use of benefit assessment districts is limited to certain types of taxing districts
<b>Local improvement district</b>	Specified by the boundaries of the district	<b>Possibly</b> - Community Renewal Law authorizes activities to remedy areas such as those that are "injurious to public safety" though a community renewal district  If confined to just URM owners, there would be no incremental incentive value	<b>Not determined</b> - It is unclear whether a levy could be applied to the City as a whole, or only to the owners of URM buildings
<b>Earmarked funds</b>	The Seattle City Council can earmark general funds for governmental purposes	Possibly - City Council needs to determine that URM retrofit funding is a priority over other City priorities that rely on general funds	Yes - presumably legal as long as state constitutional limitations are honored.
<b>Tax increment financing</b>	N/A	No - Not legal for this purpose	No

# Possible incentives

- ▣ Transfer of Development Rights(TDRs)
- ▣ Community Development Block Grants
- ▣ Historic and Rehabilitation Federal Income Tax Credits
- ▣ Property Tax Special Valuation for Historic Properties
- ▣ Multi-family Tax Exemption
- ▣ Seismic Retrofit Property Tax Exemption
- ▣ Transferable FAR bonus
- ▣ “On-Site” +! FAR bonus
- ▣ Parking requirement waivers
- ▣ Expanded allowable uses
- ▣ Early adopted Incentives

# Possible URM policy options

- ▣ To be determined