

# **Building Loss Estimation Methods**

## **A Comparison of Methods and Recommendations for the Future**

**Dustin Cook, MS**

**Katherine Fitzgerald, MS**

**Travis Chrupalo, MS**

**Dr. Curt Haselton, PE, Ph.D**

ATC-SEI: 2<sup>nd</sup> Conference on Improving the Seismic Performance of  
Existing Buildings and Other Structures

San Francisco, CA | December 10-12, 2015

## ■ Program

- Seismic Loss Assessment Methodologies
- Buildings Assessed In This Study
- Results
- Looking Forward

- Loss Methodologies and Tool
  - T-Z Method
  - ATC-13
  - HAZUS
  - SeismiCat
  - ST-Risk
  - FEMA P-58

## ■ Loss Methodologies and Tool

- **T-Z Method**

**General**

- ATC-13

- HAZUS

- SeismiCat

- **ST-Risk**

- **FEMA P-58**

**Building Specific**

- TZ Method (Thiel Zsutty Method)
  - Published in 1986
  - General and intended for wide variety of building types and sites. Not building specific. Judgment needed for modeling parameters.

$$d = 0.554 * (b * m * s)PGA^{0.630}$$

- $d$  = Damage ratio
- $PGA$  = Ground acceleration
- $b$  = Building vulnerability coefficient
- $m$  = Spectral response coefficient
- $s$  = Soil coefficient

## ■ ST Risk

- Proprietary Risk Assessment Tool
- Developed by Risk Engineering Incorporated and Degenkolb Engineers
- Develops damage curves by correlating ground motion hazard with economic loss using historical loss data, organized engineering reconnaissance information, and instrumental ground shaking measurements.
- Uses either Degenkolb or HAZUS damage curves.
- Uses building specific and site specific input to modify damageability curves based on expected trends.
- Pseudo building specific with judgement based parameters.  
(Scale FEMA 310 parameters on a scale of 1 to 10)

- P-58 is a performance prediction methodology (10 years in the making, \$12M budget, some further development ongoing)
- P-58 is tailored for building-specific analysis (vs. other methods for building classes)
- FEMA P-58 output results:
  - Repair costs
  - Repair time (with REDI extensions) & red tagging
  - Fatalities & injuries



## Seismic Performance Assessment of Buildings

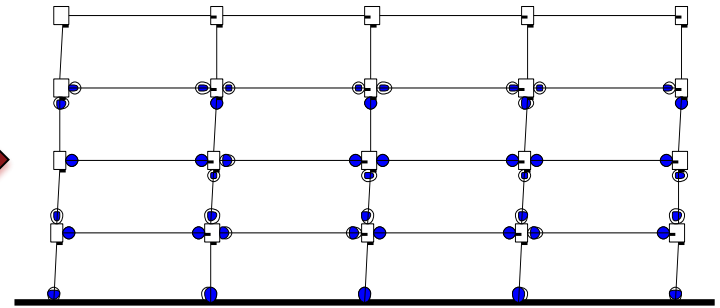
Volume 1 – Methodology

FEMA P-58-1 / September 2012

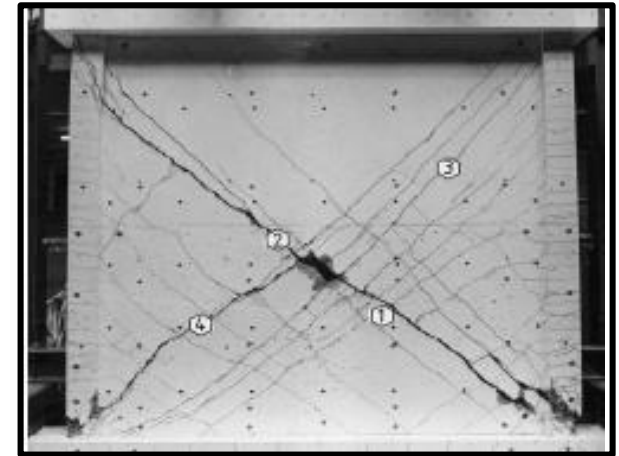




Ground Motion Hazard



Structural Response



Component Damage



Casualties



Repair Time



Economic Loss



## ■ Building Models

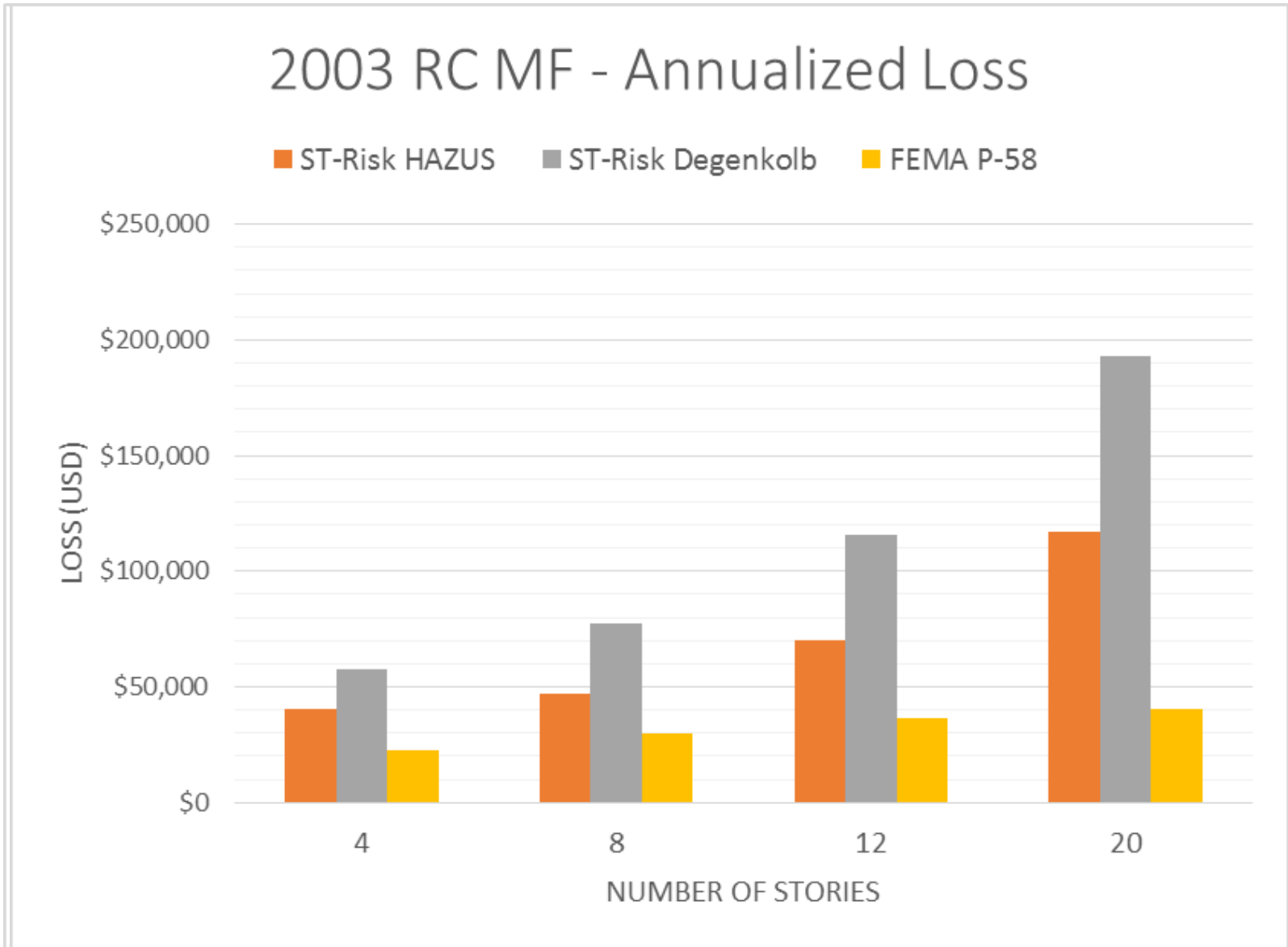
- Based on Archetype RC Frame models developed by Dr. Haselton
- Two Basic Building Models
  - 2003 Reinforced Concrete Moment Frame Office Building
  - 1967 Reinforced Concrete Moment Frame Office Building

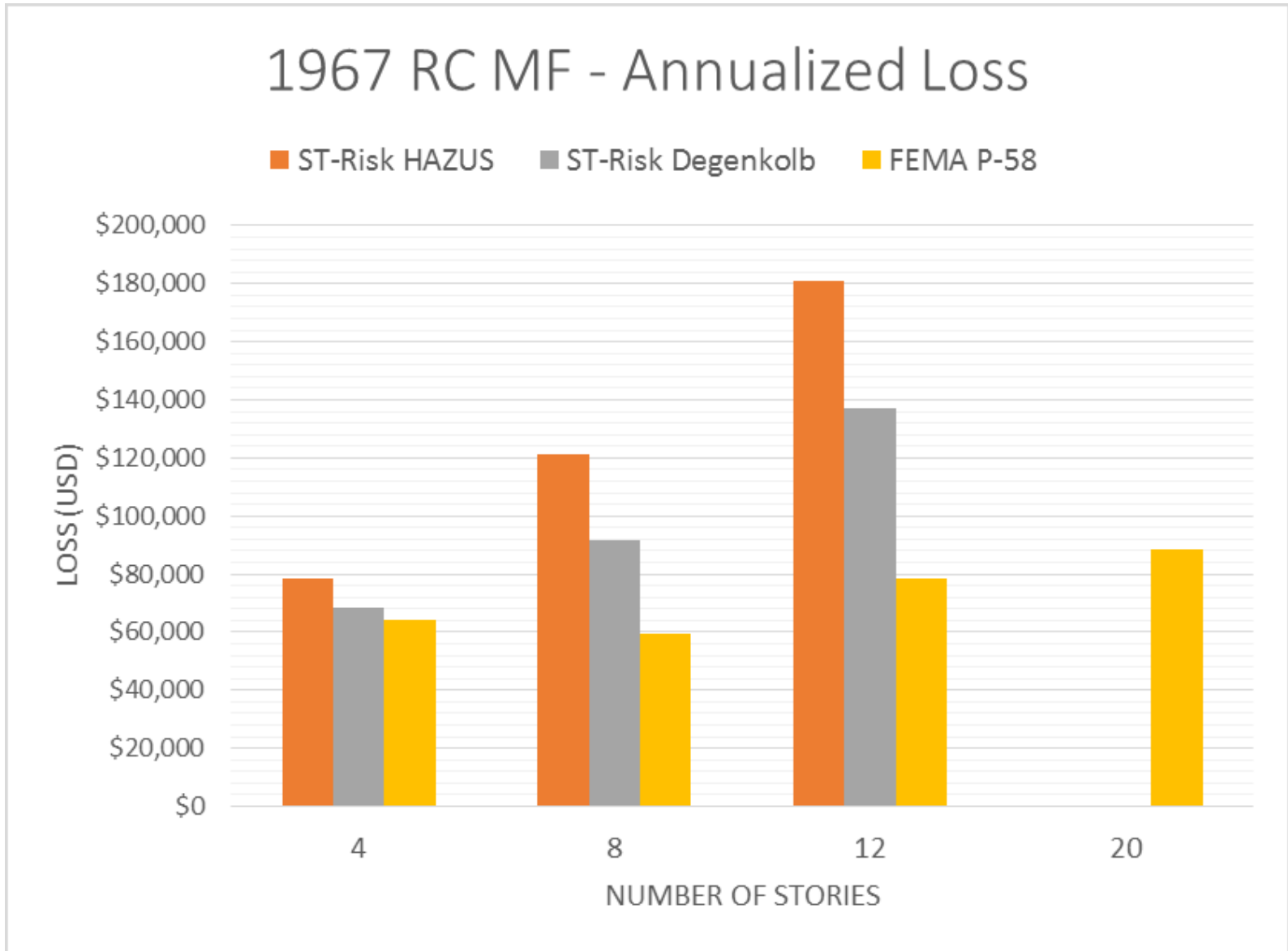
# of Stories	Building Footprint	Bay Width (ft)	Typical Story Height (ft)	$T_{HAZUS}$	Estimated Building Value
4	120' x 180'	30	13	0.62	\$21,600,000
8	120' x 120'	20	13	1.16	\$28,800,000
12	120' x 120'	20	13	1.67	\$43,200,000
20	120' x 120'	20	13	2.3	\$72,000,000

## ■ Site Properties

- 2801 South Eastern Ave, Commerce CA, 90040
- SDC: D
- Site Class: D

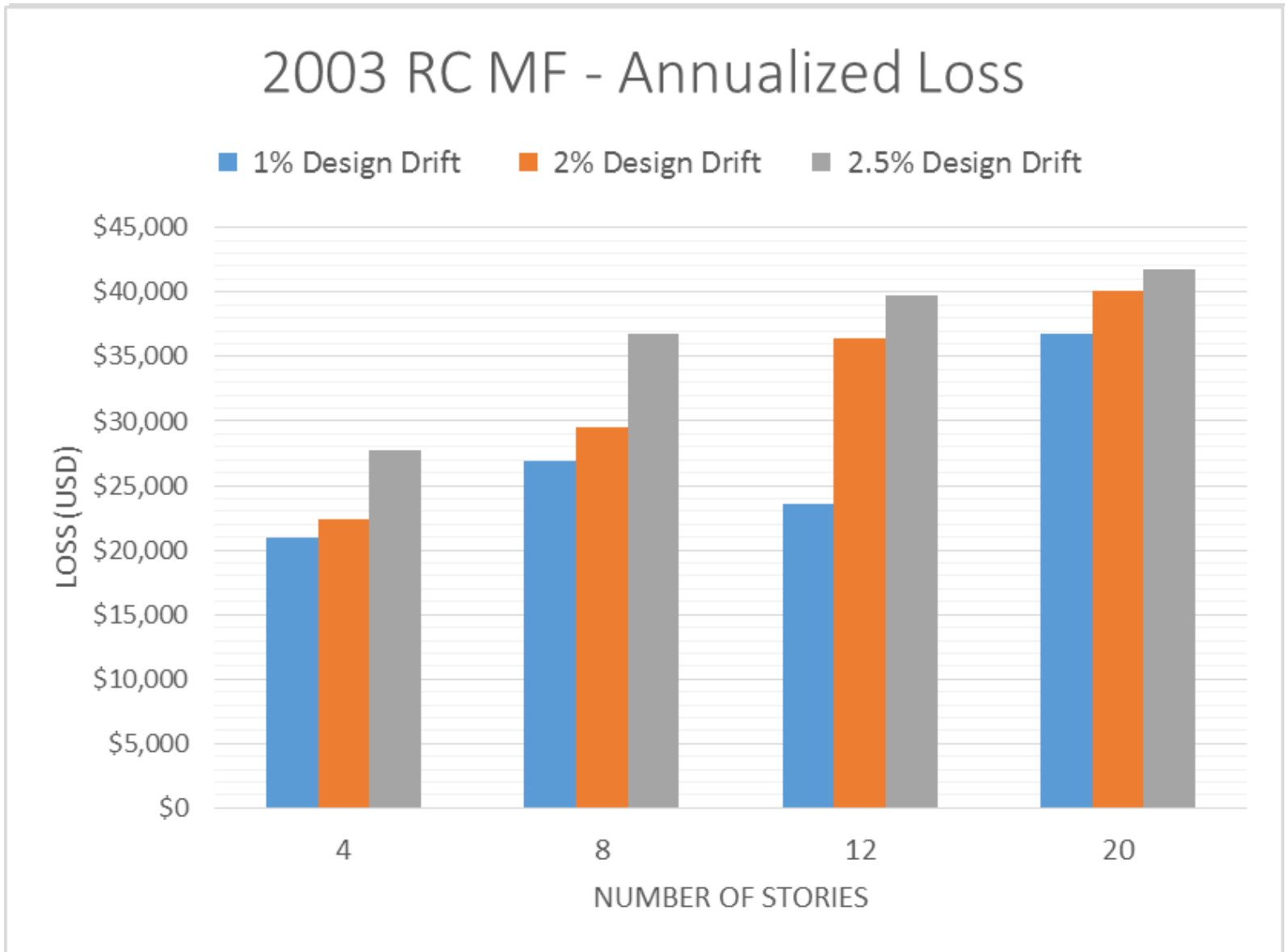


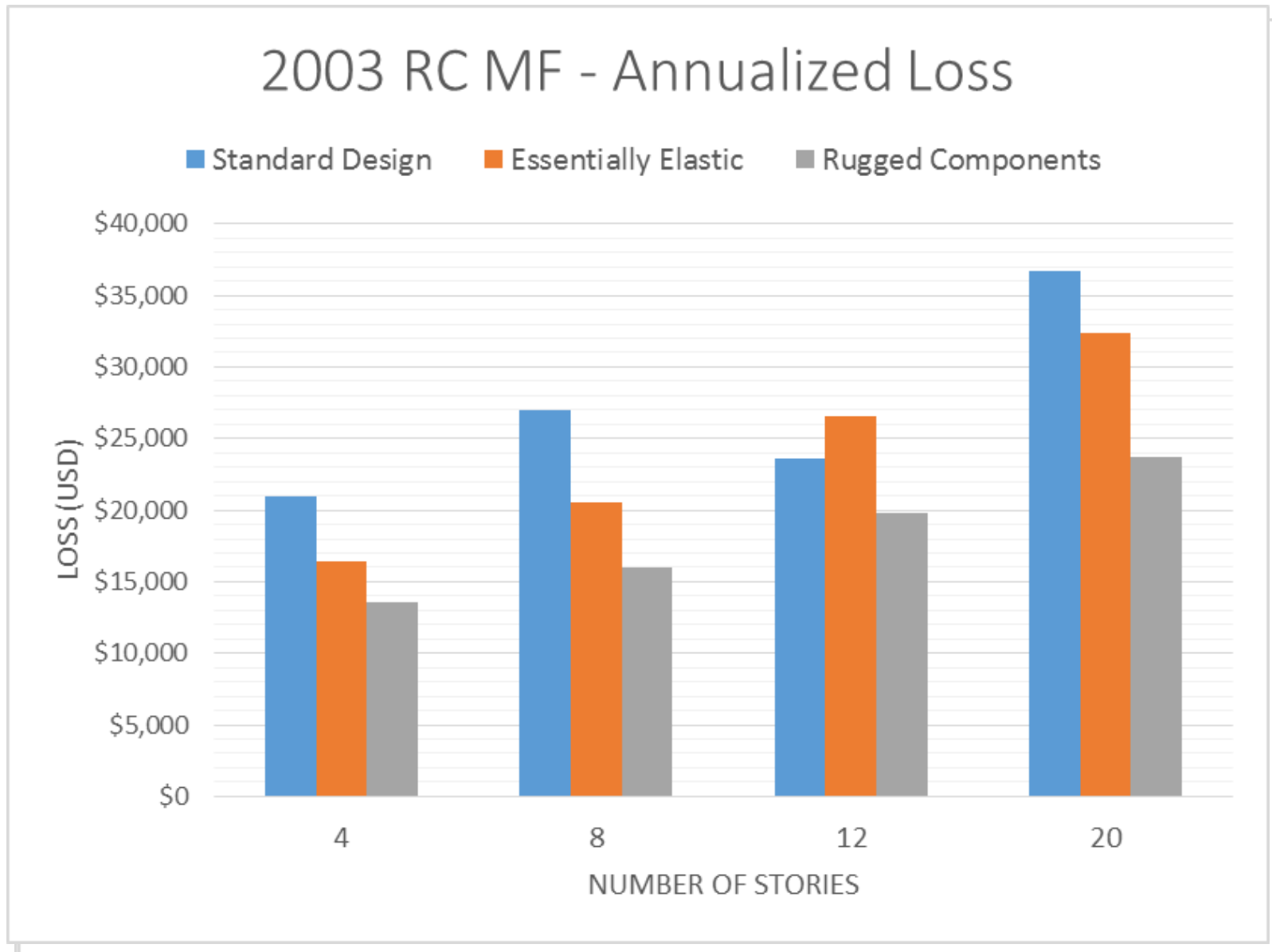




- Design Variability
  - Step 1: Design Drift 1%, 2%, 2.5%
  - Step 2: Essentially Elastic
  - Step 3: Isolated and Rugged Partition Walls and Mechanical and Electrical Components







## ■ Looking to the Future

- P-58 provides generally comparable loss predictions to that of other methods, especially at the 10% in 50 year event.
- The framework of P-58 is fundamentally different than previous loss assessment methodologies, therefore they are difficult to compare.
- Open new doors for design procedure.
- Building specific output needs building specific input



- Thank you for your time.
- Please contact me if you would like more information.
- Contact Information:
  - Dustin Cook, MS
  - Direct: (530) 521-1331
  - E-mail: [dustin@hbrisk.com](mailto:dustin@hbrisk.com)