Building Loss Estimation Methods

A Comparison of Methods and Recommendations for the Future

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Overview

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

Loss Methodologies and Tools

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

Loss Methodologies and Tools

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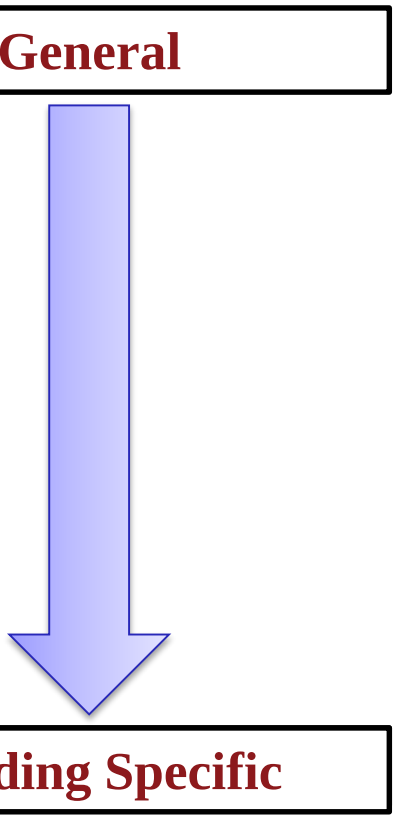
  - **T-Z Method**
  - ATC-13
  - HAZUS
  - SeismiCat
  - **ST-Risk**
  - **FEMA P-58**



Loss Methodologies and Tools

- 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.

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

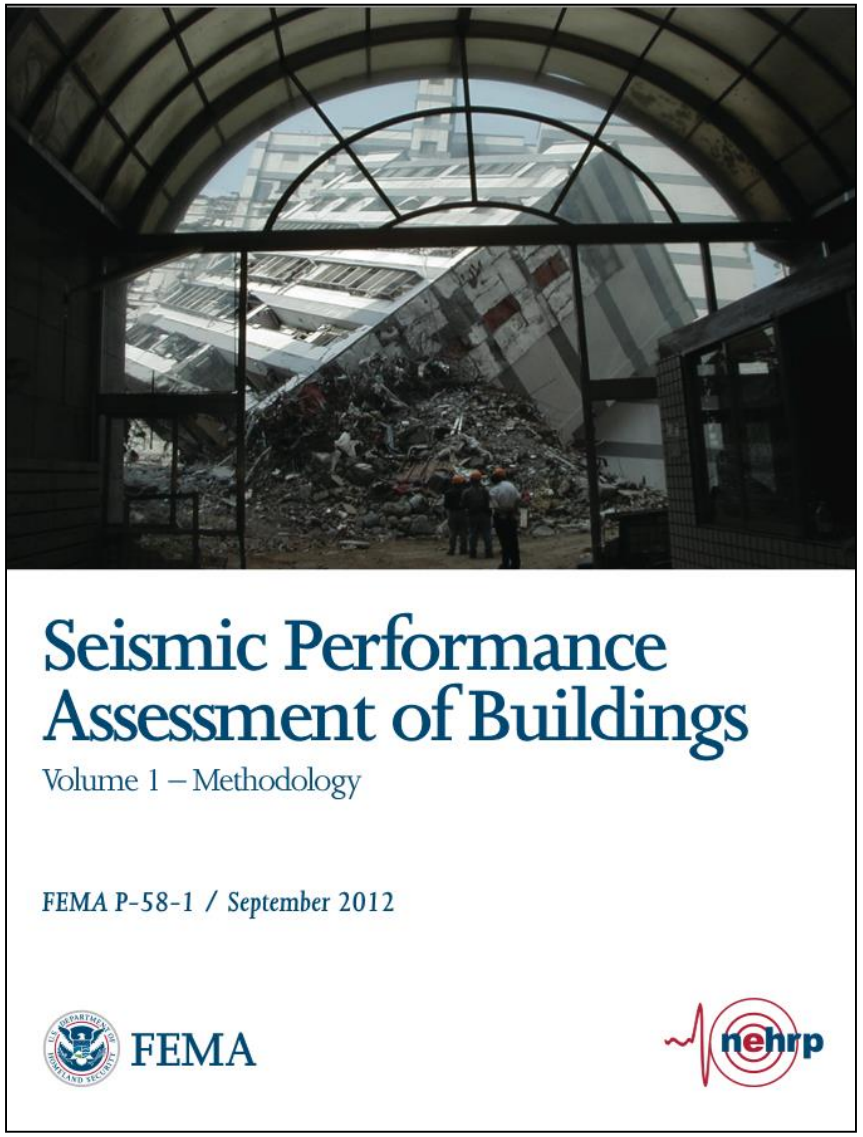
  - d = Damage ratio
  - PGA = Ground acceleration
  - b = Building vulnerability coefficient
  - m = Spectral response coefficient
  - s = Soil coefficient

Loss Methodologies and Tools

- 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)

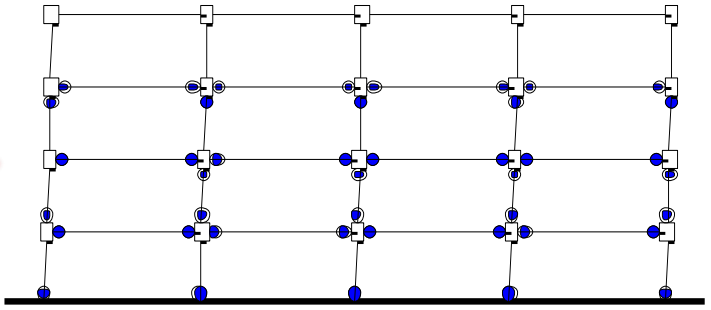
Loss Methodologies and Tools

- 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

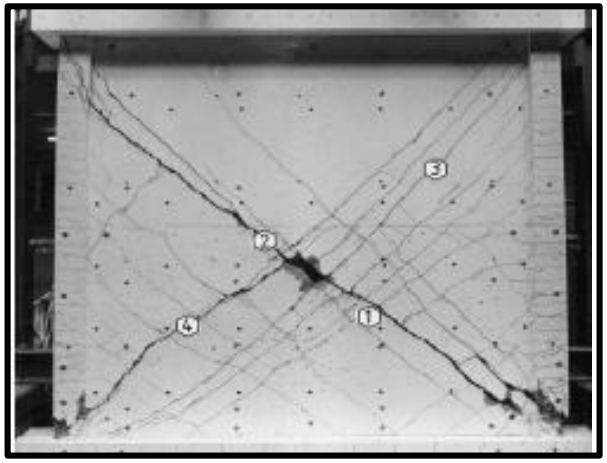


Loss Methodologies and Tools

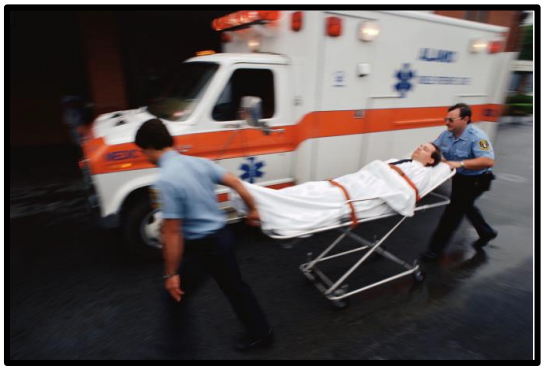
Ground Motion Hazard



Structural Response



Component Damage



Casualties

Repair Time

Economic Loss

[Source: Some graphics from presentation by Ron O. Hamburger on FEMA P-58.]

Building Overview

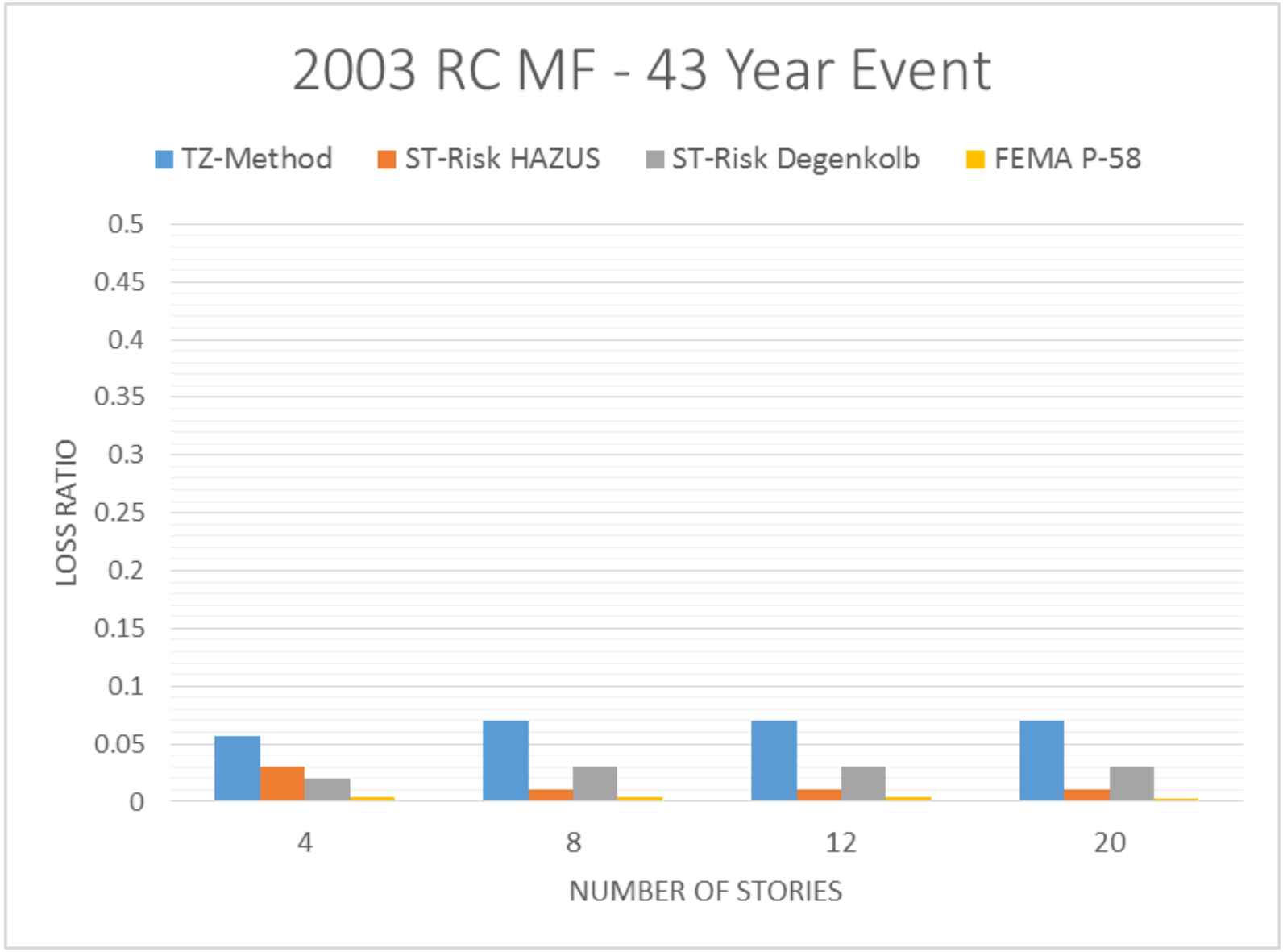
- Building Models
  - Based on Archetype RC Frame models developed by Dr. Haselton
  - Two Basic Building Models
    - 2003 Reinforced Concrete Moment Frame Office Building
    - 1967 Reinforced Concrete Moment Frame Office Building

# 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

Building Overview

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

Results



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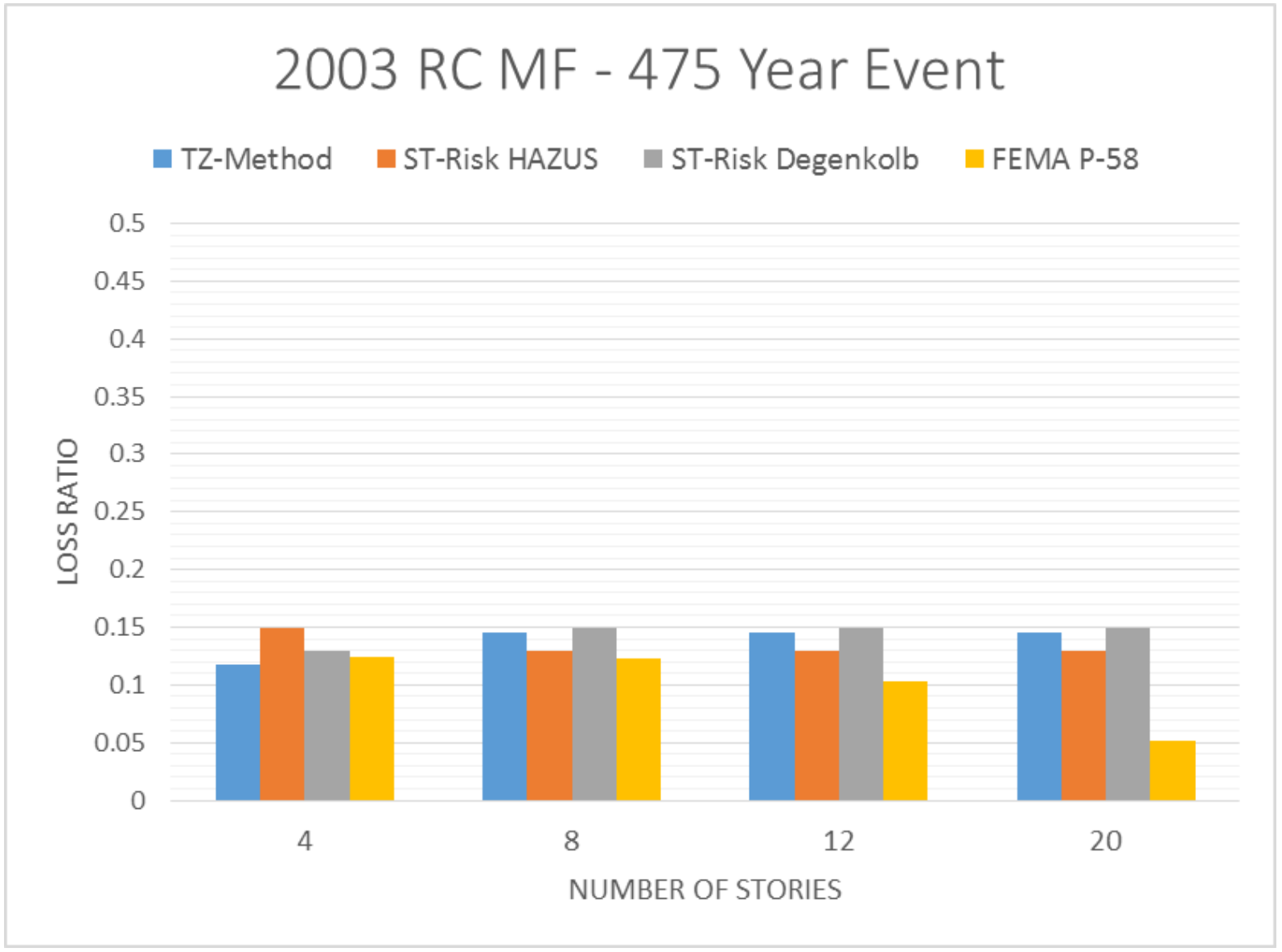

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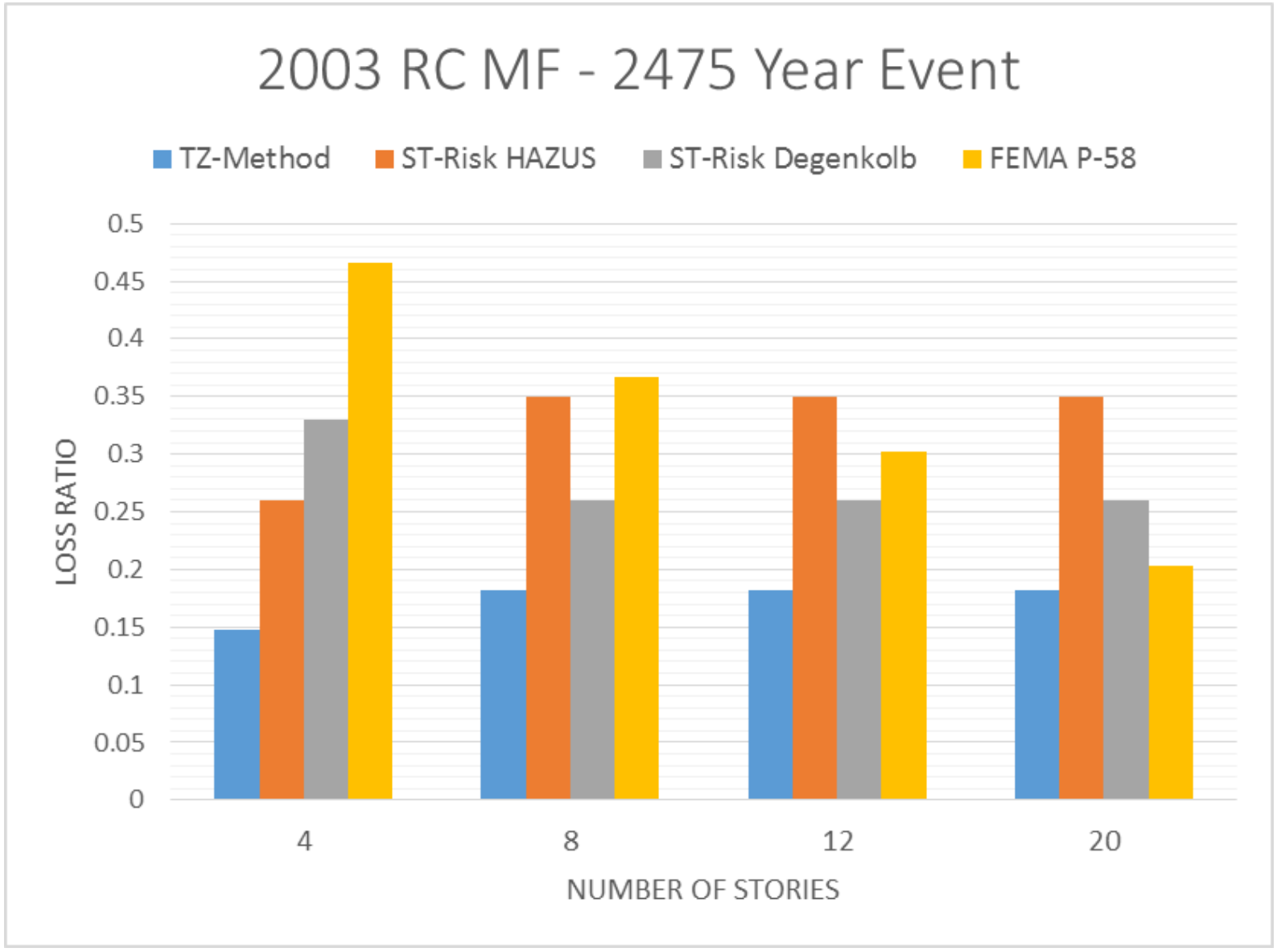

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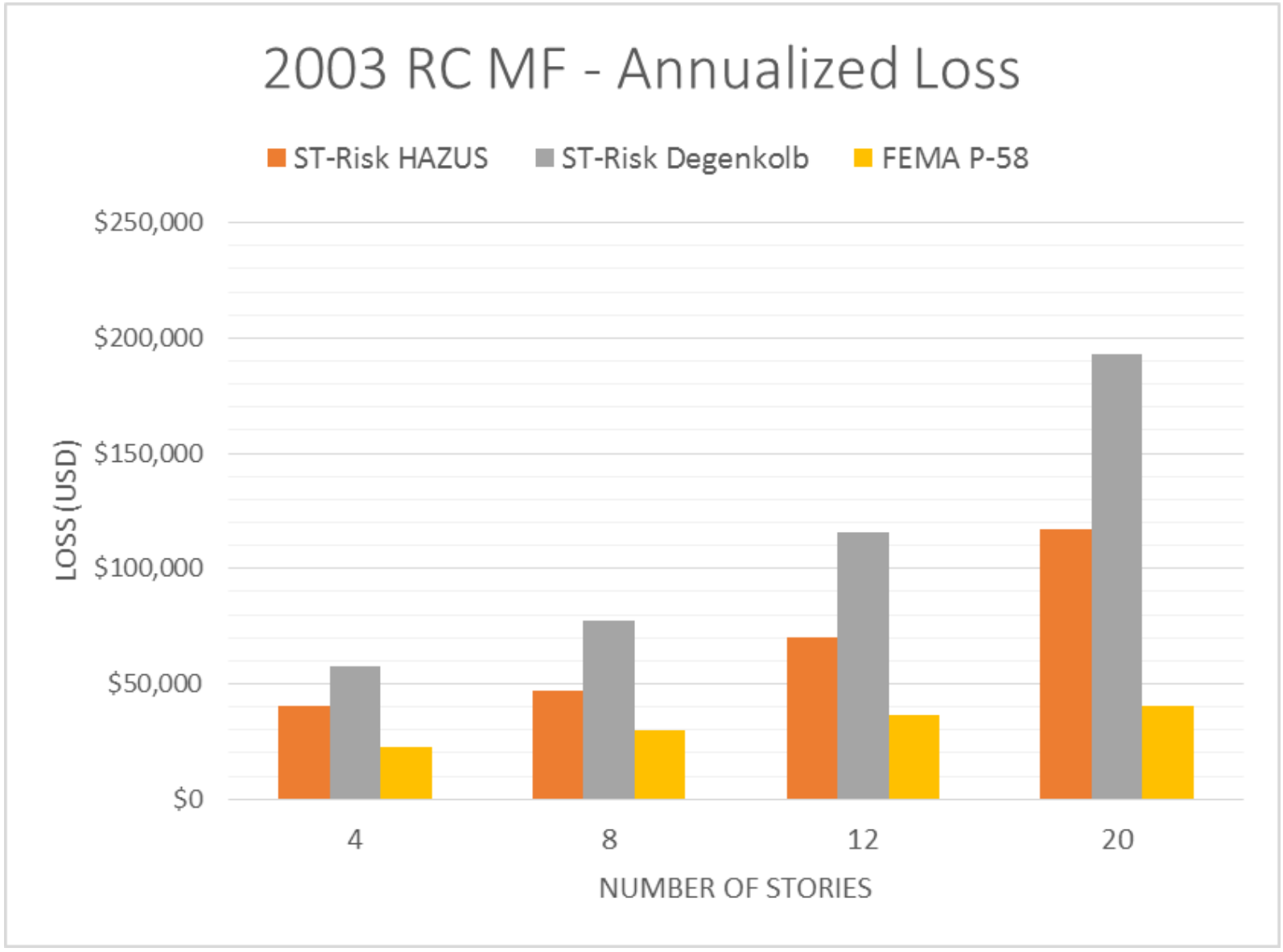

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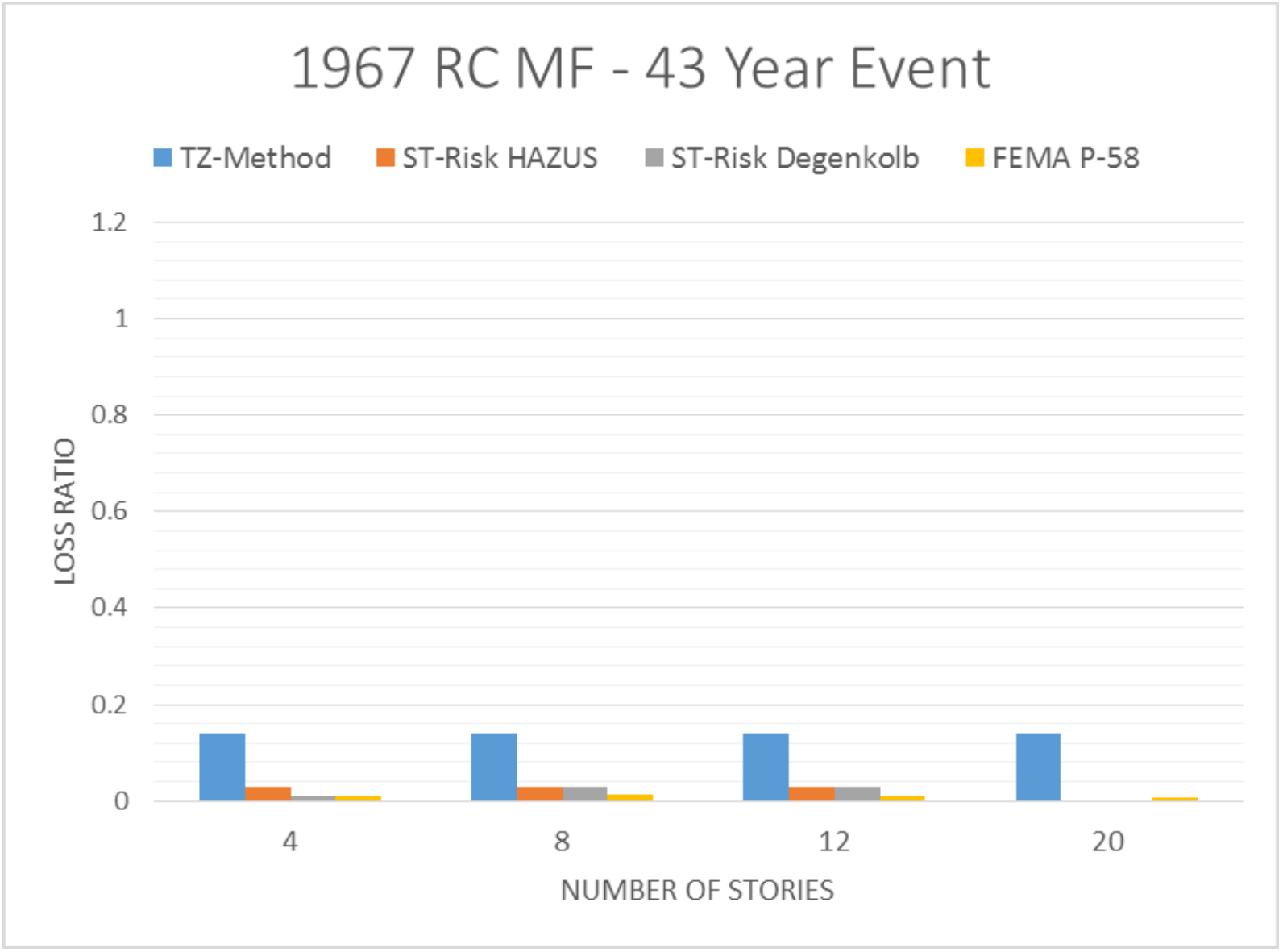

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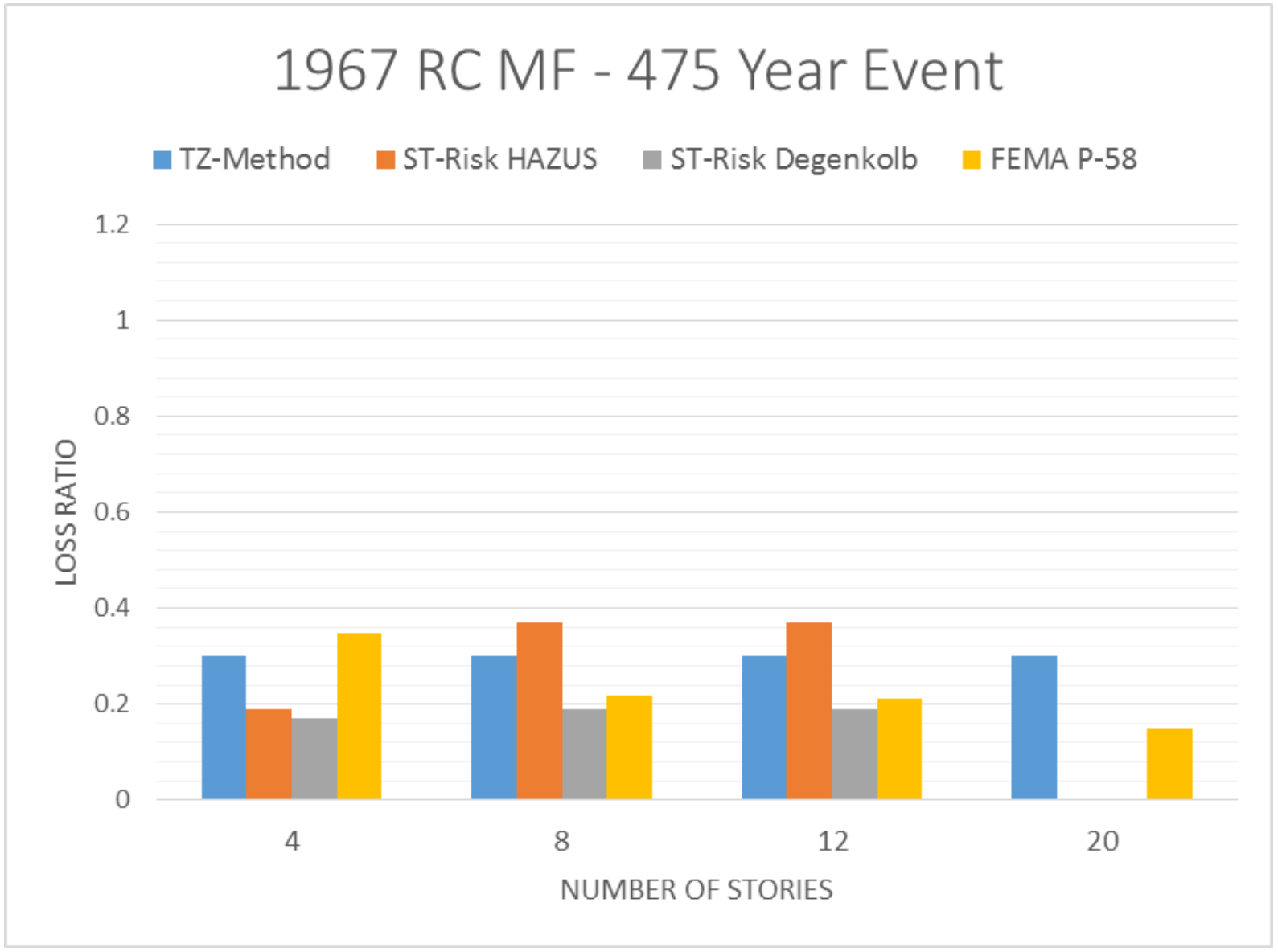

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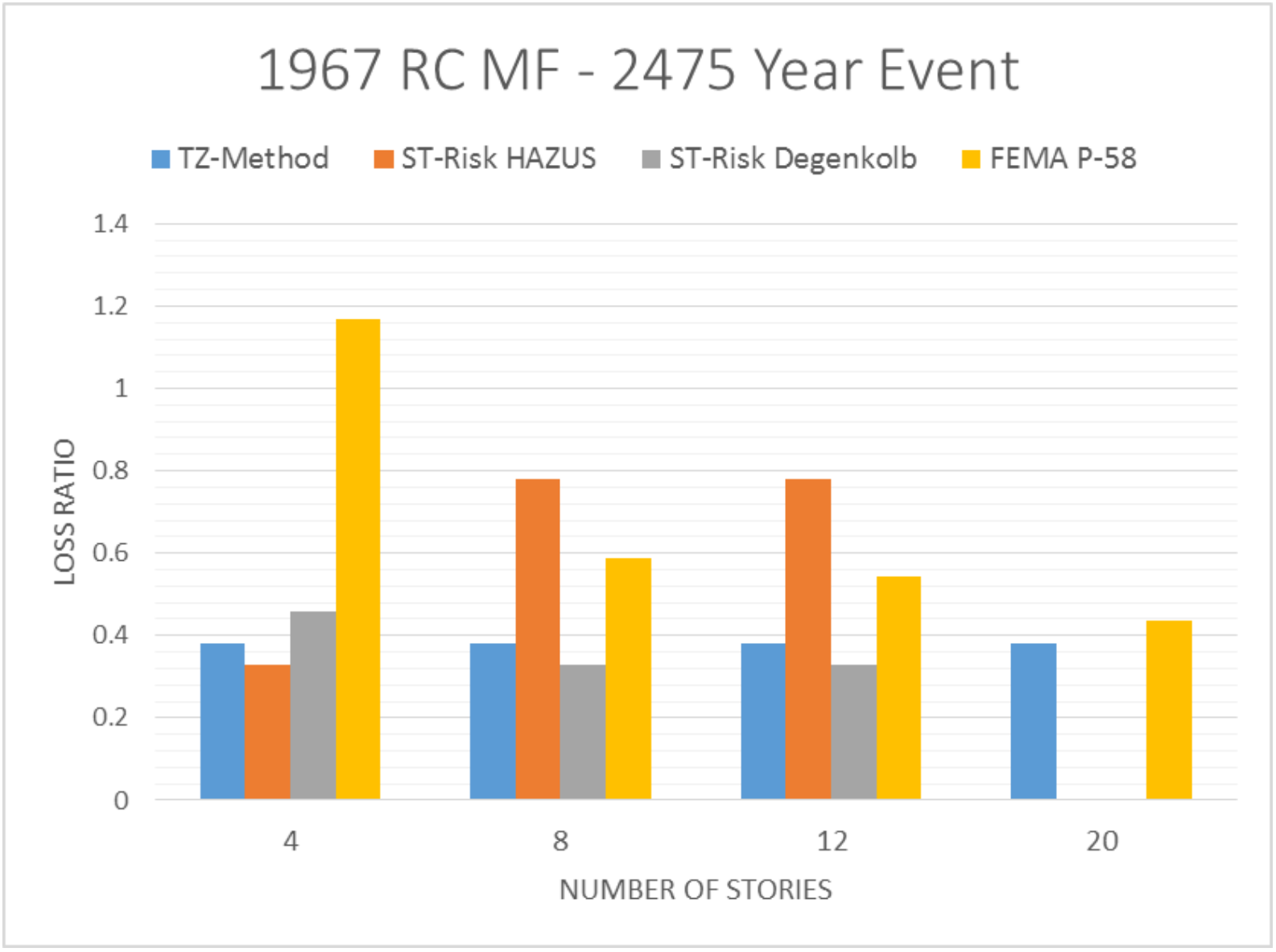

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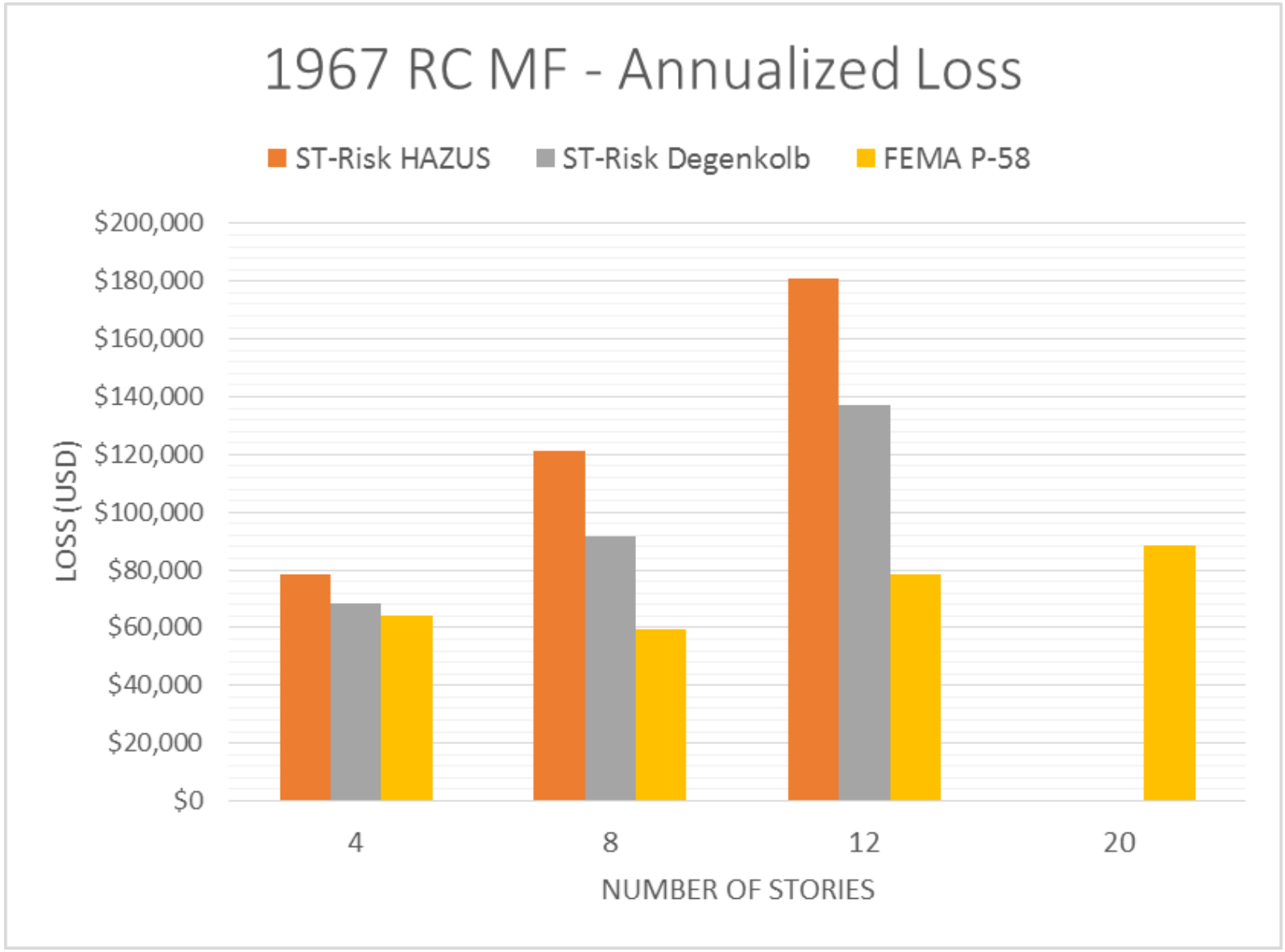
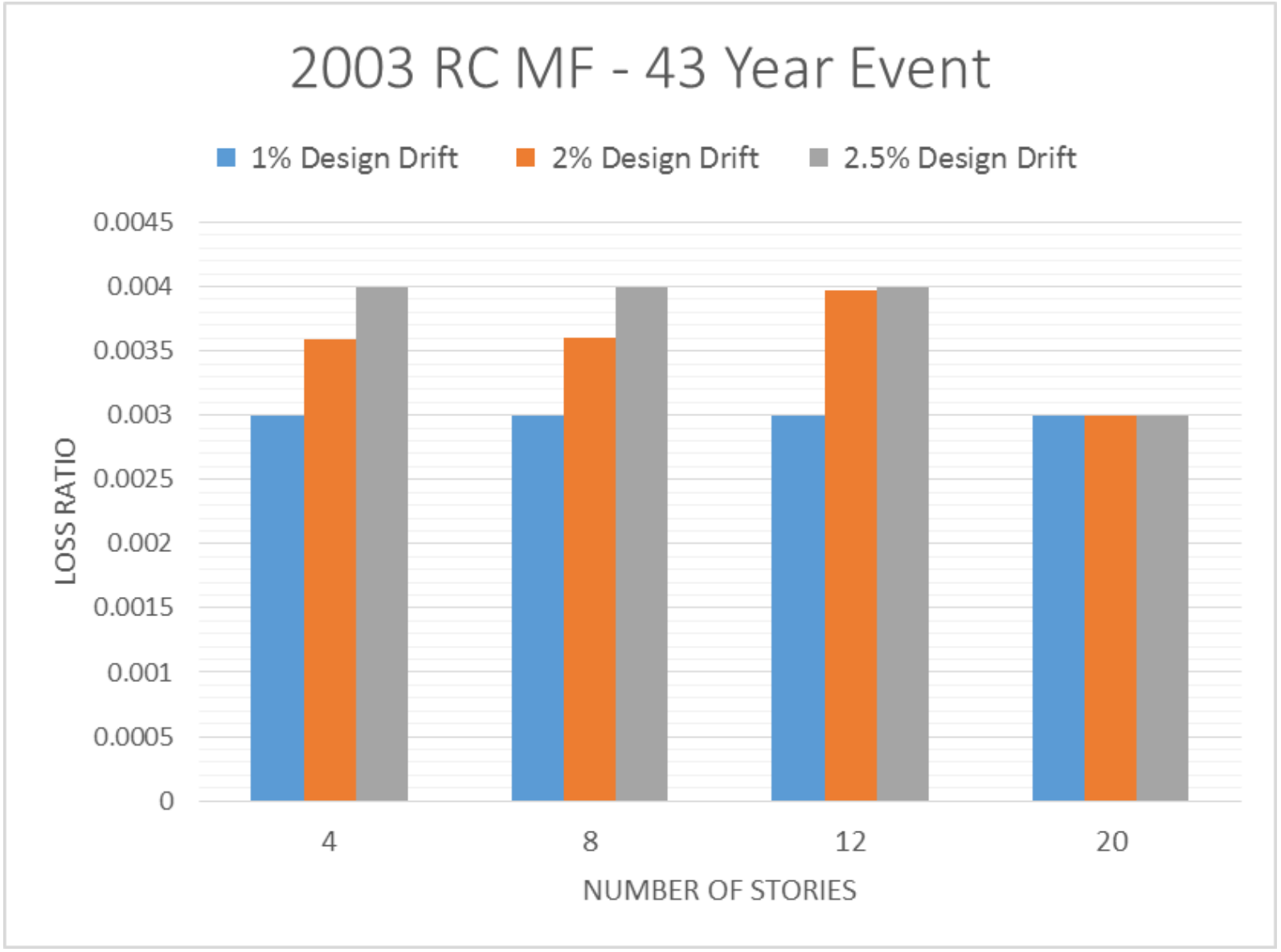


Building Specific Parameters

- 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

Building Specific Parameters



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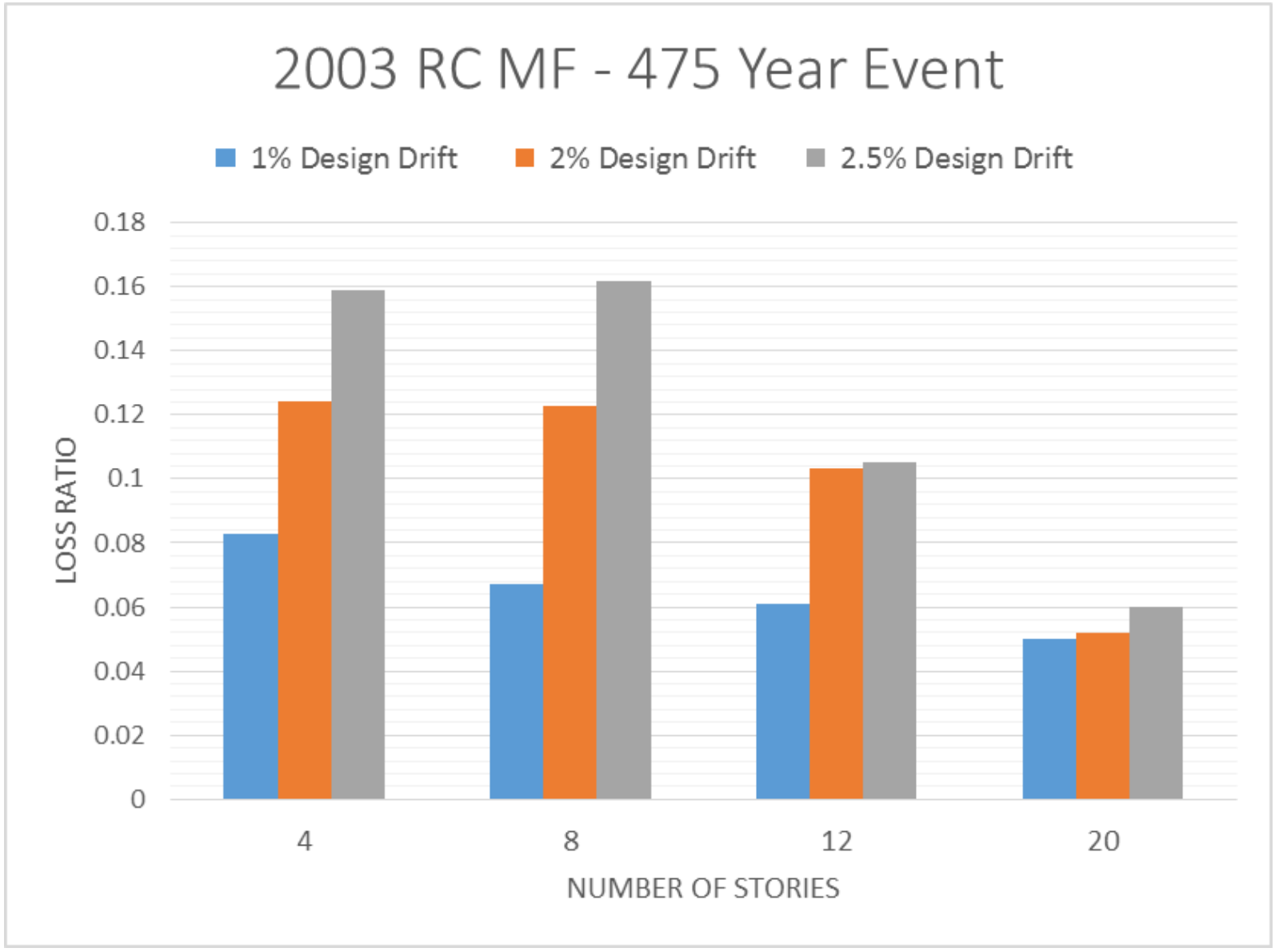

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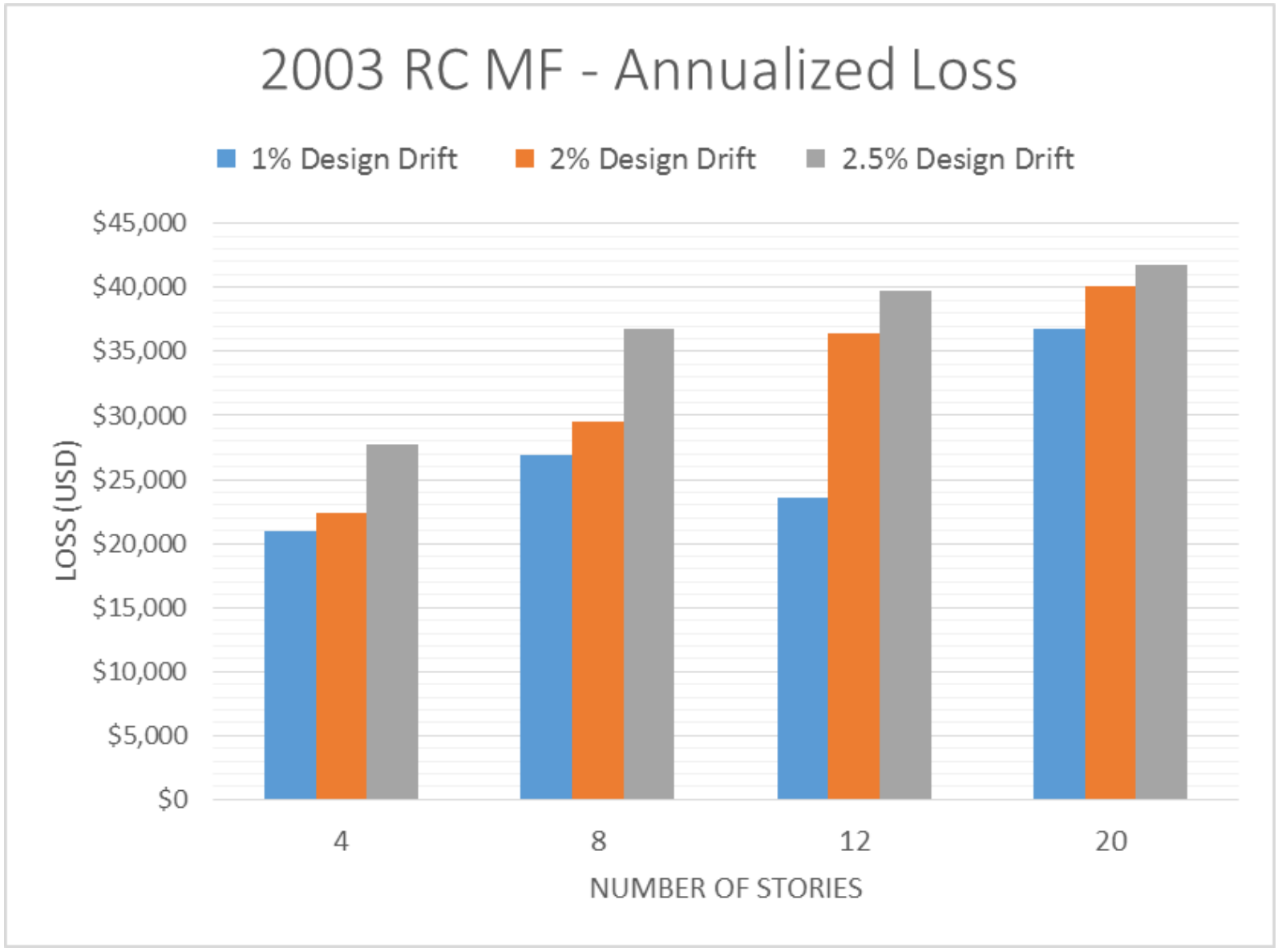

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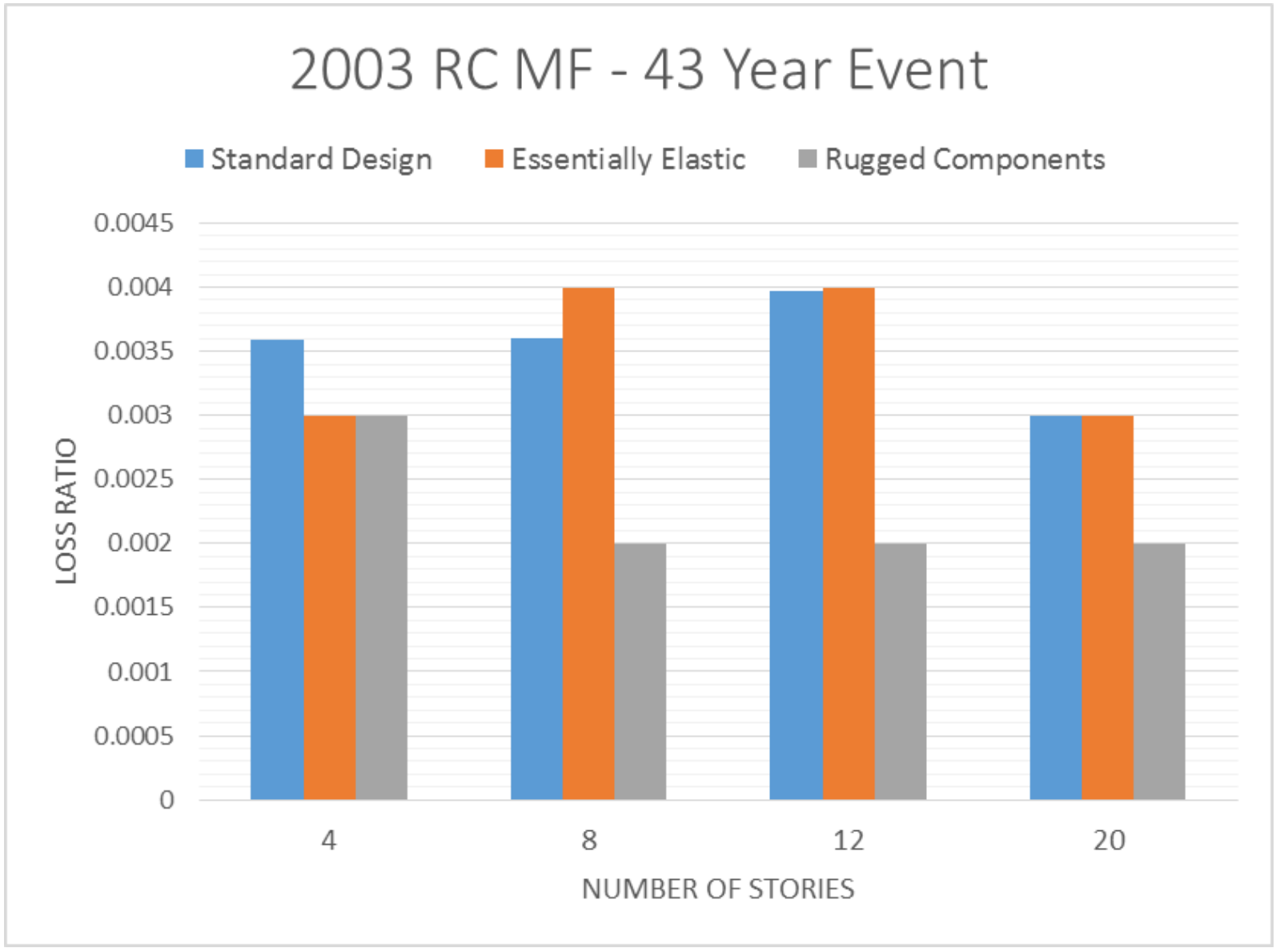

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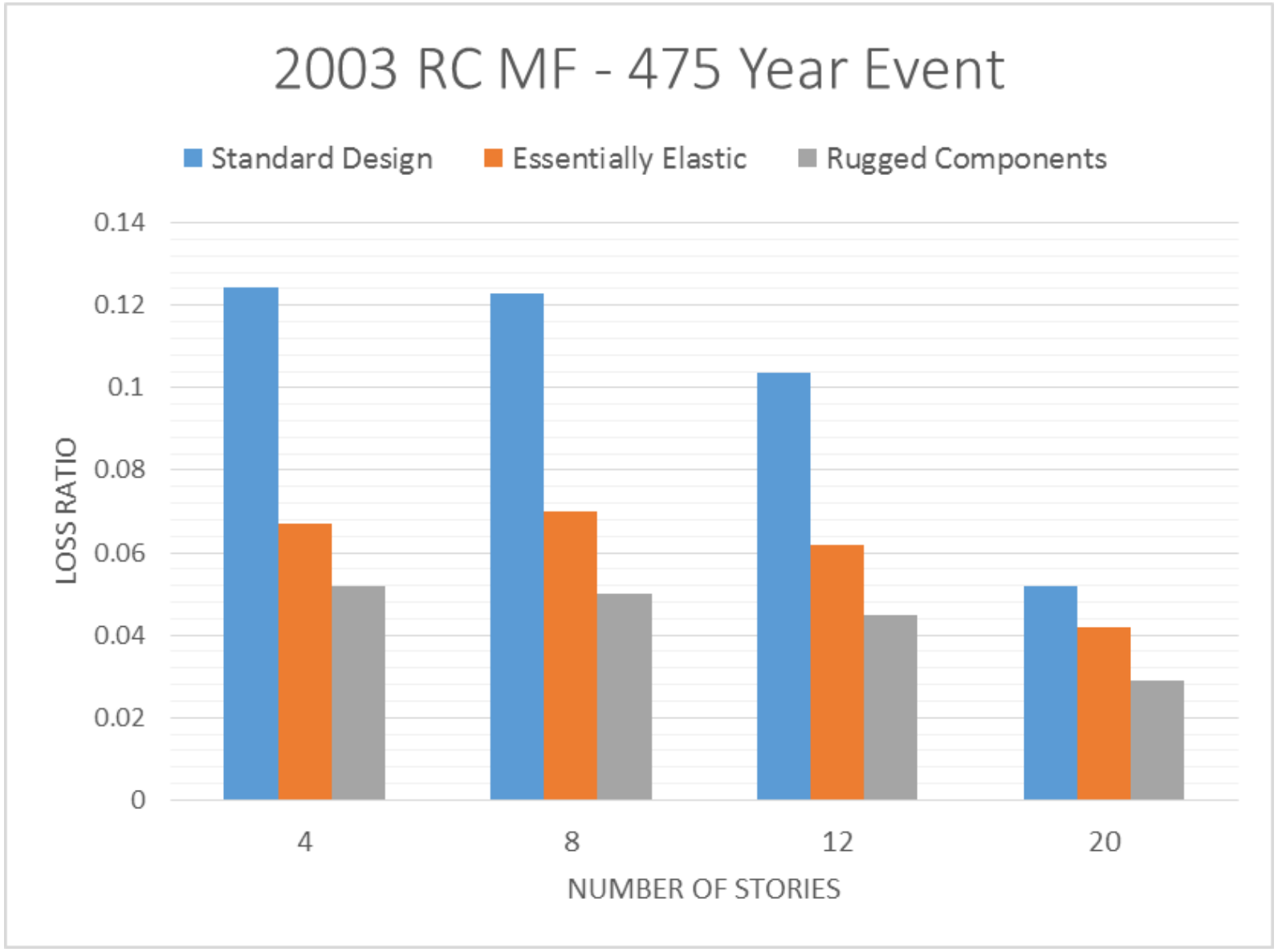

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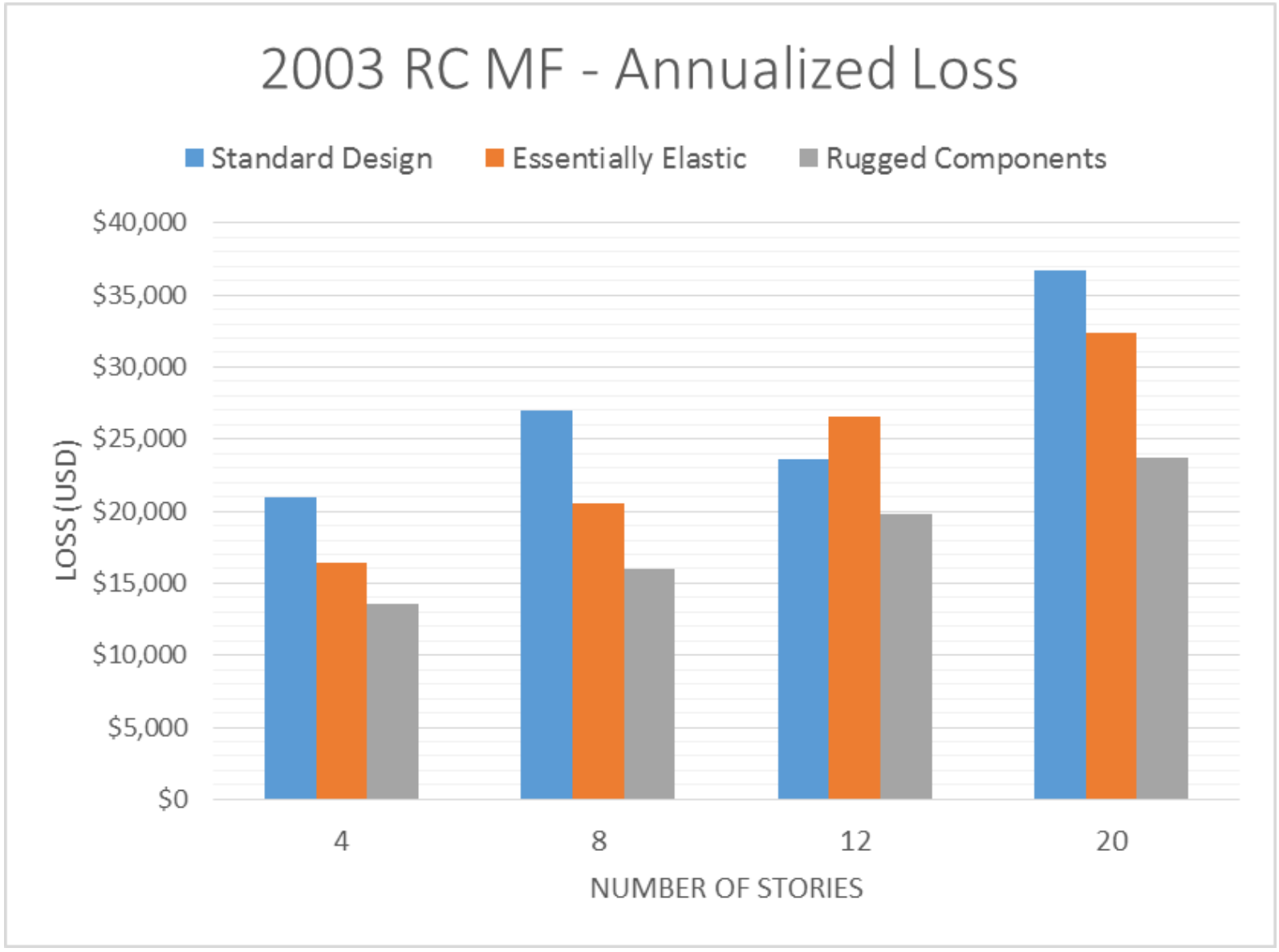

Conclusion

- 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 that previous loss assessment methodologies, therefor they are difficult to compare.
  - Open new doors for design procedure.
  - Building specific output needs building specific input

Thank You

- Thank you for your time.
- Please contact me if you would like more information.
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