NYC Buildings

2020 DIGITAL: SAFETY, INNOVATION & SUSTAINABILITY CONFERENCE

15 YEARS OF CONSTRUCTION INCIDENTS

PRESENTED BY

Dan Eschenasy, PE, F.SEI

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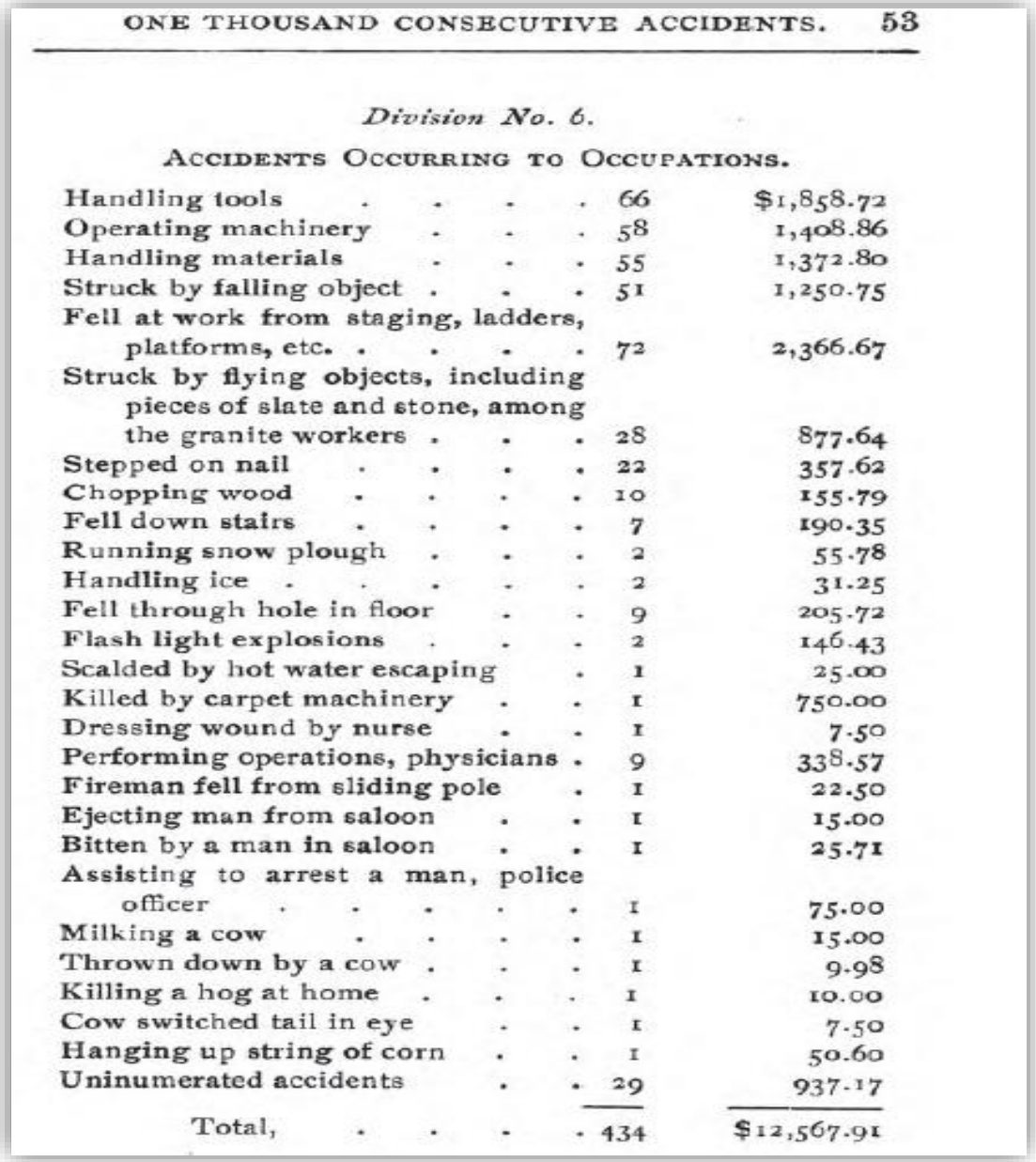
PRESENTATION DESCRIPTION

This presentation utilizes case studies to provide an overview of the last 15 years of building construction in New York City and lessons learned in various areas (soil work, demolition, crane operations and general site safety). The presentation will show that despite the changes in Code and additional measures taken by the Department, some accidents tend to repeat. In essence it is necessary for construction companies to evaluate their own performance and improve their own controls.

SAME TYPE OF ACCIDENT REPEATED

ACCIDENTS AROUND 1915

- Handling tools
- Operating machinery
- Handling materials
- Struck by a falling Object
- Fell at work from stagings, Ladders, etc.
- ……
- Cow switched tail in eye $7.50



ONE THOUSAND CONSECUTIVE ACCIDENTS. 53

Division No. 6.

ACCIDENTS OCCURRING TO OCCUPATIONS.

Handling tools	66	$1,858.72
Operating machinery	58	1,408.86
Handling materials	55	1,372.80
Struck by falling object	51	1,250.75
Fell at work from staging, ladders, platforms, etc.	72	2,366.67
Struck by flying objects, including pieces of slate and stone, among the granite workers	28	877.64
Stepped on nail	22	357.62
Chopping wood	10	155.79
Fell down stairs	7	190.35
Running snow plough	2	55.78
Handling ice	2	31.25
Fell through hole in floor	9	205.72
Flash light explosions	2	146.43
Scalded by hot water escaping	1	25.00
Killed by carpet machinery	1	750.00
Dressing wound by nurse	1	7.50
Performing operations, physicians	9	338.57
Fireman fell from sliding pole	1	22.50
Ejecting man from saloon	1	15.00
Bitten by a man in saloon	1	25.71
Assisting to arrest a man, police officer	1	75.00
Milking a cow	1	15.00
Thrown down by a cow	1	9.98
Killing a hog at home	1	10.00
Cow switched tail in eye	1	7.50
Hanging up string of corn	1	50.60
Uninumerated accidents	29	937.17
Total,	434	$12,567.91

THE HIERARCHY OF THE MAJOR EVENTS

- Falling from a height
- Contact with falling or collapsing objects
- Contact with electricity
- Falling from a moving platform
- Contact with hoisted, hanging, swinging objects
- Hit by a vehicle
- Squeezed between or against something

After S. Winge

NYC's HIDE AND LEATHER BUILDING

- World highest concrete building erected without accident

WORLD'S HIGHEST CONCRETE BUILDING ERECTED WITHOUT ACCIDENTS

One of the most interesting achievements in concrete construction is the recent completion of the Hide and Leather Building in New York City. This is an 18-story, all-concrete structure, 225 feet high, dominating its surroundings, including the world-famous Brooklyn bridge. It holds several world records, one of which is that its erection was completed without any serious accident. Because of the extreme care taken for the safety of the workmen there was not a single accident during the construction of this building other than the usual minor bruises and abrasions.

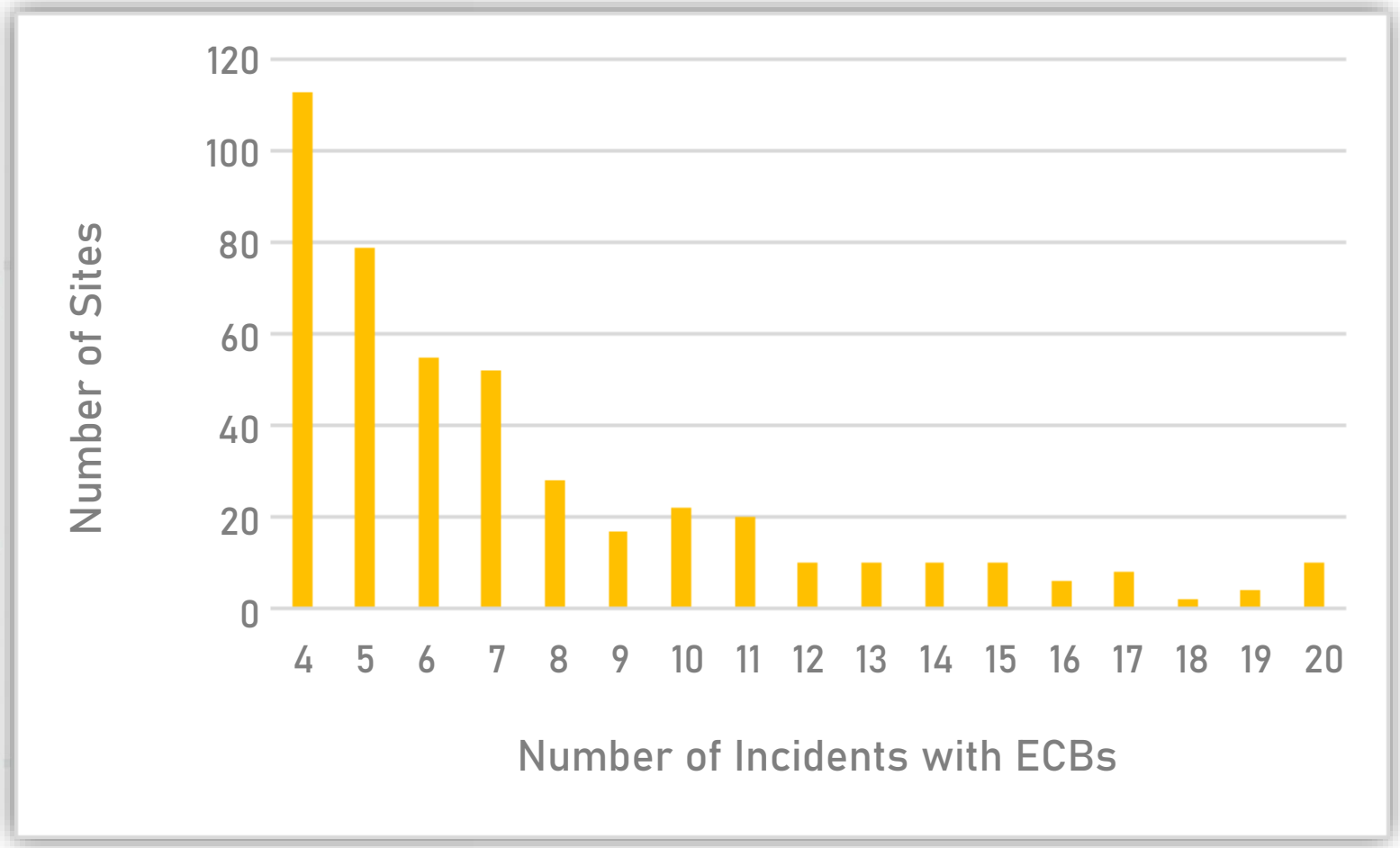
The old rule is that it costs a human life to build each floor of a skyscraper.

Mark up another virtue for concrete construction. Not only is it durable, fire-safe and economical, but the Hide and Leather Building proves that it is also erection-safe. To what other material can all these virtues be applied? Now let us make it as safe in its manufacture as it is in its application and use.

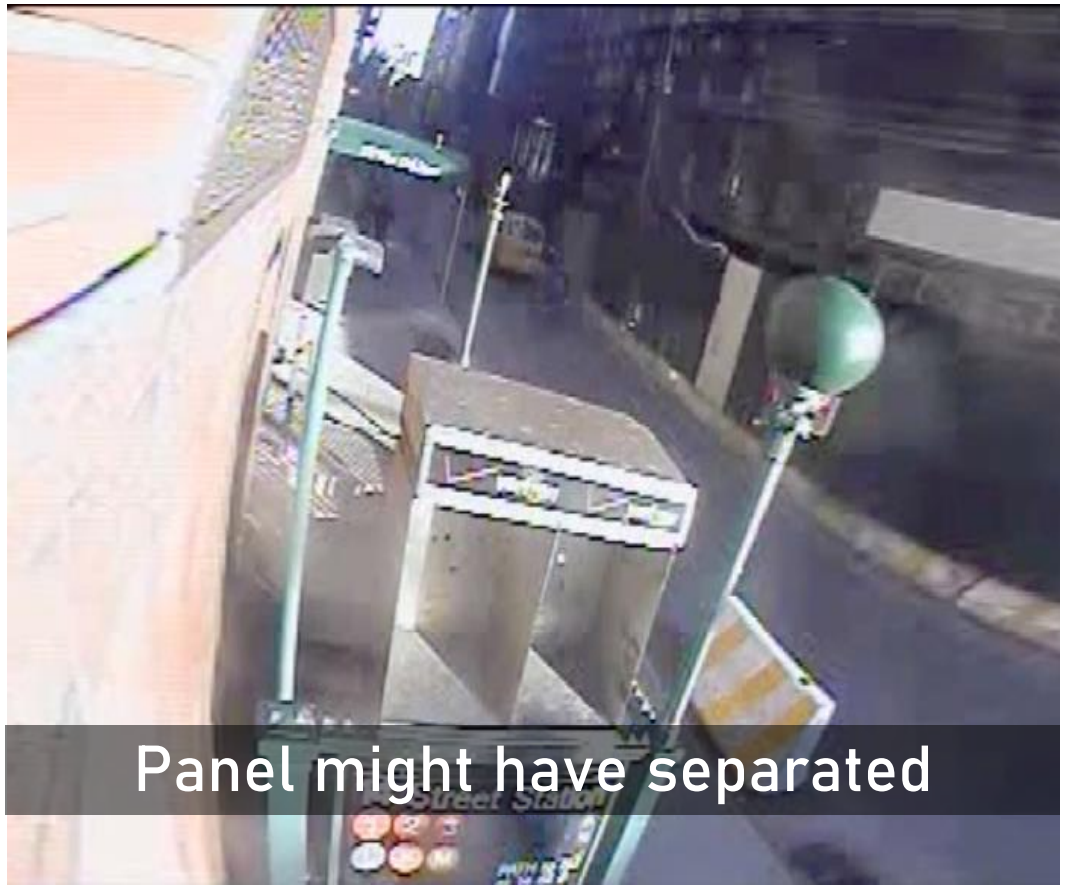
The Hide and Leather Building not only established a record for safety, but was built at the rate of a floor a week, a record for concrete buildings.

INCIDENTS WITH ECBs

- 32 sites had more than 20 ECBs



ACCIDENT: WIND?



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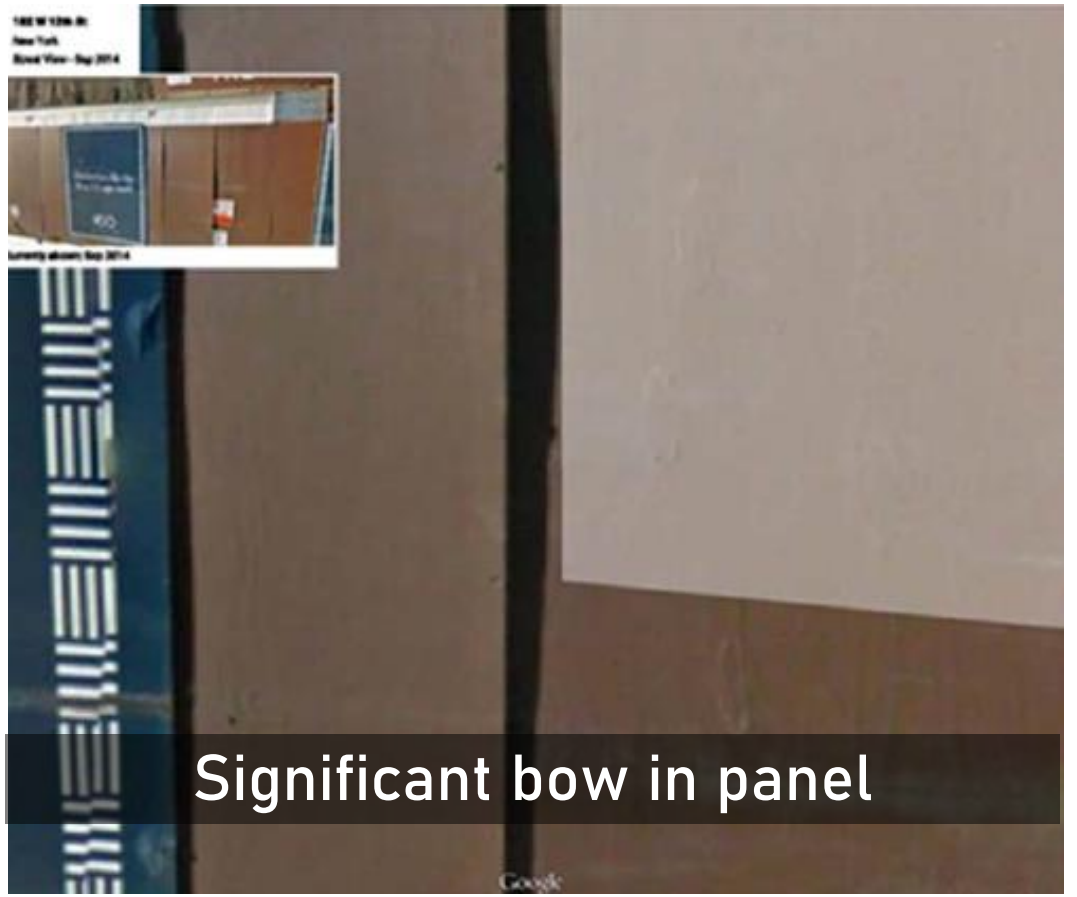
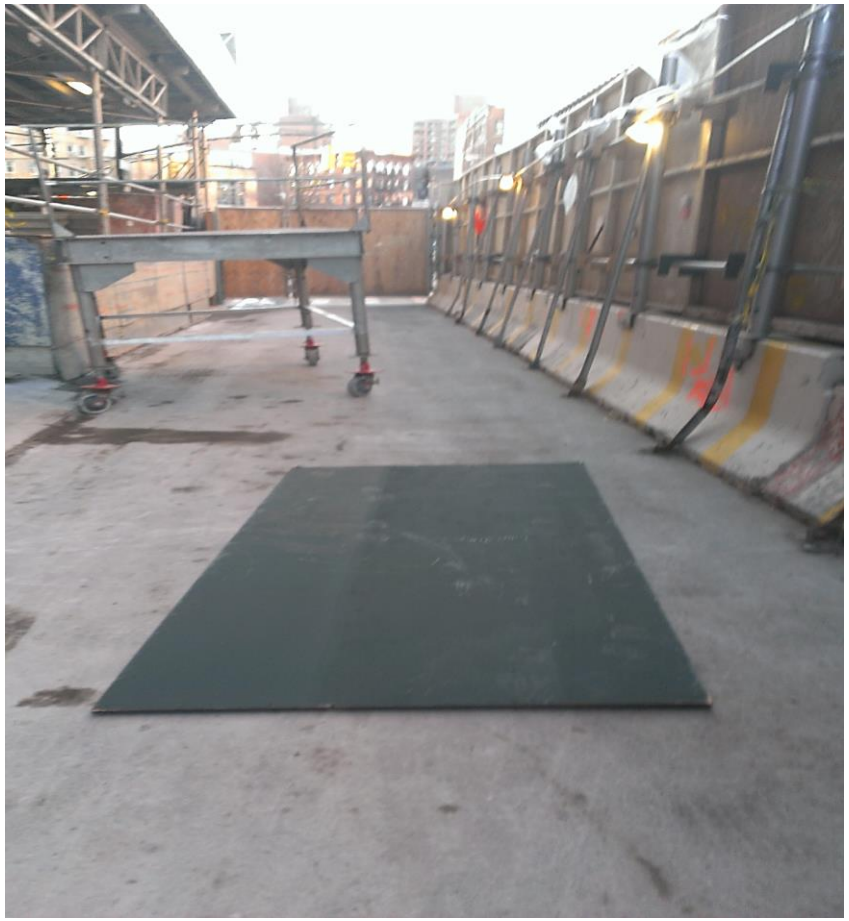
FATALITY

From a separate clip, panel hits pedestrian



Significant bow in panel

FENCE STRUCTURE



MINOR INSTALLATION ISSUES?

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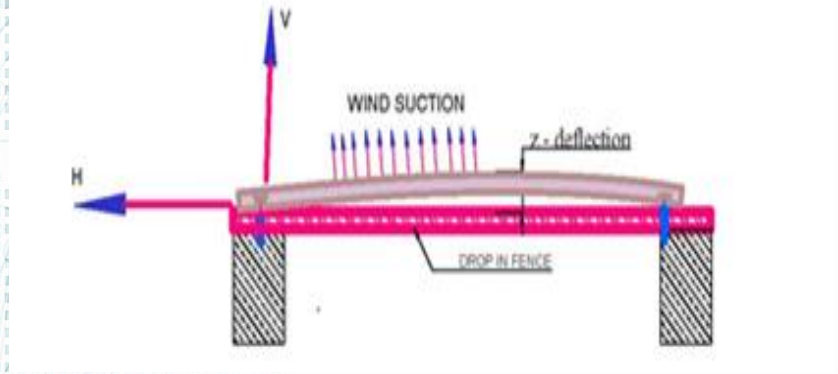
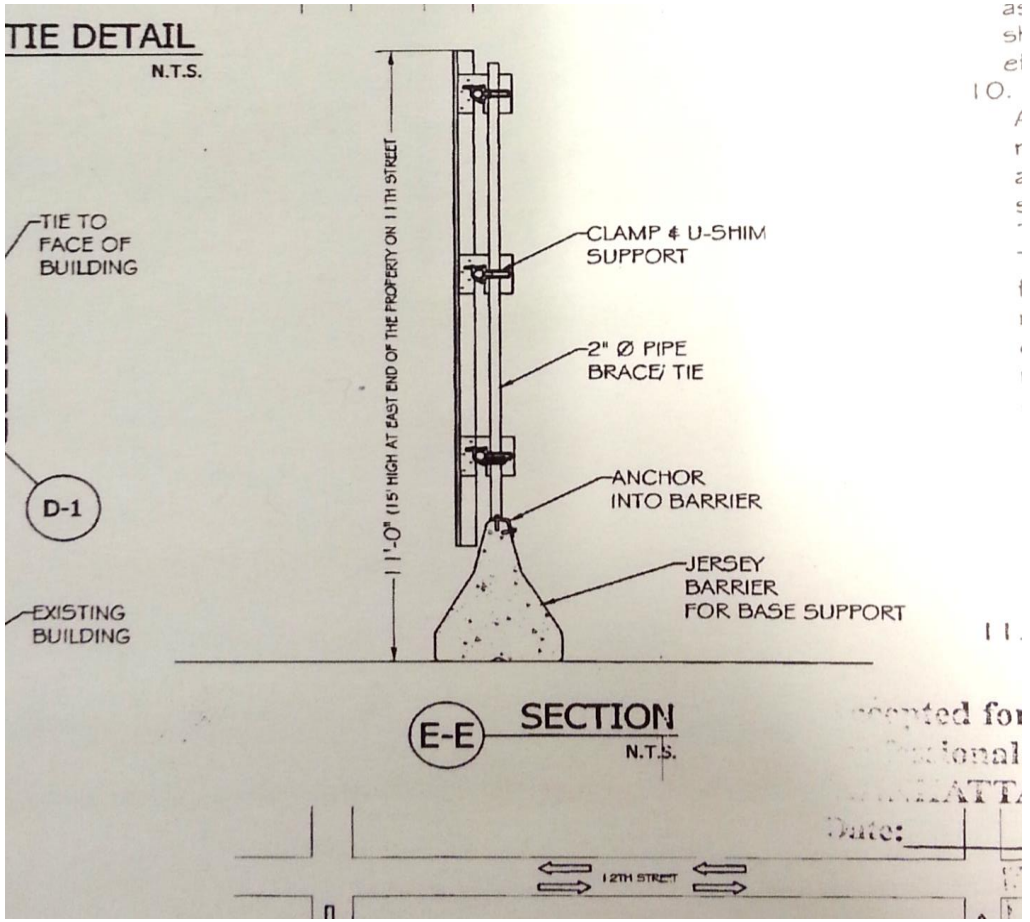
DESIGN & INVESTIGATION





MATERIAL INVESTIGATION

Labeled hole marks


Screw mark at edge


Screw horizontal fillet marks on panel backside

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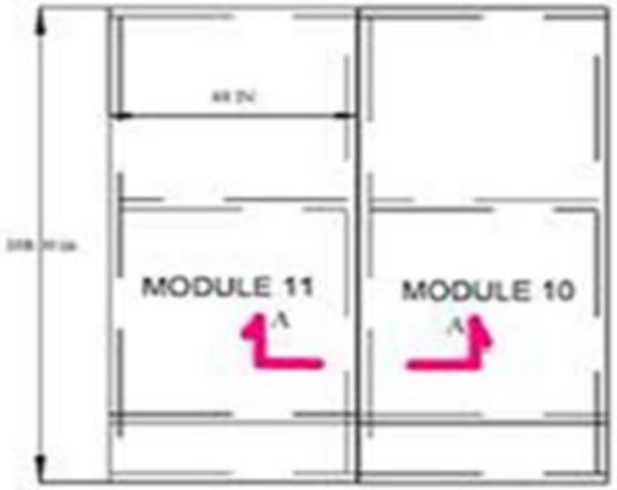
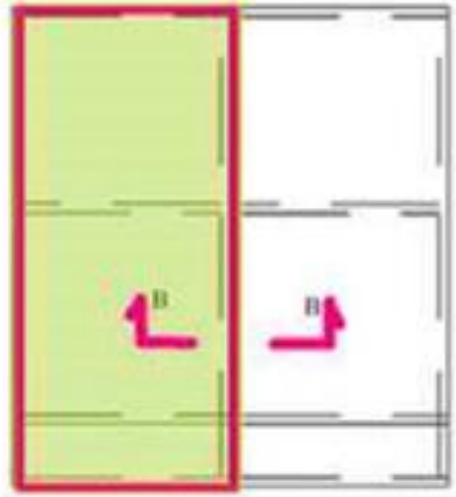
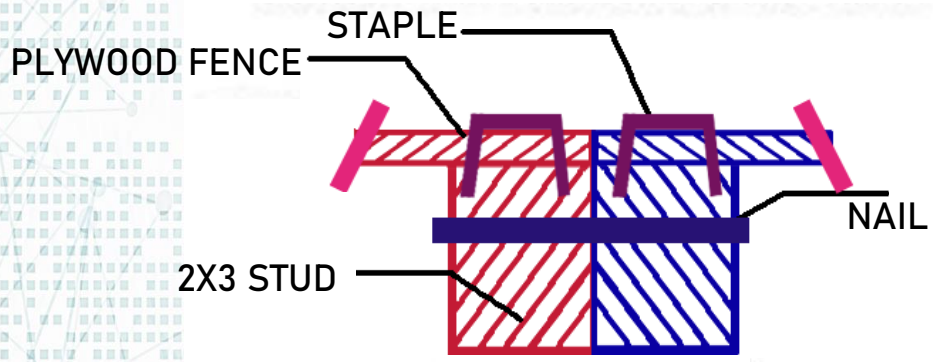
CLASSIFICATION OF THE ACCIDENT



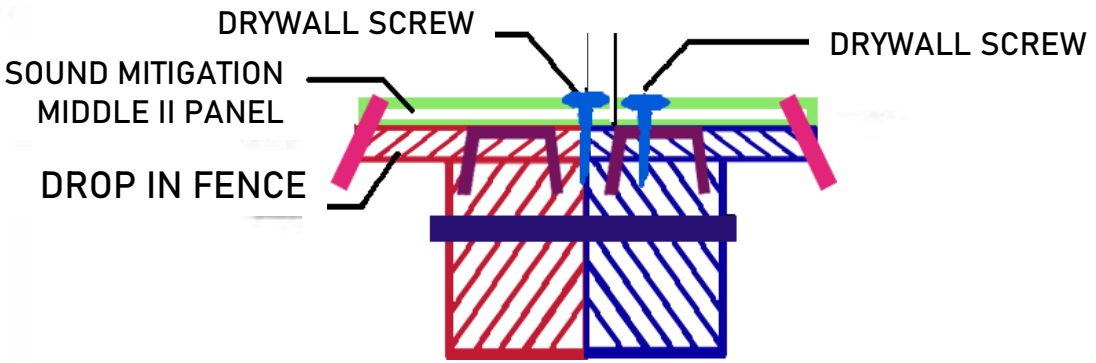
DROP IN FENCE INSTALLATION



SOUND MITIGATION PANELS



SECTION A-A



SECTION B-B

INCIDENTS

UNSAFE ACT

UNSAFE CONDITION

INCIDENT

INJURY

DAMAGE

NEAR MISS

After Petersen

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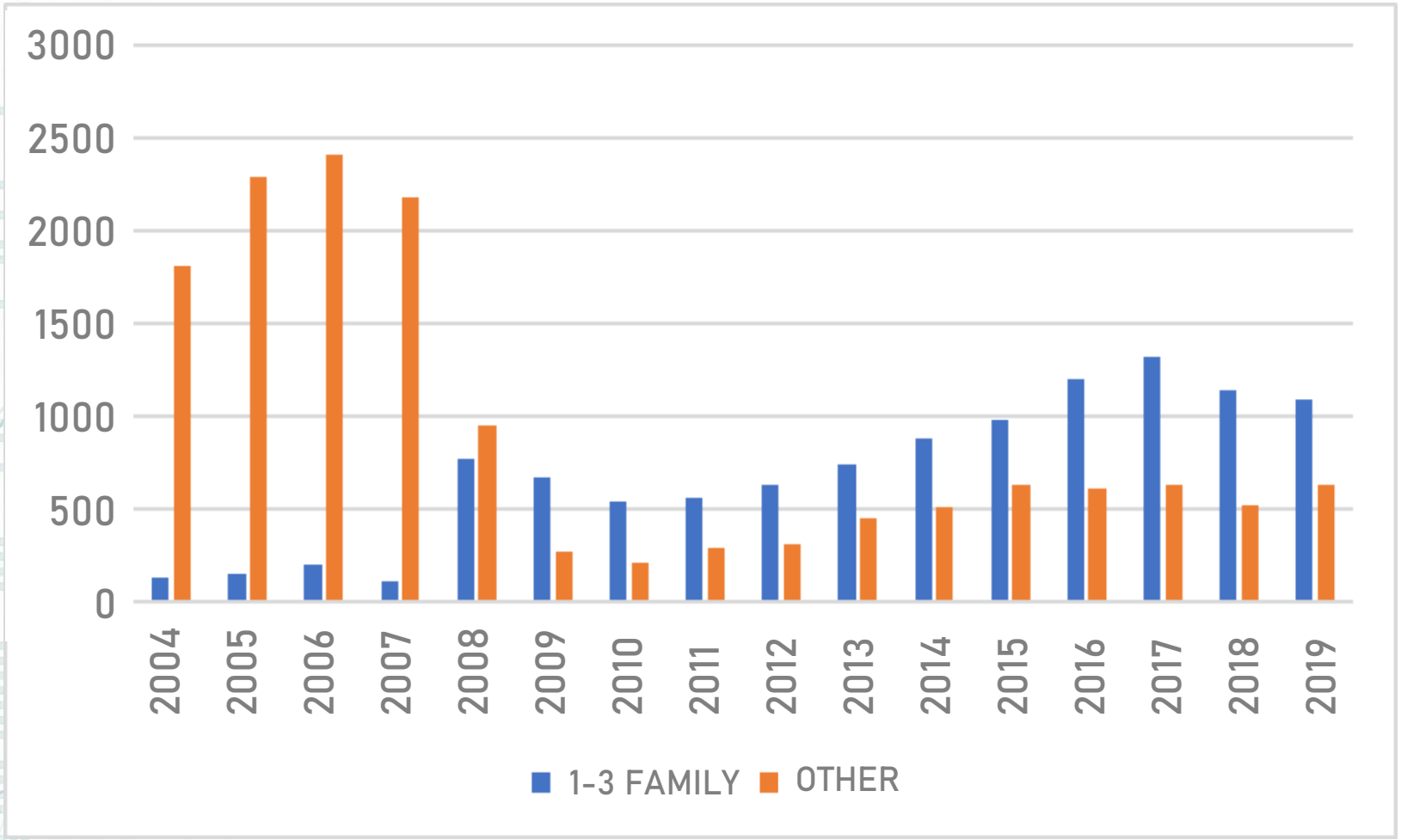
2004-2019 DEMOLITION PERMITS ISSUED



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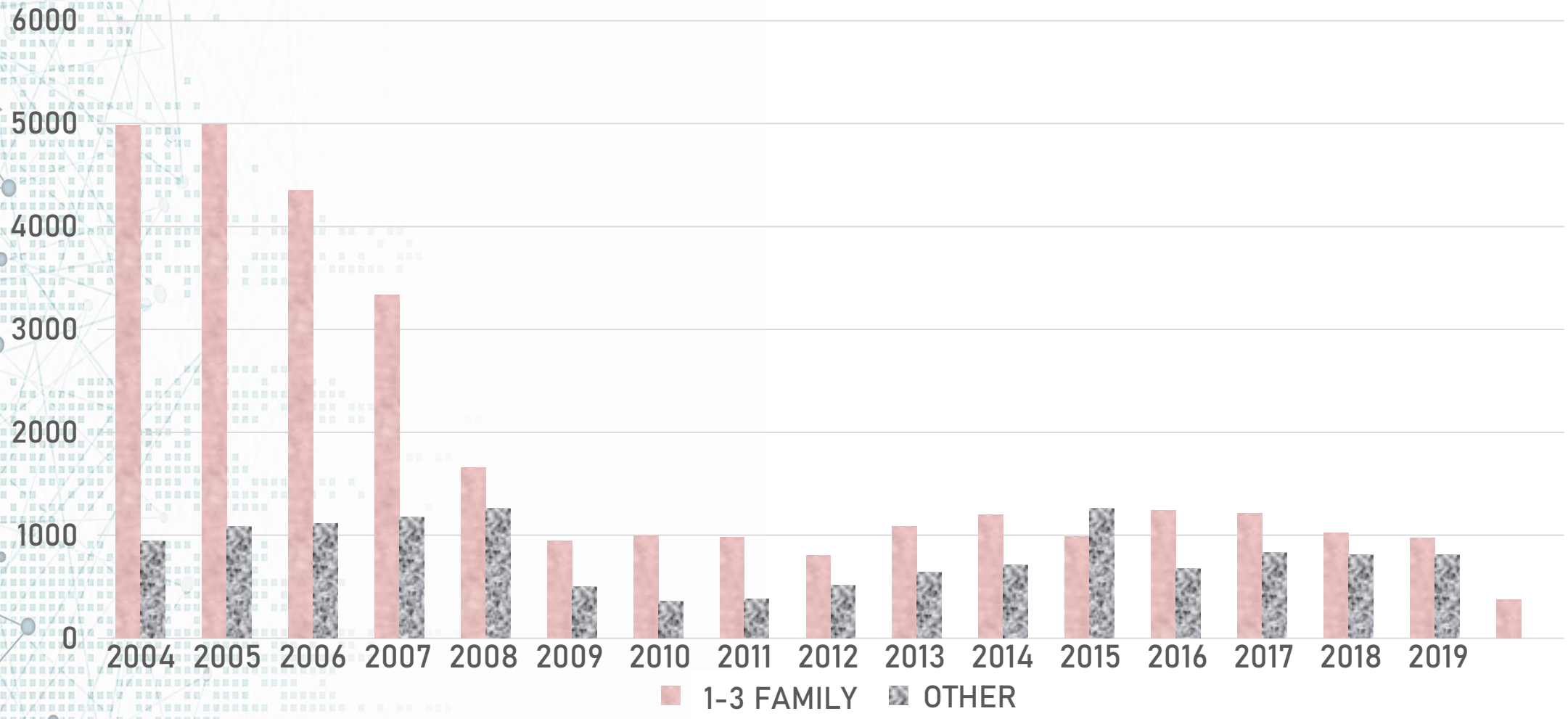
2004-2019 NB PERMITS ISSUED



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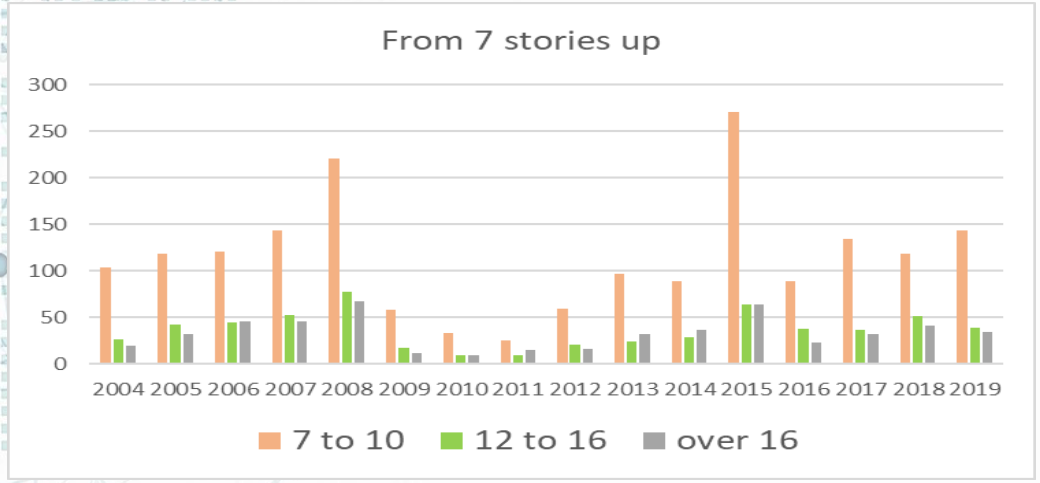
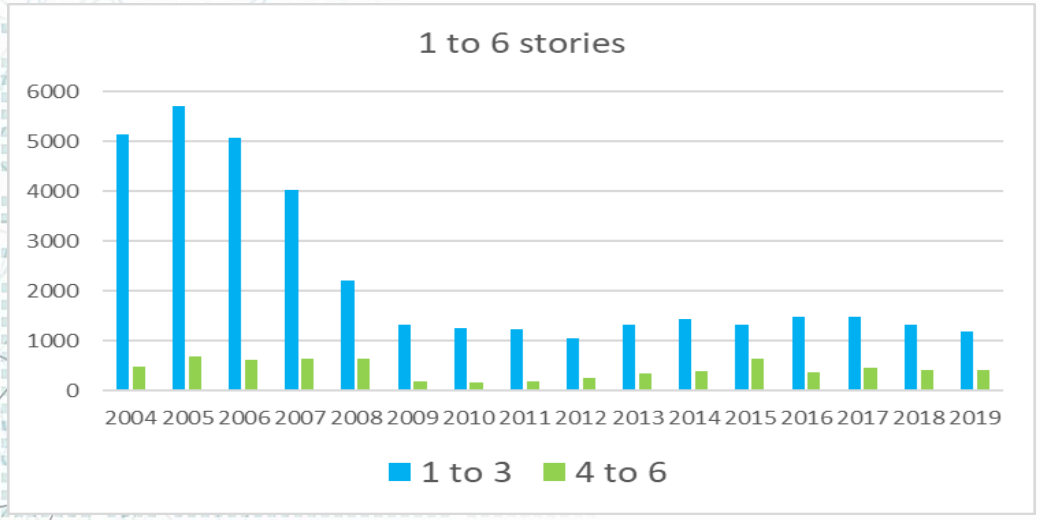
NEW BUILDING (NB) APPLICATIONS





Applications 2003 to 2020

FLOORS	TOTAL
1 to 3	41,892
4 to 6	7,519
7 to 10	1,980
12 to 16	618
over 16	561
Over 600	46

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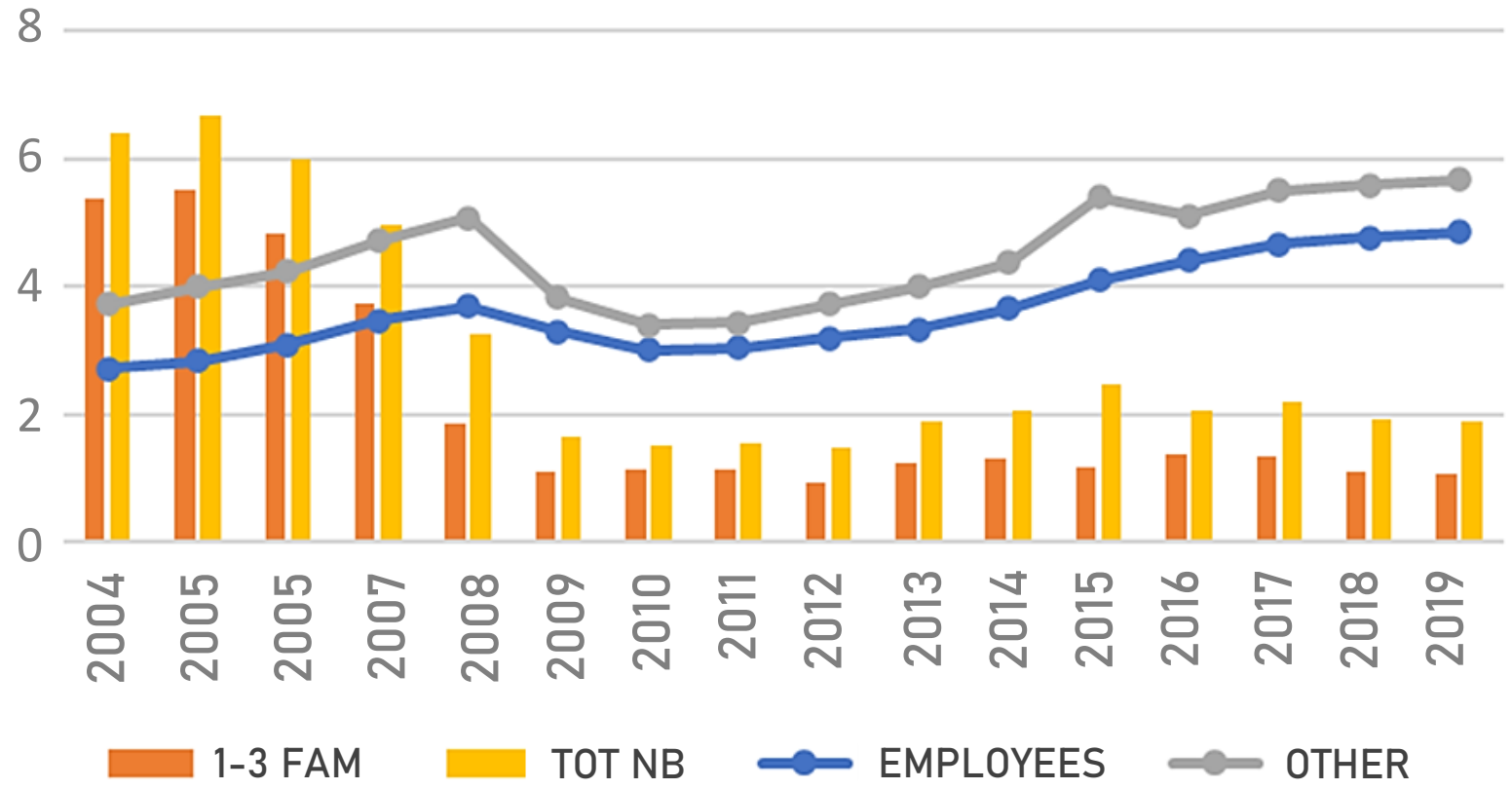
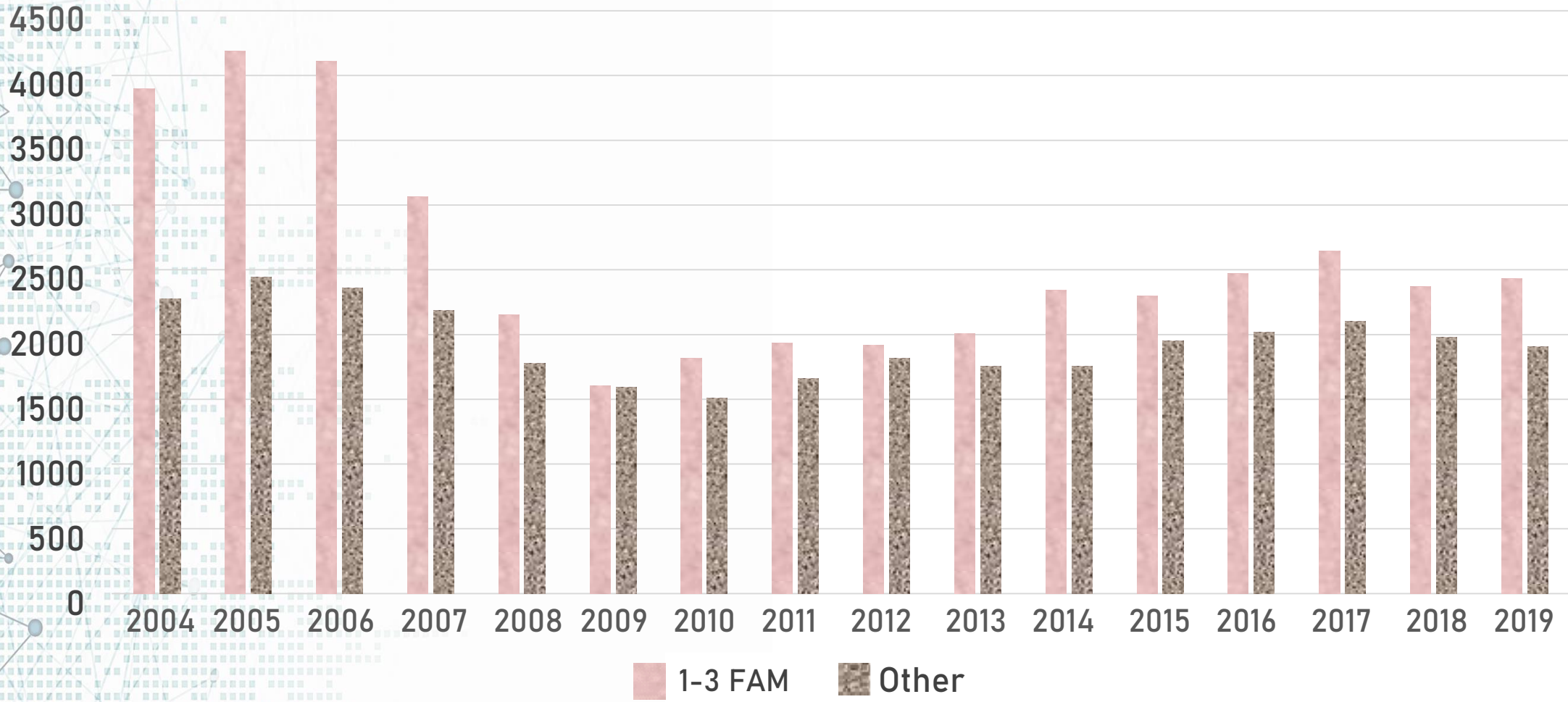
EMPLOYMENT vs. NBs

- NB in thousands
- Employees in ten thousands



2004-2019 ALT-1 PERMITS ISSUED



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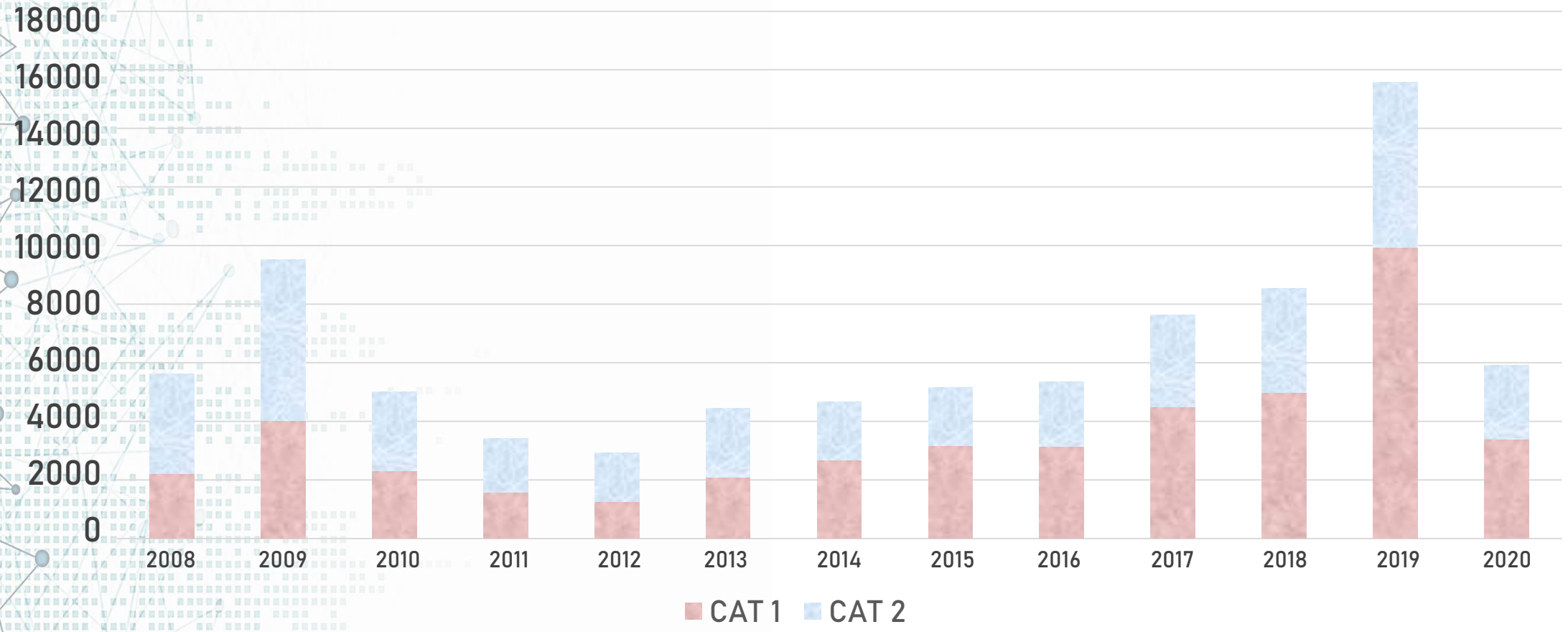
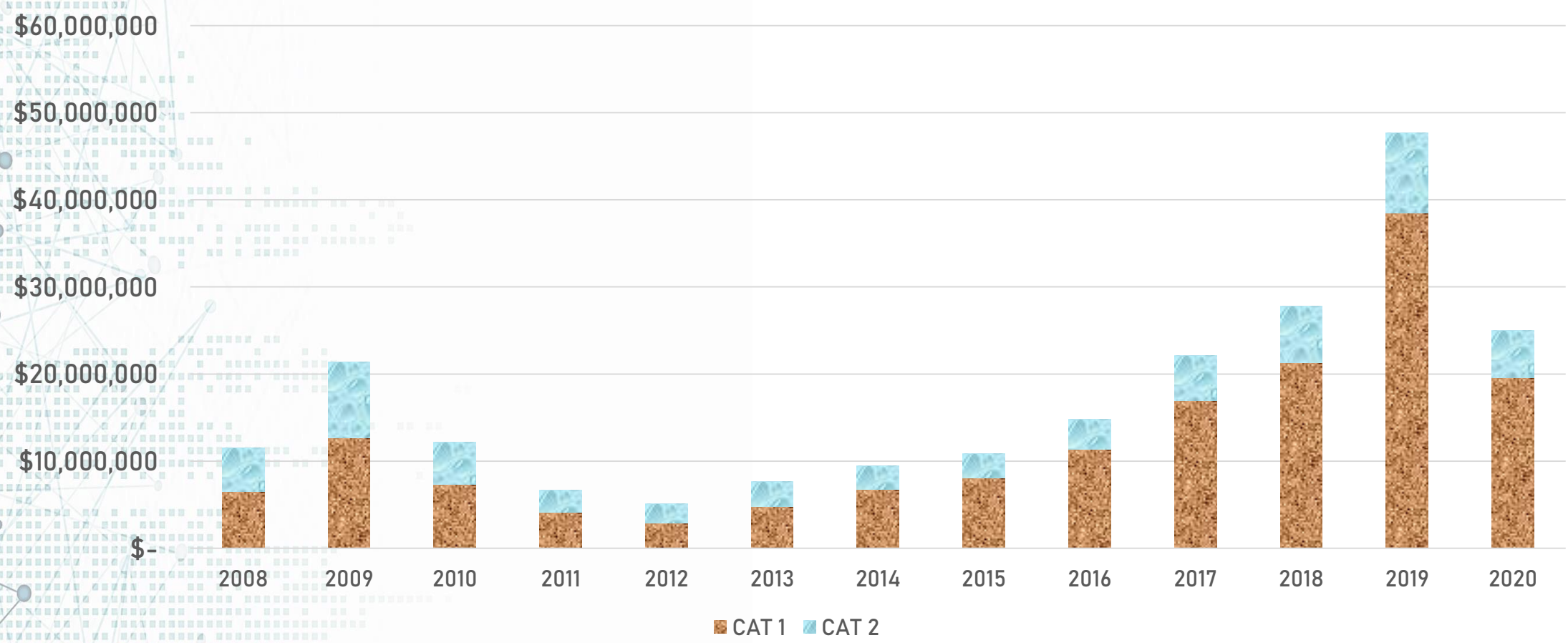
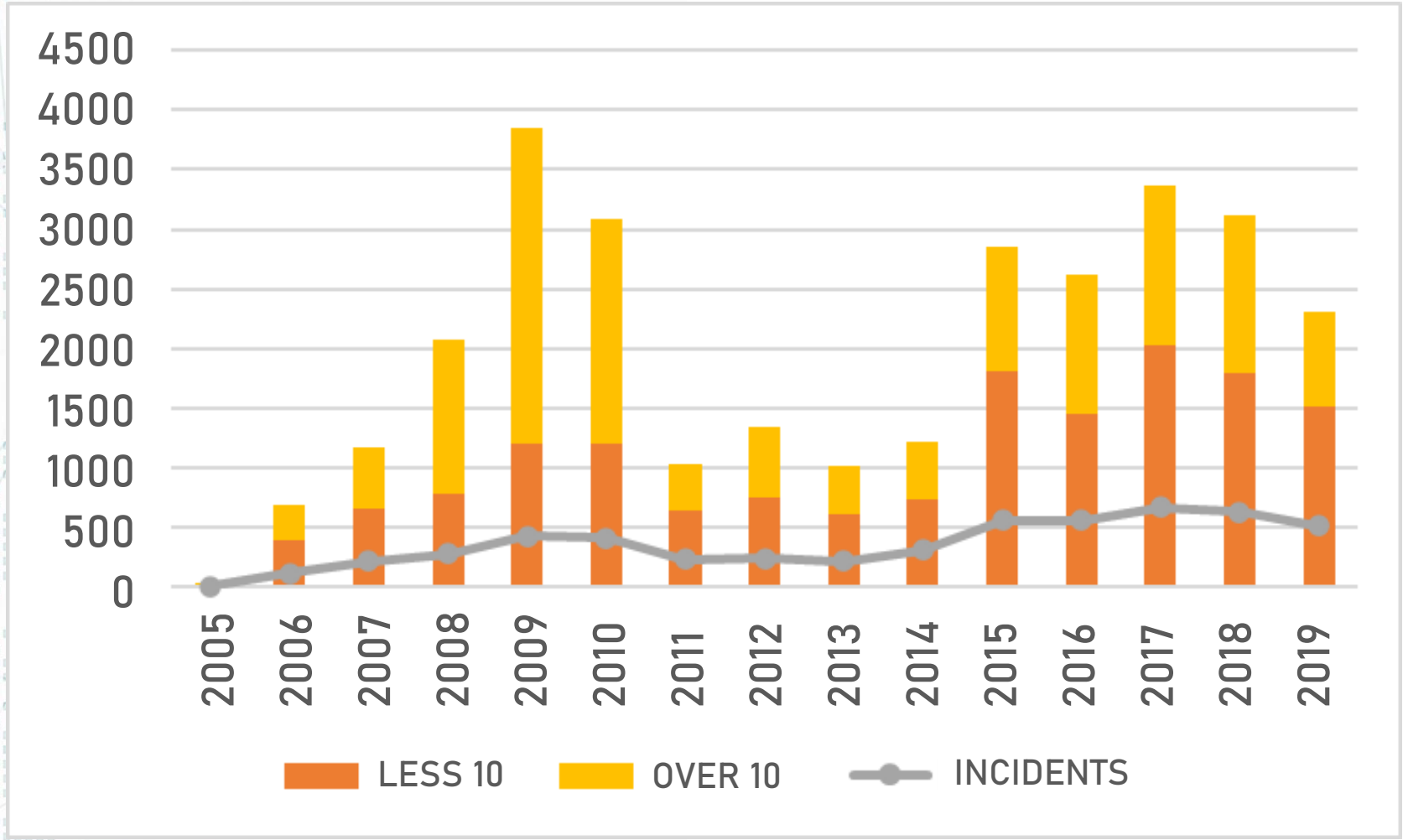
ECB ISSUED BASED ON CHAPTER 33



2008-2020 ECB PENALTIES IMPOSED



OPEN ECBs PRIOR INCIDENT



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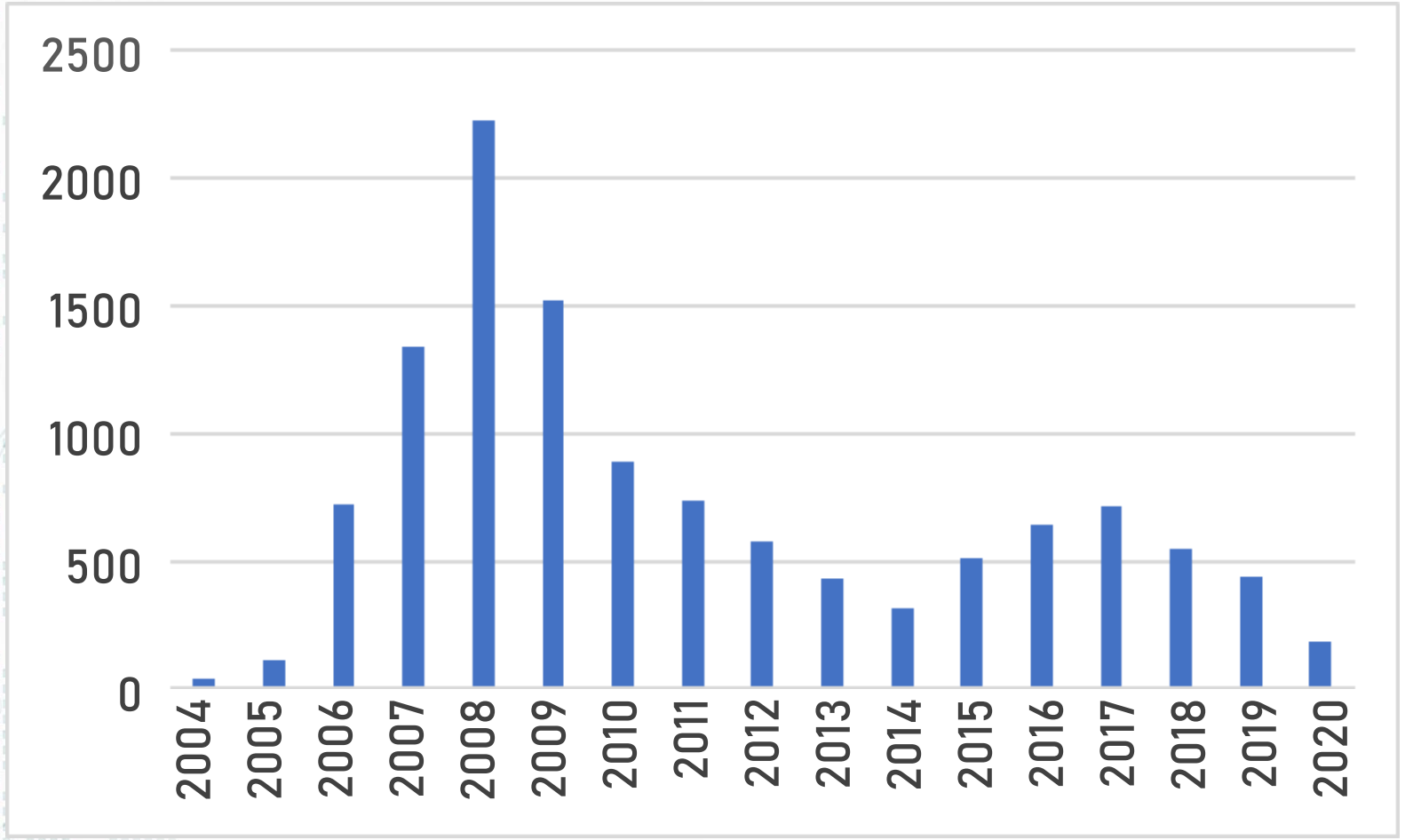
FAILURE TO PROTECT ECBs

STOP WORK ORDERS



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DATA: A WORK IN PROGRESS

- Incident data was extracted from the DOB incident database.
- The classification of incidents was modified by the author only for the purpose of this presentation.
- The main modification consists in assigning different meanings the Material Fall and Worker Fall categories.
- Most of the photos of older accidents were copied from old build safe|live safe presentations or BTEA presentations.
- Some of the recent accidents were taken from Construction Safety: Code Review & Case Studies presented by Matt Milner and Geoff Eisele yesterday.

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AD-HOC CHANGES

Material Fall

- Was reduced only to cases of actual material failure or fall. Where the fall was in effect due to negligence by the worker (e.g. dropped a tool) it was moved to Worker Fall.

Worker Fall

- Includes (in this presentation) all worker activities where the incident was due to worker inattention.
- In addition to fall, slips, etc. the incidents count dropping material (e.g. plank) or negligence during work (i.e. hurt during stripping) and similar.

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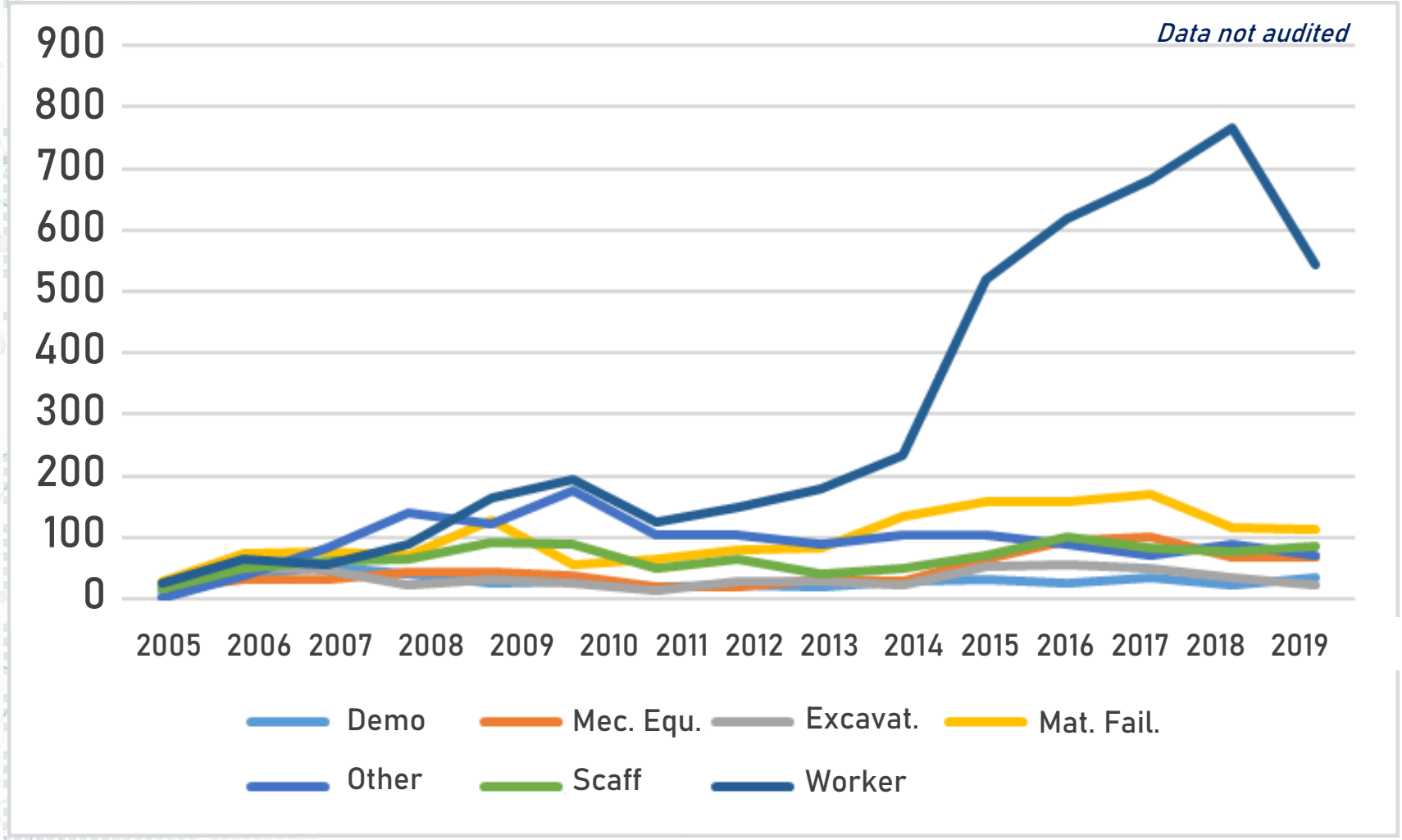
USE OF DATA FOR CONSTRUCTION SAFETY

- Probability theory is based on the assumption of randomness, whereas projects deal with consciously planned human actions that are generally not random.
- Construction projects are inherently unique by definition.
- This reduces the relevance and reliability of statistical aggregates derived from probability-based analysis.
- Probability theory assumes future states can be defined. However, uncertainty and ignorance are inevitable on construction projects. Especially with regard to human actions, the future is fundamentally imprecise.

After A. Pinto

INCIDENT NUMBERS PER YEAR CHANGES NYB BC



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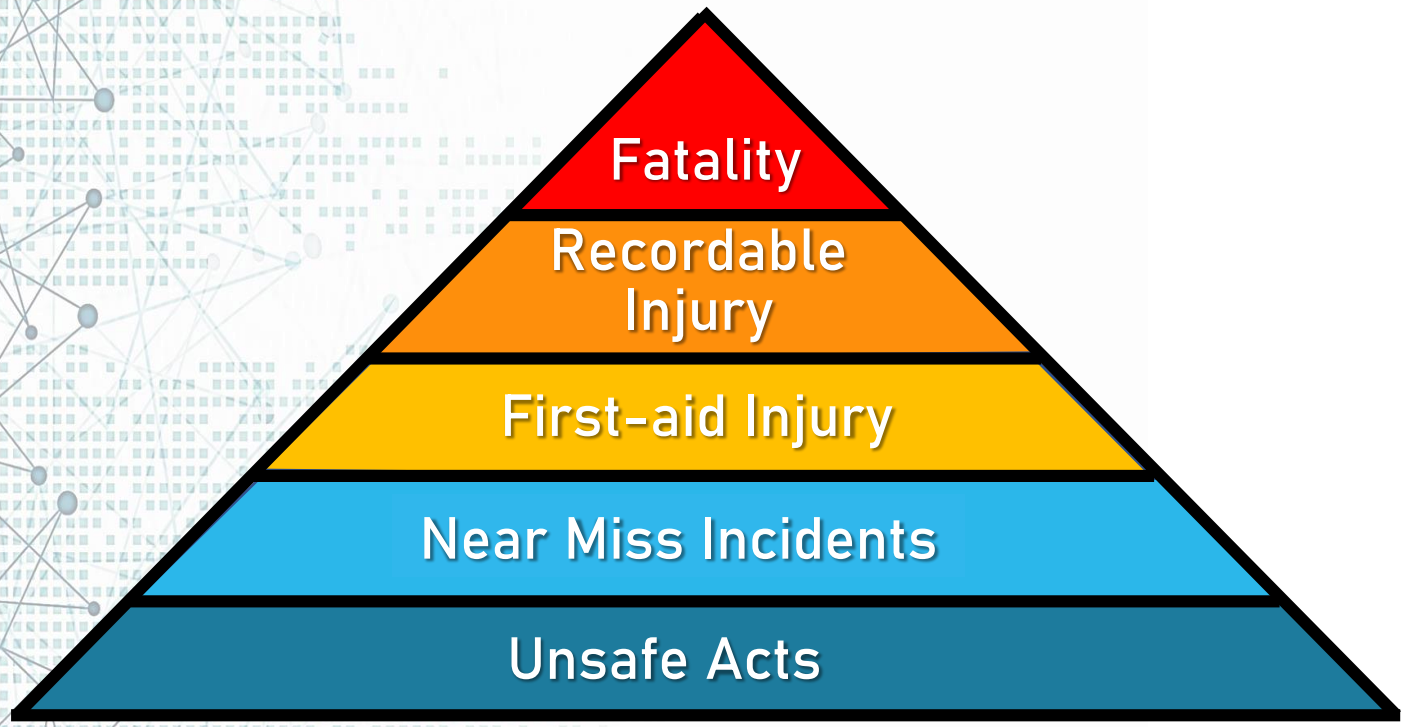
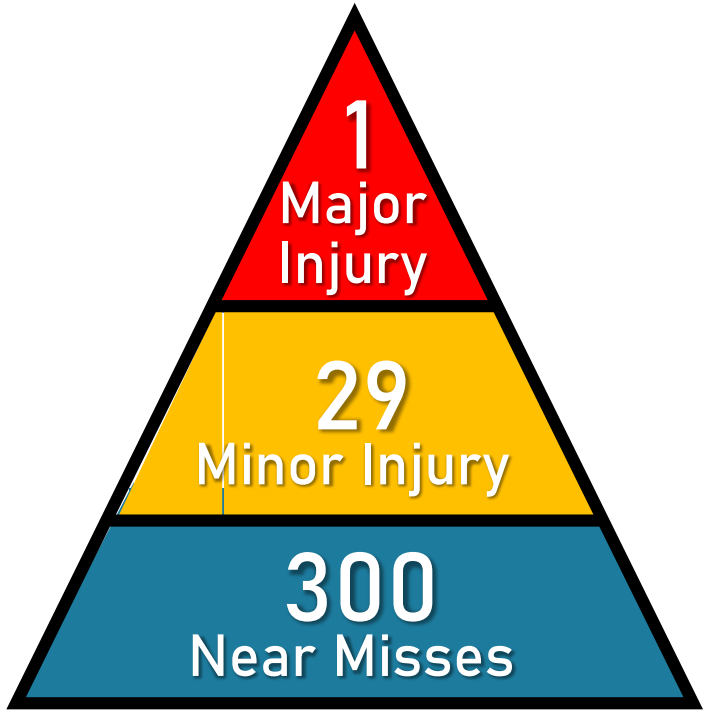
DIFFICULTY TO COMPARE RESULTS

Change In Data



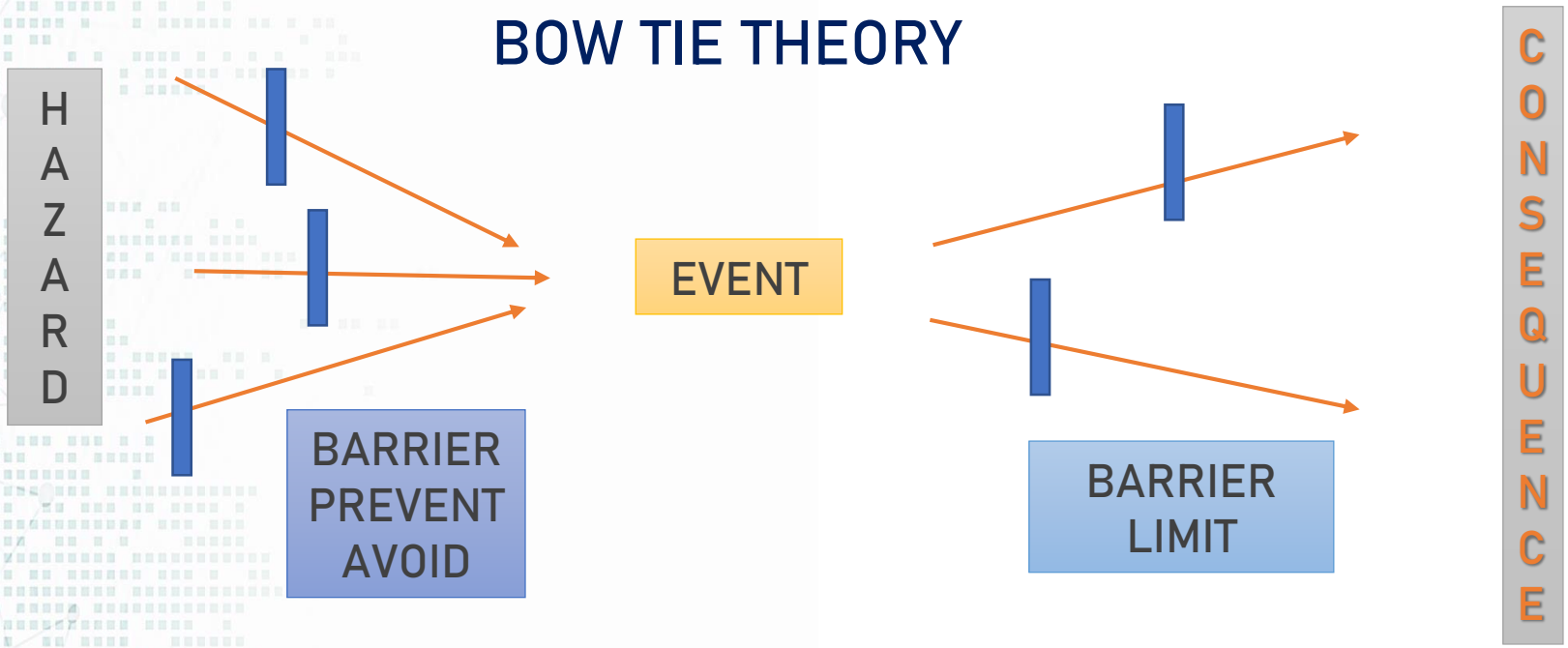
After SHP

1-2-9 Triangle

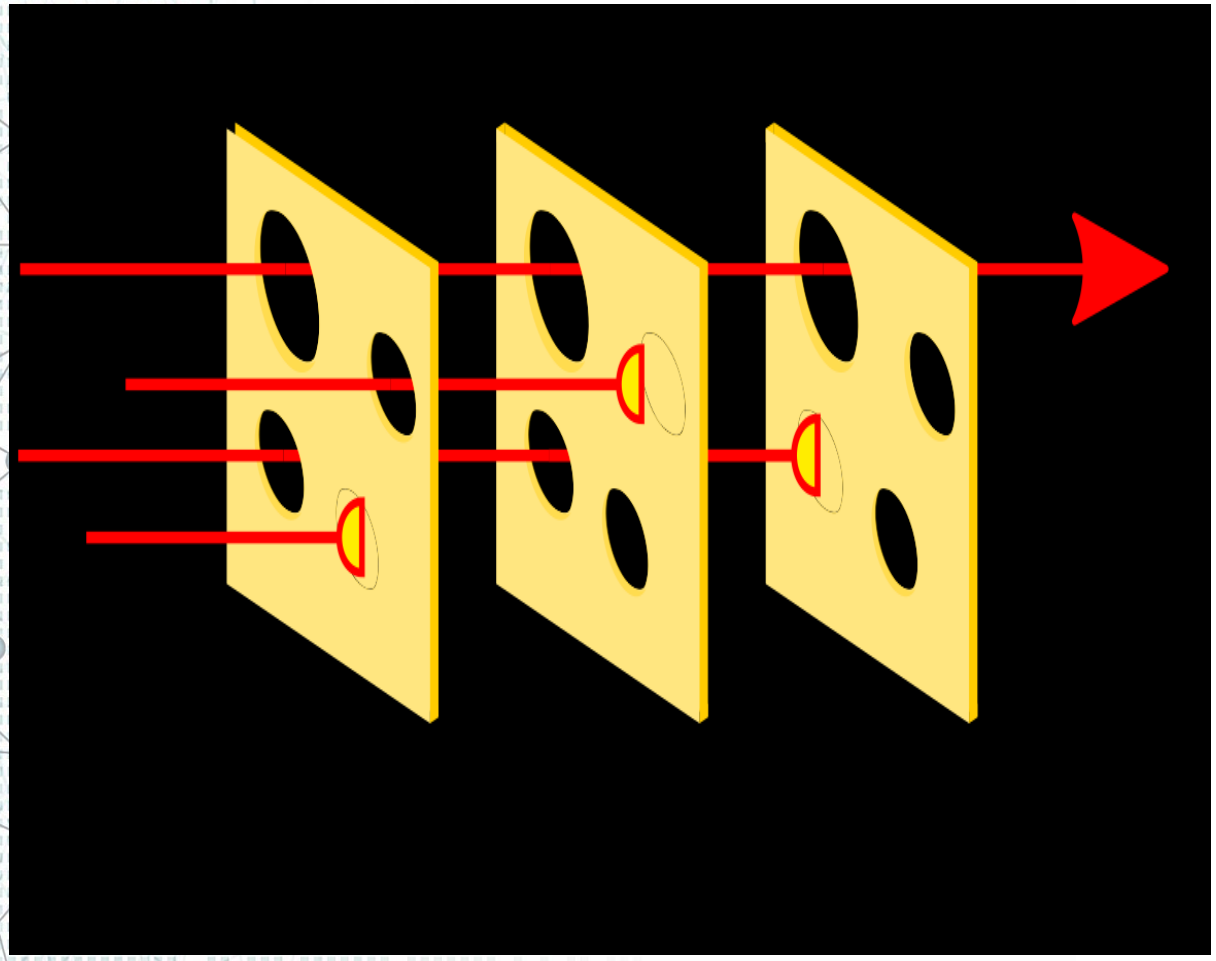


SAFETY BARRIERS

Safety barriers are physical and/or non-physical means planned to prevent, control, or mitigate undesired events or accidents.



SWISS CHEESE MODEL OF CAUSATION



The Swiss cheese model of accident causation illustrates that although many layers of defense lie between hazards and accidents, there are flaws in each layer that, if aligned, can allow the accident to occur.

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SAFETY BARRIERS

Hard Barriers

- Physical
- Technical

Include passive measures are predictive over an extended period of time

Soft Barriers

- Administrative
- Human
- Organizational

Include some active measures that can initiate corrective steps in a short period of time

Include long term organizational culture of safety

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DOB ACTIVITIES RELATED TO SAFETY

Observe/Violation

- Barriers that were in place and how they performed
- Barriers that were in place but not used
- Barriers that were not in place but were required

Prescribe

- Competence to use/climb scaffold
- Structural integrity of the scaffold
- Correct placing/attachment so it will not fall

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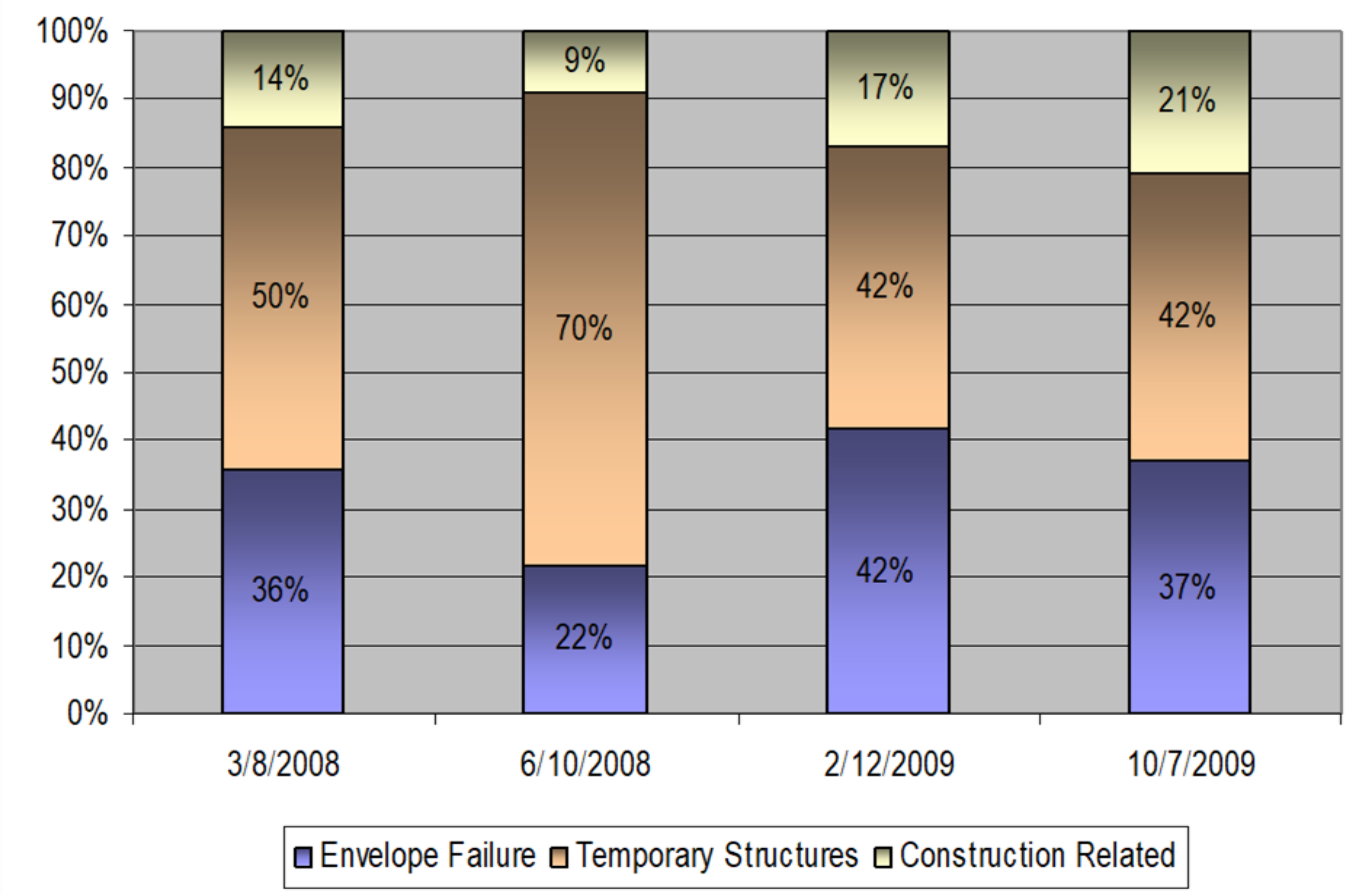
TEMPORARY STRUCTURES

40%-50% FOR 2008-2009

- Engineering Solutions
- Loads
- Calculation Requirements



DEMOLITION

PRIOR 2008 NYC BC

Currently under the pretext that only what is filed as a demo should follow the safety provision, some contractors treat partial demolitions as an alteration and claim that they are not be subject to all demolition requirements. This will greatly enhance safety during demolitions. (Section 3306)

ENGINEERED DEMOLITION

DEMOLITION: 2008 NYCBC

- Full Demolition: the dismantling, razing, or removal of all of a building or structure, and all operations incidental thereto.
- Partial Demolition: the dismantling, razing, or removal of structural members, floors, interior bearing walls, and/or exterior walls or portions thereof, including all operations incidental thereto.
- The demolition safety requirements apply whenever any demolition operations are being performed, regardless of the permit type issued.
- Mechanical Demolition Definition: the use of mechanical demolition equipment , other than hand-held equipment, in full and partial demolition operations.
- Required Documents: Submittal documents must be signed and sealed by a registered professional engineer showing:
  - Means and methods of demolition including all equipment to be used
  - Calculations showing the adequacy of the existing structure to support the loads imposed will be required.
  - Mechanical Partial and Full Demolition operations will be subject to Special Inspection (BC 1704.19) to ensure site safety procedures and approved documents are adhered to.

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DEMOLITION: 2008 (BC 3306)

Categories

- Full Demolition: the dismantling, razing, or removal of all of a building or structure, and all operations incidental thereto.
- Partial Demolition: the dismantling, razing, or removal of structural members, floors, interior bearing walls, and/or exterior walls or portions thereof, including all operations incidental thereto.
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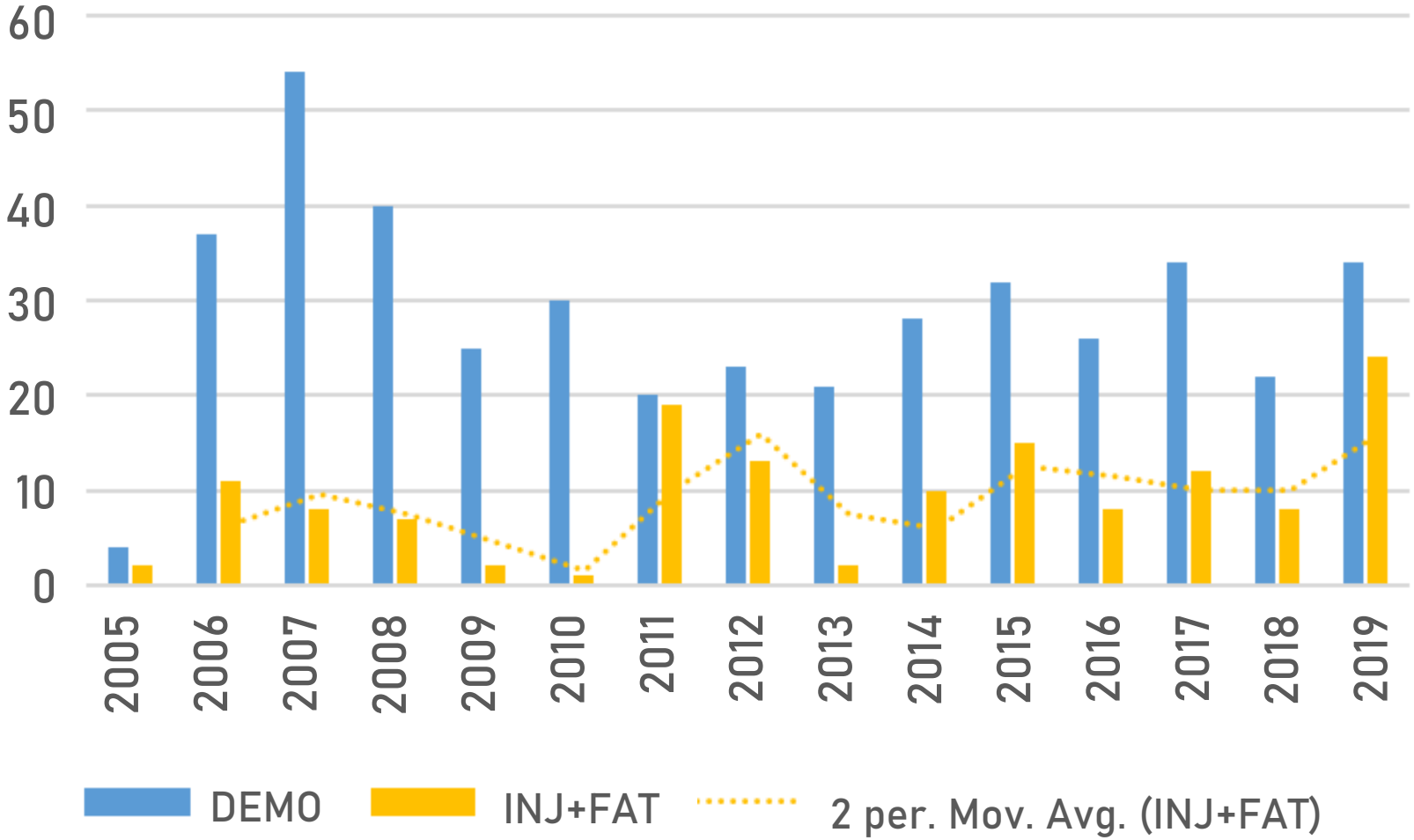
DEMO INCIDENTS vs. FATALITIES AND INJURIES



Incidents.....432
Injuries.....132
Fatalities.....10

Data not audited

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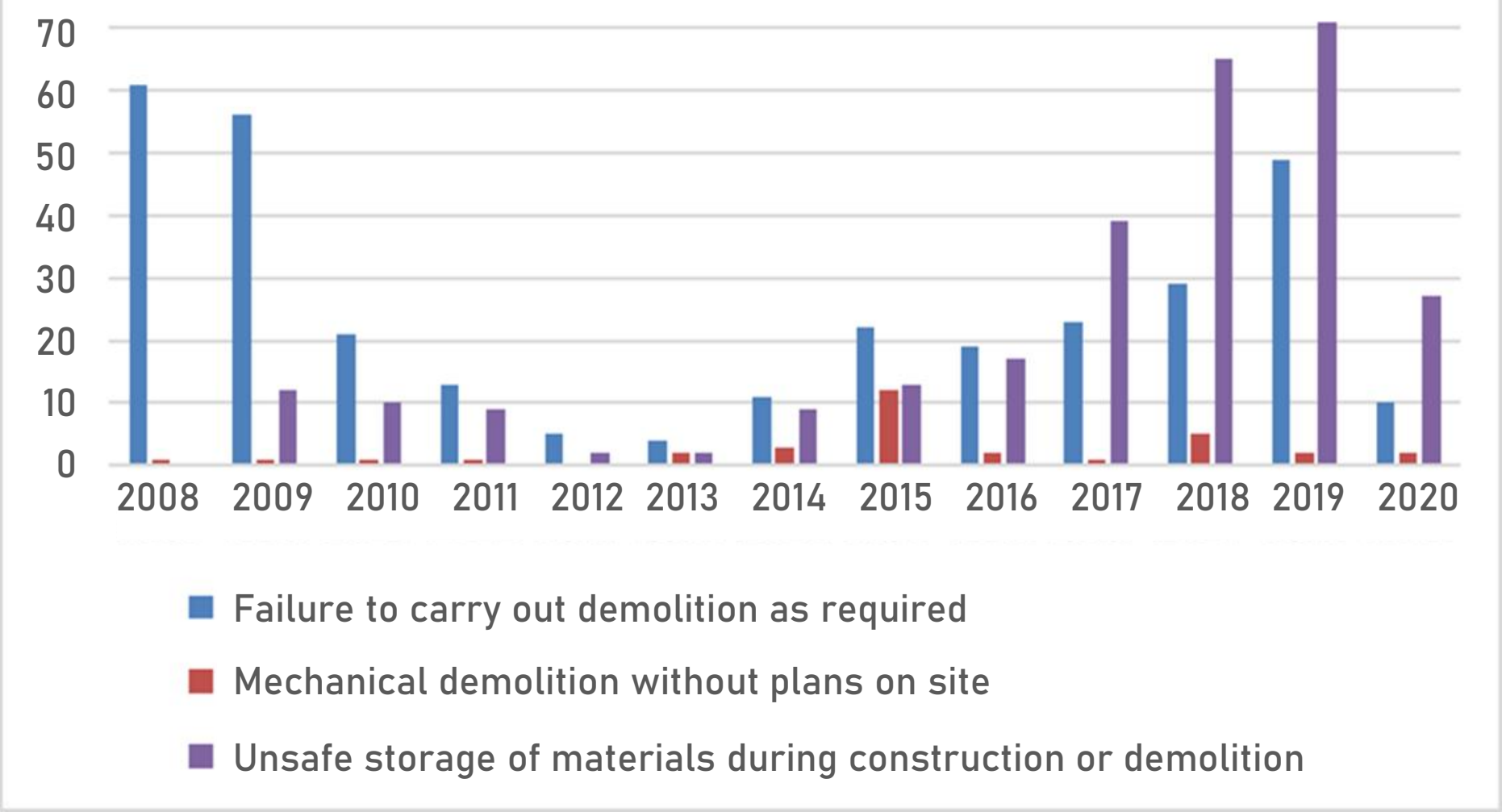
ECBs DEMOLITION



2008 NYC BC: EXCAVATION

- The Department is required to be notified at least 24 hours in advance, but no more than 48 hours prior to the commencement of certain earthwork operations.
- Adjacent property owners are required to be notified in writing 10 days in advance of certain earthwork operations.
- Person causing excavation or fill to be made is now responsible for protection of adjacent property regardless of depth of excavation.
- Pre-condition survey required; Pre-condition surveys of adjoining properties are required for:
  - Excavations between 5ft. and 10ft. deep within 10ft. of an adjacent building
  - All excavations more than 10 feet deep

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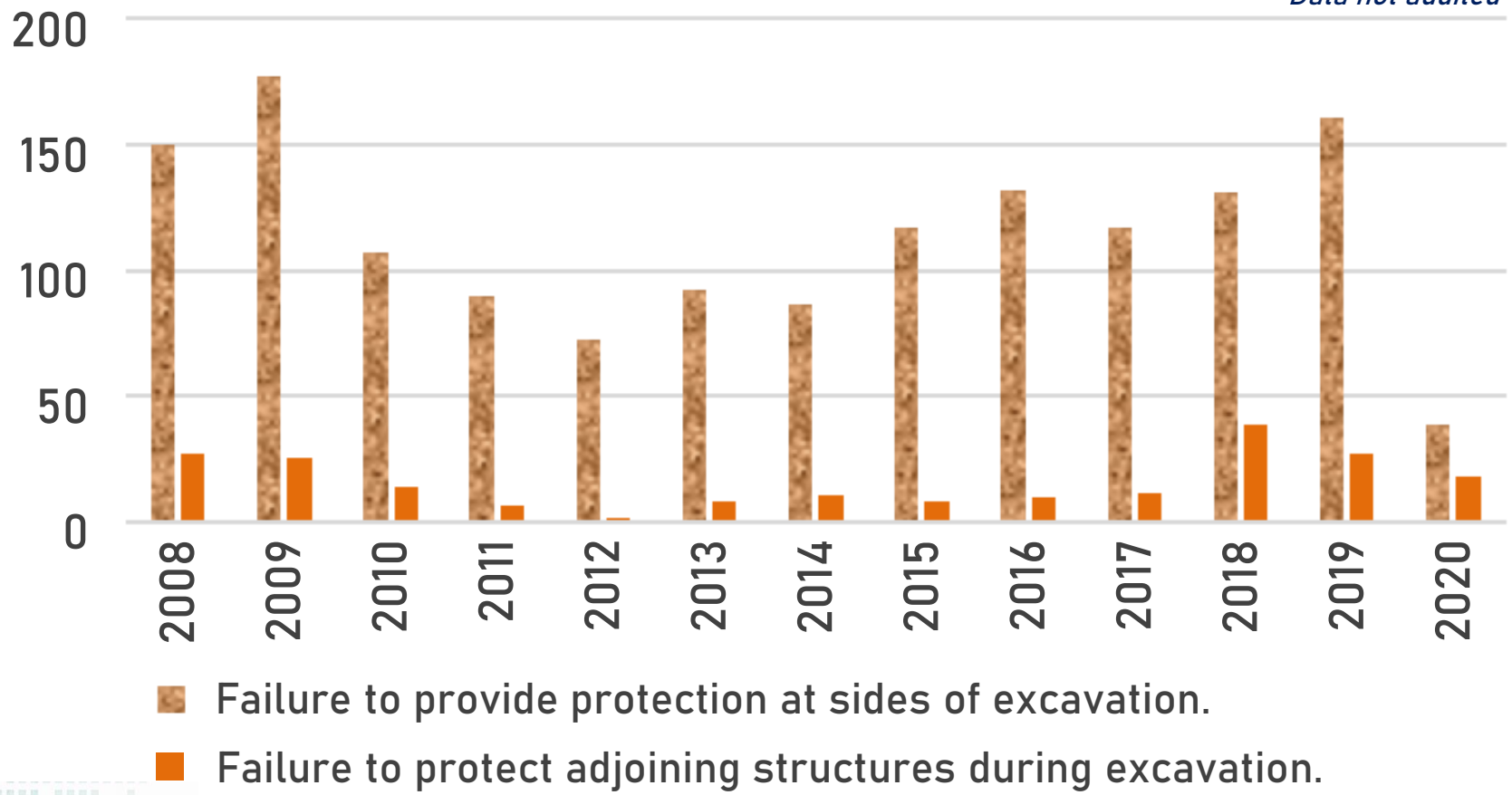
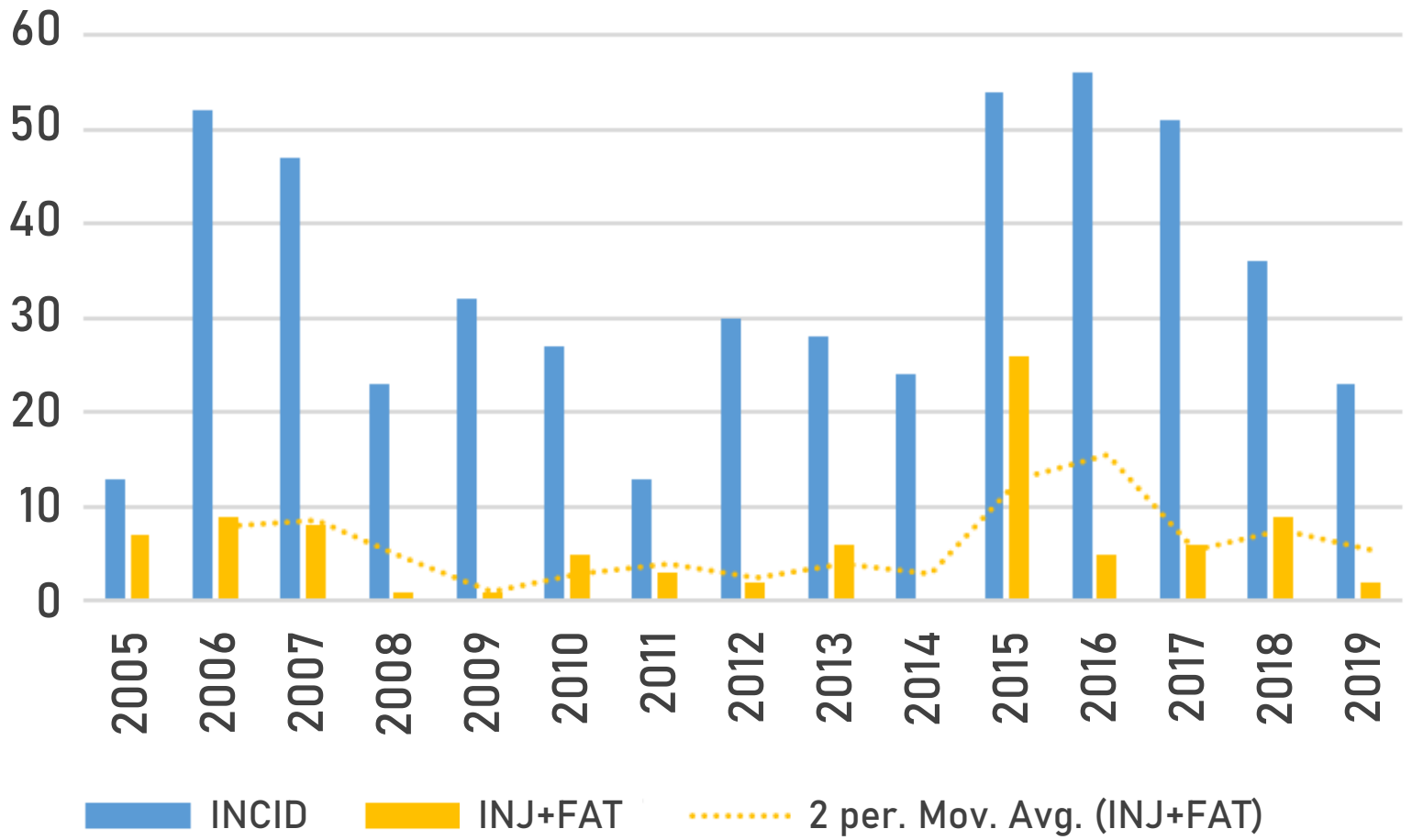
DEMOLITION

EXCAVATION

Data not audited



EXCAVATION INCIDENTS vs. FATALITIES INJURIES



Incidents.....50
Injuries.....85
Fatalities.....5

Data not audited

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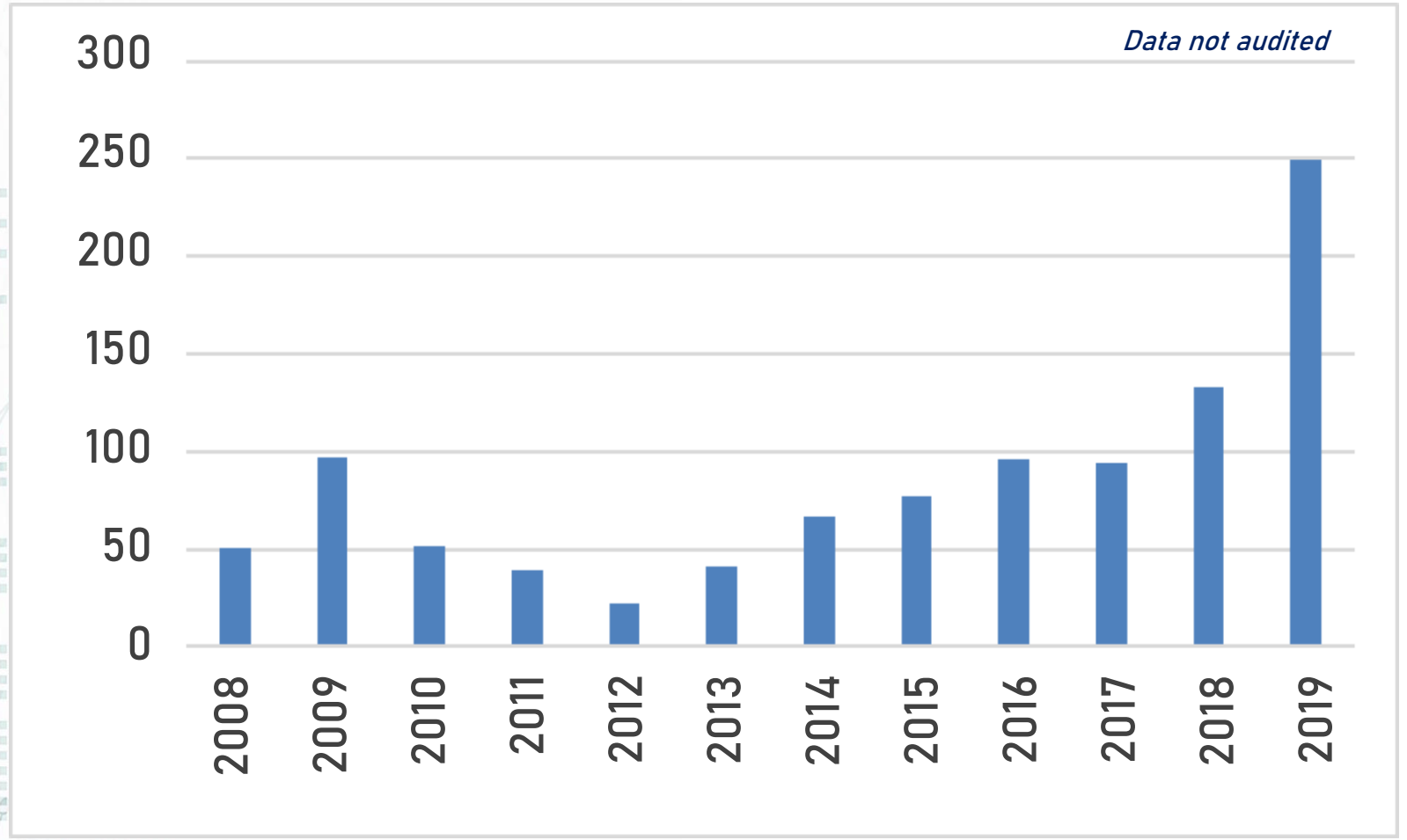
UNDERPINNING LIGHT STRUCTURES

ECB FAILURE TO PROTECT ADJOINING STRUCTURES DURING EXACAVATION



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1814.1.1 UNDERPINNING & BRACING

- Underpinning piers, walls, piles and footings shall be designed as permanent structural elements. . .
- Underpinning shall be designed and installed in such manner so as to limit the lateral and vertical displacement of the adjacent structure to permissible values as established in accordance with Section 1814.3.
- The design shall take in account the effects on foundation and structure produced by the lateral earth pressure exerted on the underpinning.

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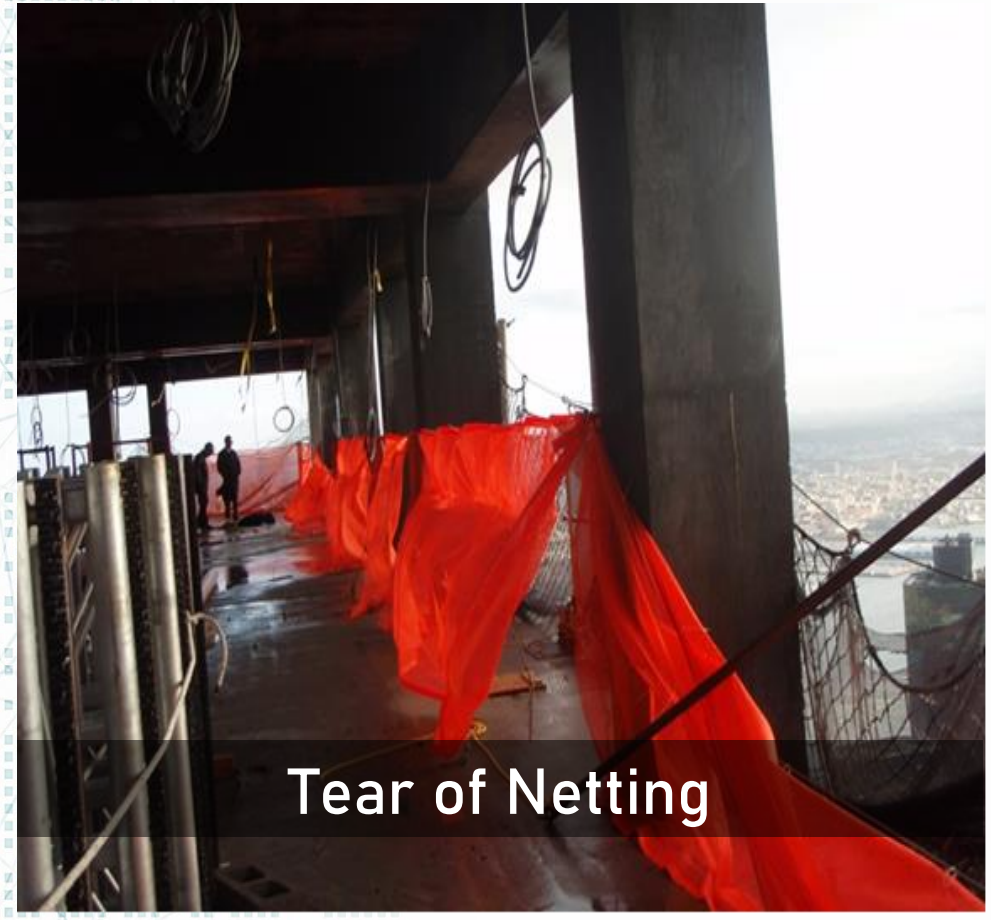
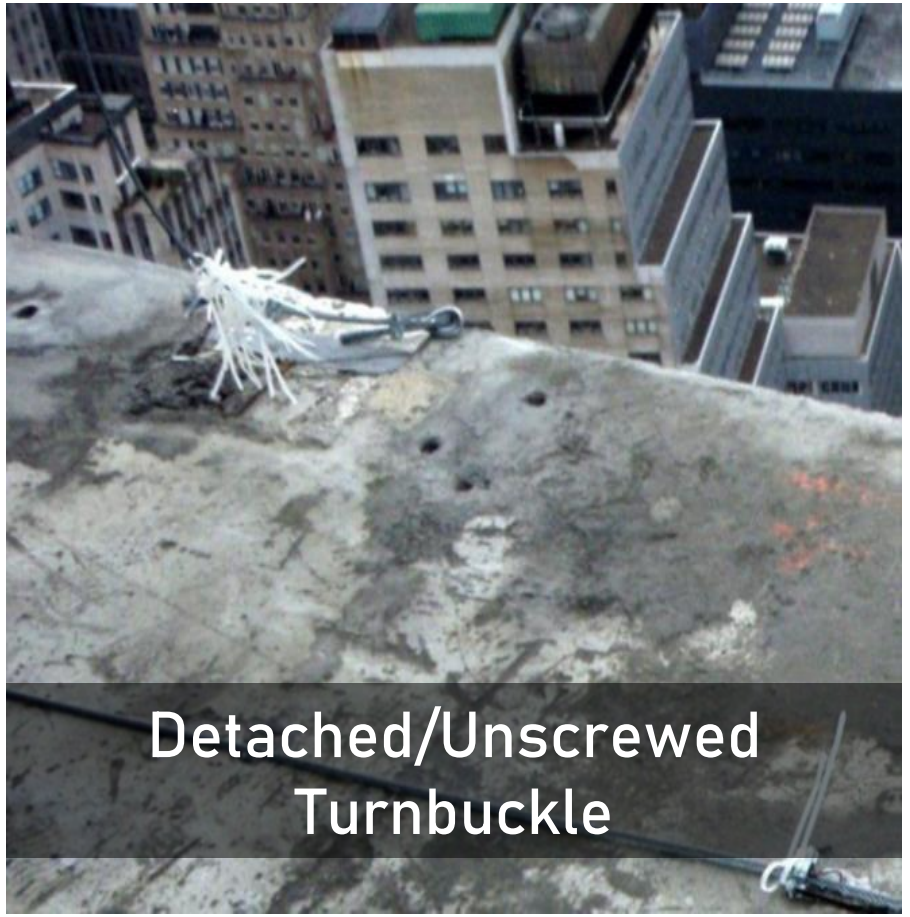
UNPROTECTED SIDES OF EXCAVATION

ACCIDENT 80 MPH SQUALL


Tear of Netting


Detached/Unscrewed Turnbuckle

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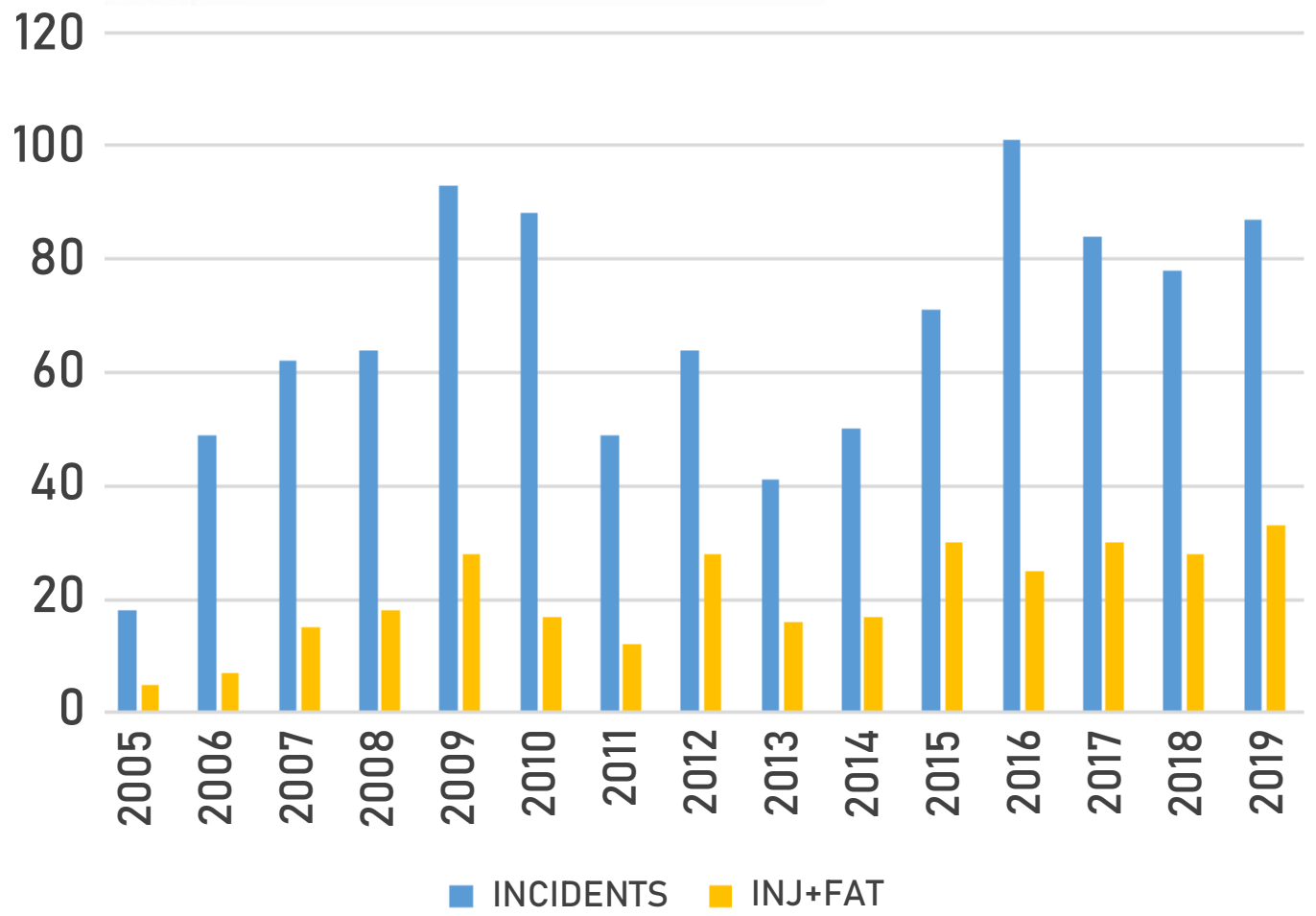
90 MPH vs. 60 MPH

ECBs SCAFFOLDS

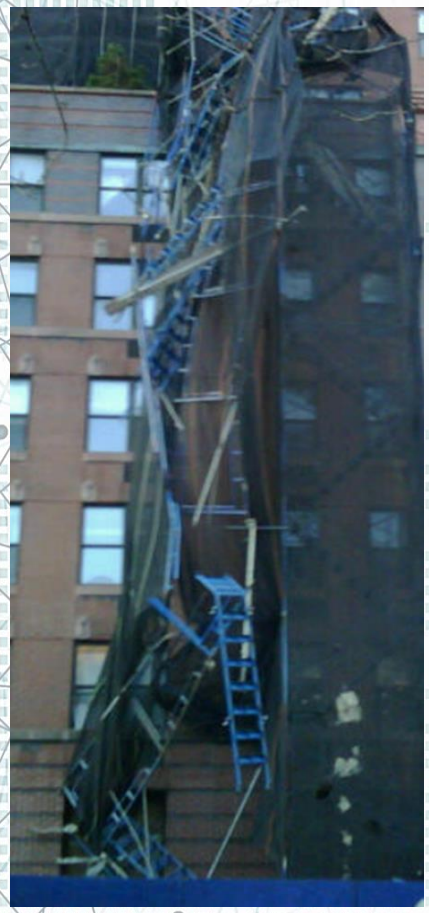
SCAFFOLD, FENCES, SHEDS



Incidents.....999
Injuries.....305
Fatalities.....3

SUPPORTED SCAFFOLD

TABLE 1704.32: Required Verification & Inspection of Post-Installed Anchors



Verification & Inspection	Continuous	Periodic	Referenced Standard	BC Reference
1. Preparation, placement, type, size and location of anchors, installed in hardened concrete, and installed to hardened concrete and to another construction	–	X	ACI318; 3.8.6.8.1.3, 15.83, 21.18	1912.1, 1908.9
2. Preparation, placement, type, size and location of anchors, including other details of anchors, installed in masonry, and installed to masonry and to another construction	–	X	Manufacturer's specifications and installation instructions	
3. Preparation, placement, type, size and location of anchors, including other details of anchors, installed in stone, and installed to stone and to another construction	–	X	Manufacturer's specifications and installation instructions	

NEW TYPES OF CONSTRUCTION
NEW CAUSES OF FAILURE

NYC Buildings

1618.2 LOADS FOR TEMPORARY INSTALLATIONS

- 1618.2 Loads. Temporary installations shall be designed and constructed to resist the loads required by Chapter 16 of this code for new construction.
- 3301.6.3 Capacity. No structure, temporary construction, or equipment shall be loaded in excess of its capacity as specified by the code, manufacturer, and/or designer. Where there is a discrepancy, the stricter standard shall apply.

  For specific installations, additional design loads are specified in Chapter 33.

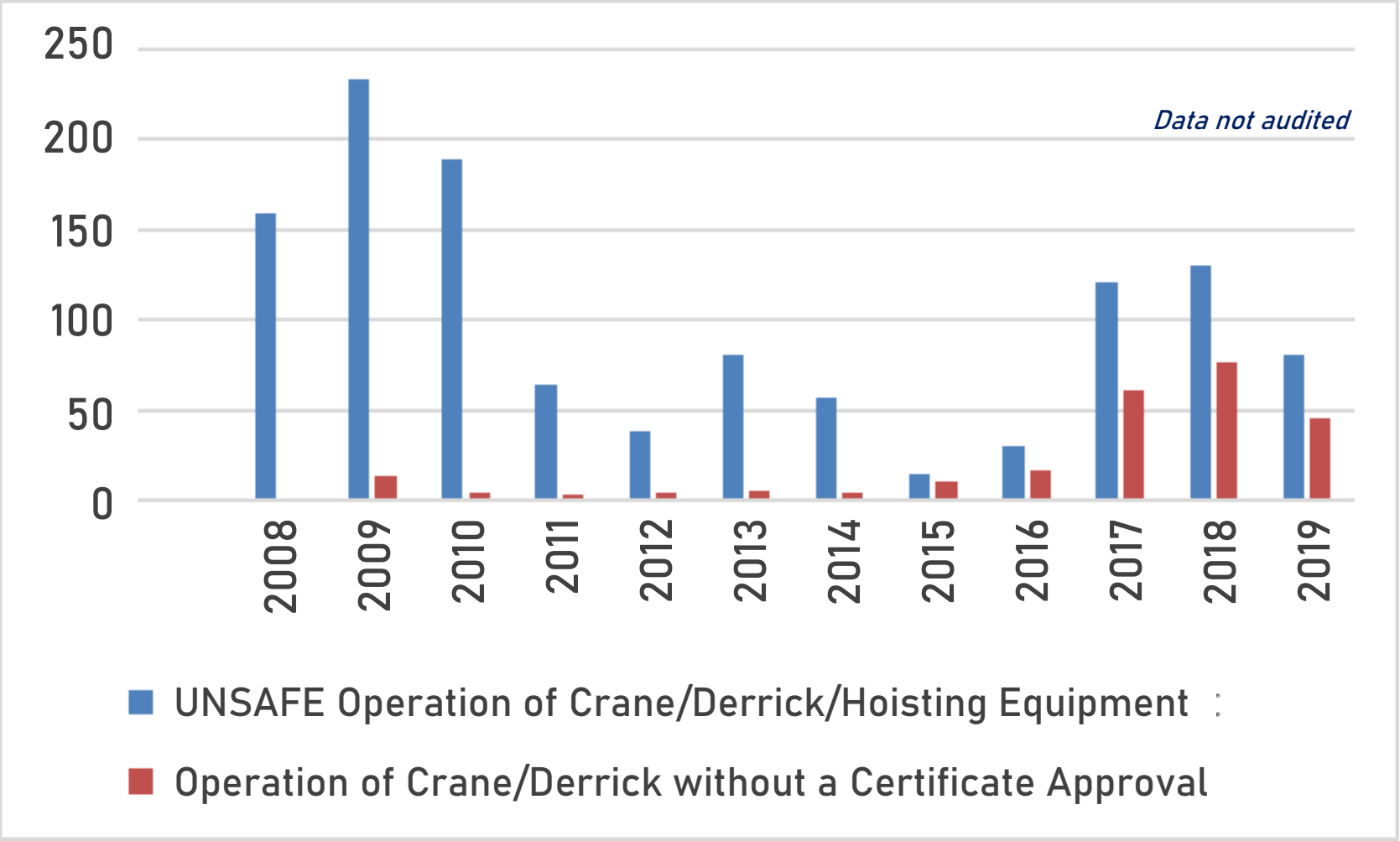
2014 NYC BUILDING CODE: SCAFFOLD

- 3314.4.4.6 Winds.

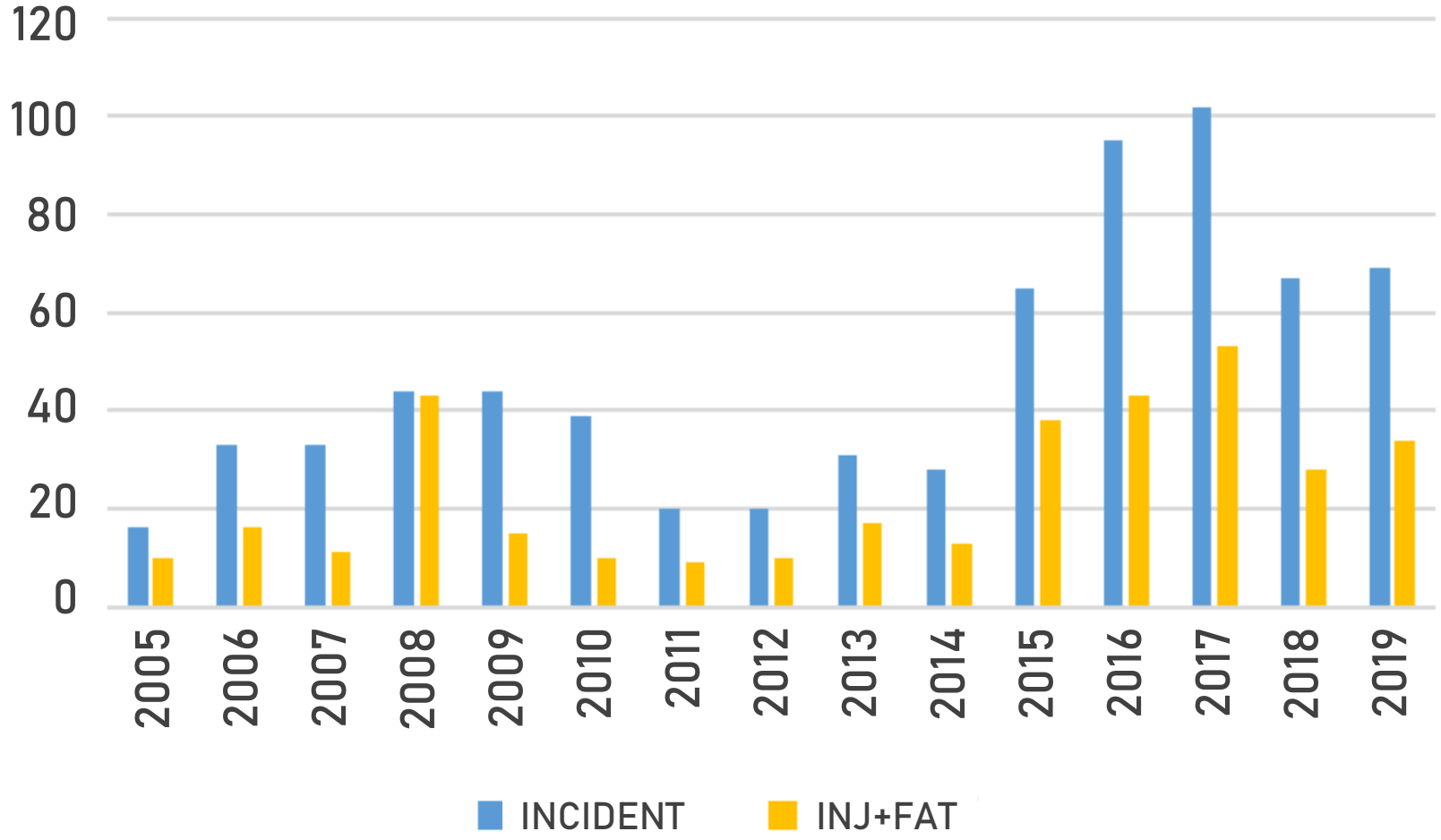
  Where sustained winds or wind gusts at the site exceed 30 miles per hour, the use and operation of scaffolds located on the roof of a building, exterior to a building or structure, on a working deck, or in an area with an unenclosed perimeter shall cease. If the manufacturer or designer of the scaffold recommends work to cease at a lower wind speed, such recommendation shall instead apply. Wind speed shall be determined based on data from the nearest United States weather bureau reporting station, or an anemometer located at the site, freely exposed to the wind, and calibrated in accordance with ASTM D5096-02.

SUSPENDED SCAFFOLD

CRANE , HOISTS, ETC.



MECHANICAL EQUIPMENT INCIDENTS vs. FATALITIES AND INJURIES

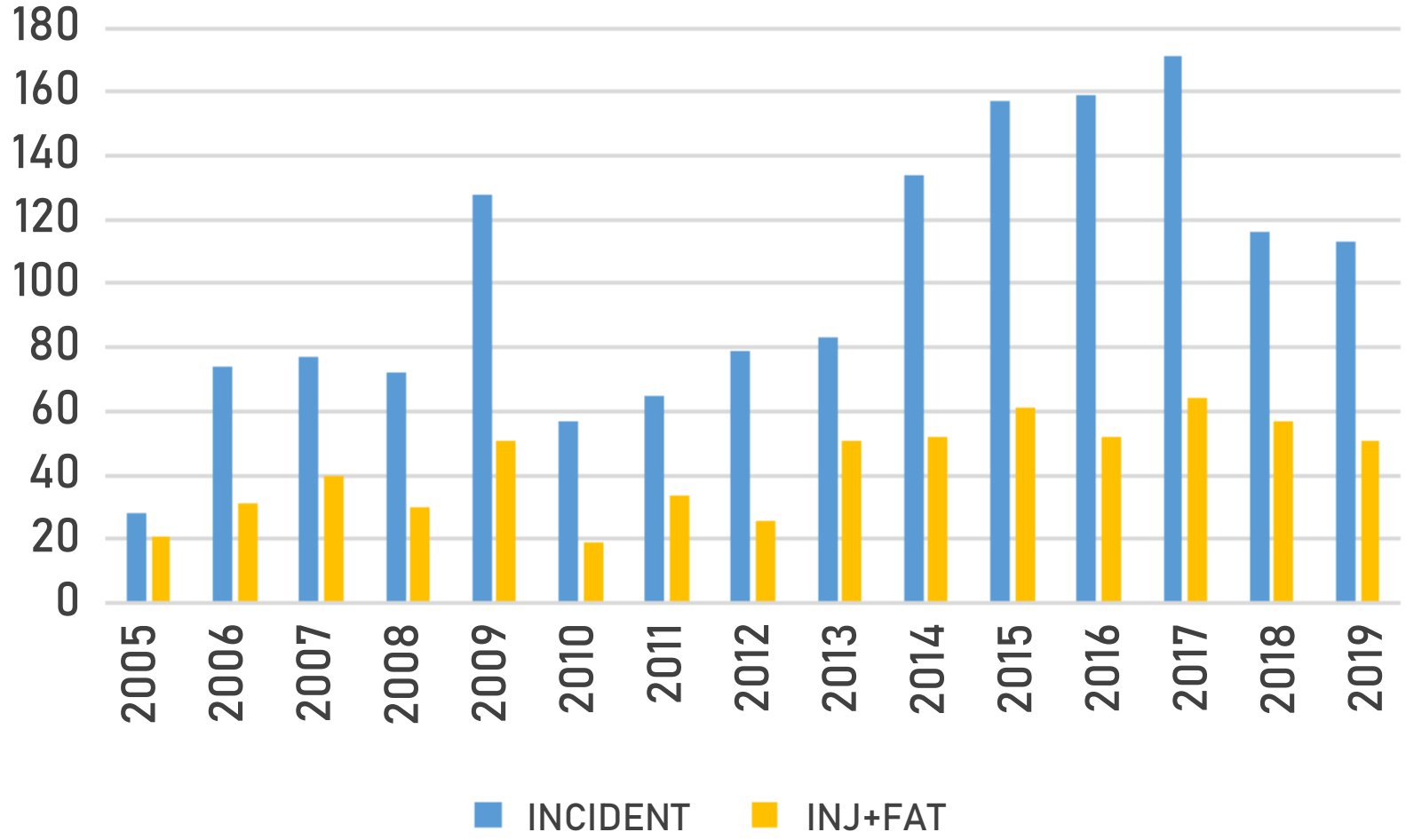


Incidents.....706
Accidents.....328
Fatalities.....22

Data not audited

NYC Buildings

MATERIAL FAILURE INCIDENTS vs. FATALITIES AND INJURIES



Incidents.....1513
Injuries.....621
Fatalities.....19

Data not audited

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SUCCESSES IN PROTECTION

SAME TYPE OF ACCIDENTS

FORMWORK COLLAPSE

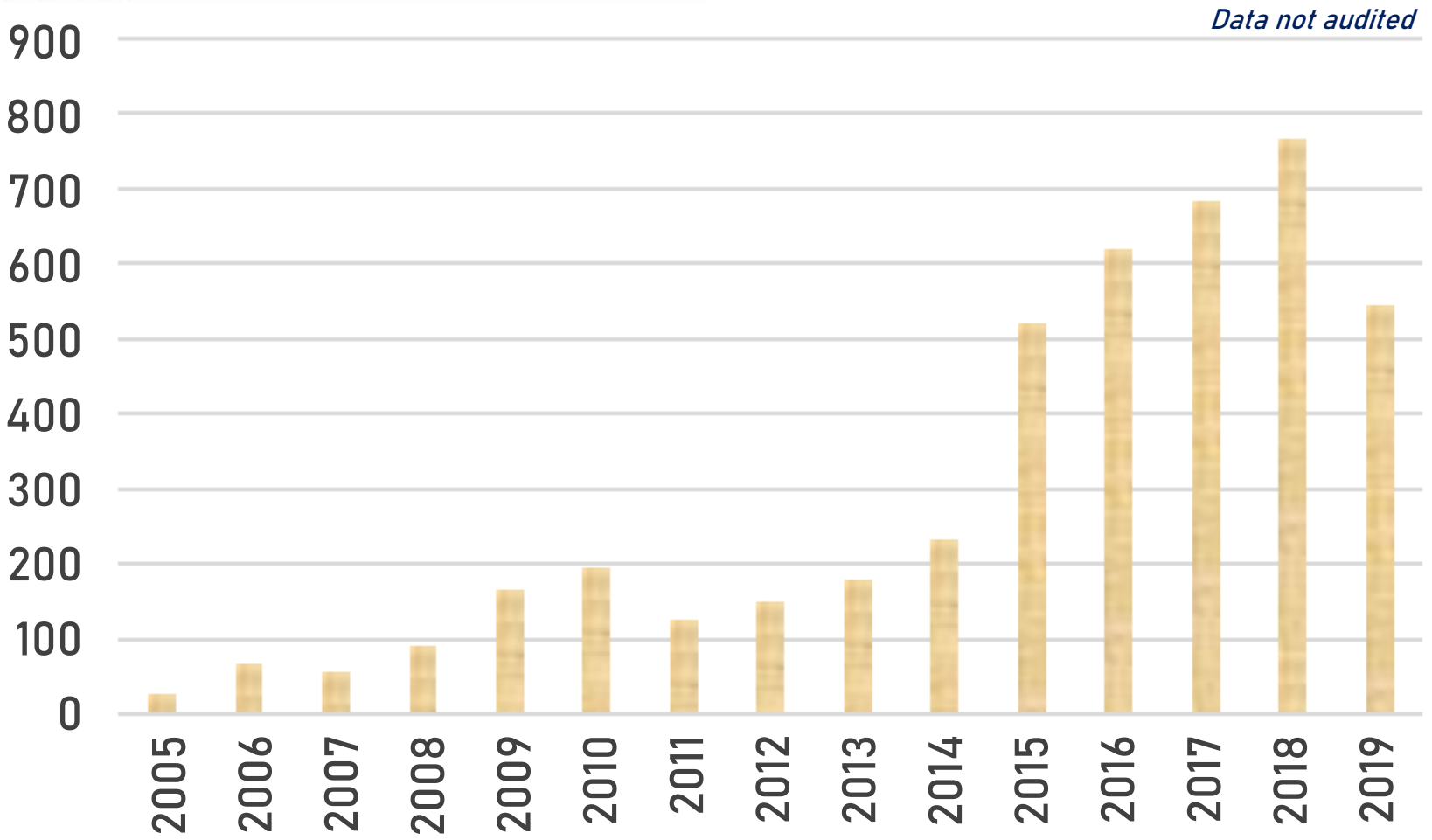
NYC Buildings

TESTING

2014 NYC BUILDING CODE: FORMWORK

- 3305.3.2.1 Design drawings.
  - For concrete formwork is in a structure classified as a major building; or
  - Wherever the slab thicknesses. . .
- 3305.3.3.2 Formwork observations.
- 3305.3.6.8 Reshoring Schedule. A signed and sealed reshoring schedule shall be provided and maintained at the construction site whenever reshoring is employed.

WORKER FALLS OR FAILS

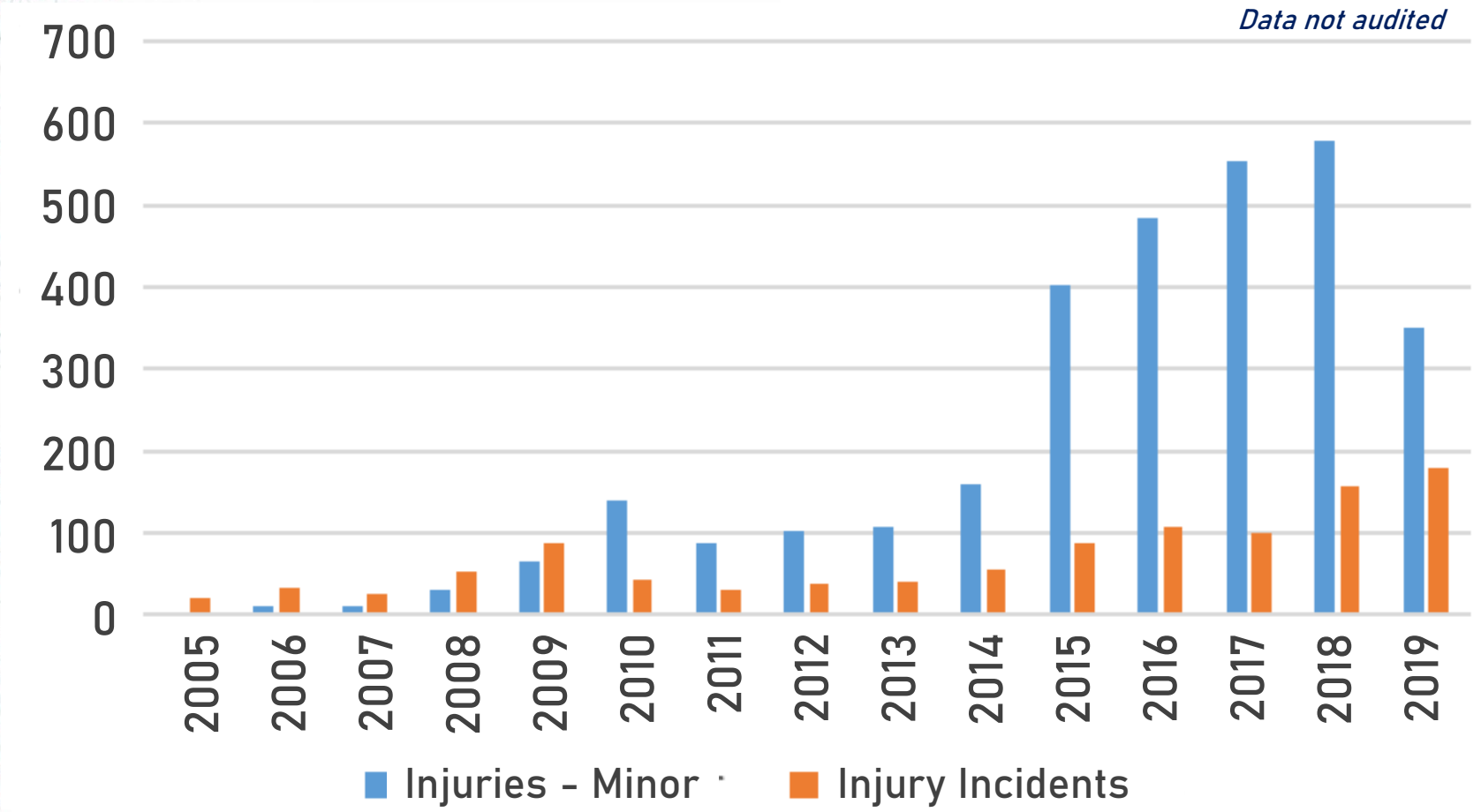


2014 NYC BC: CHANGE IN ACCIDENT DEFINITION

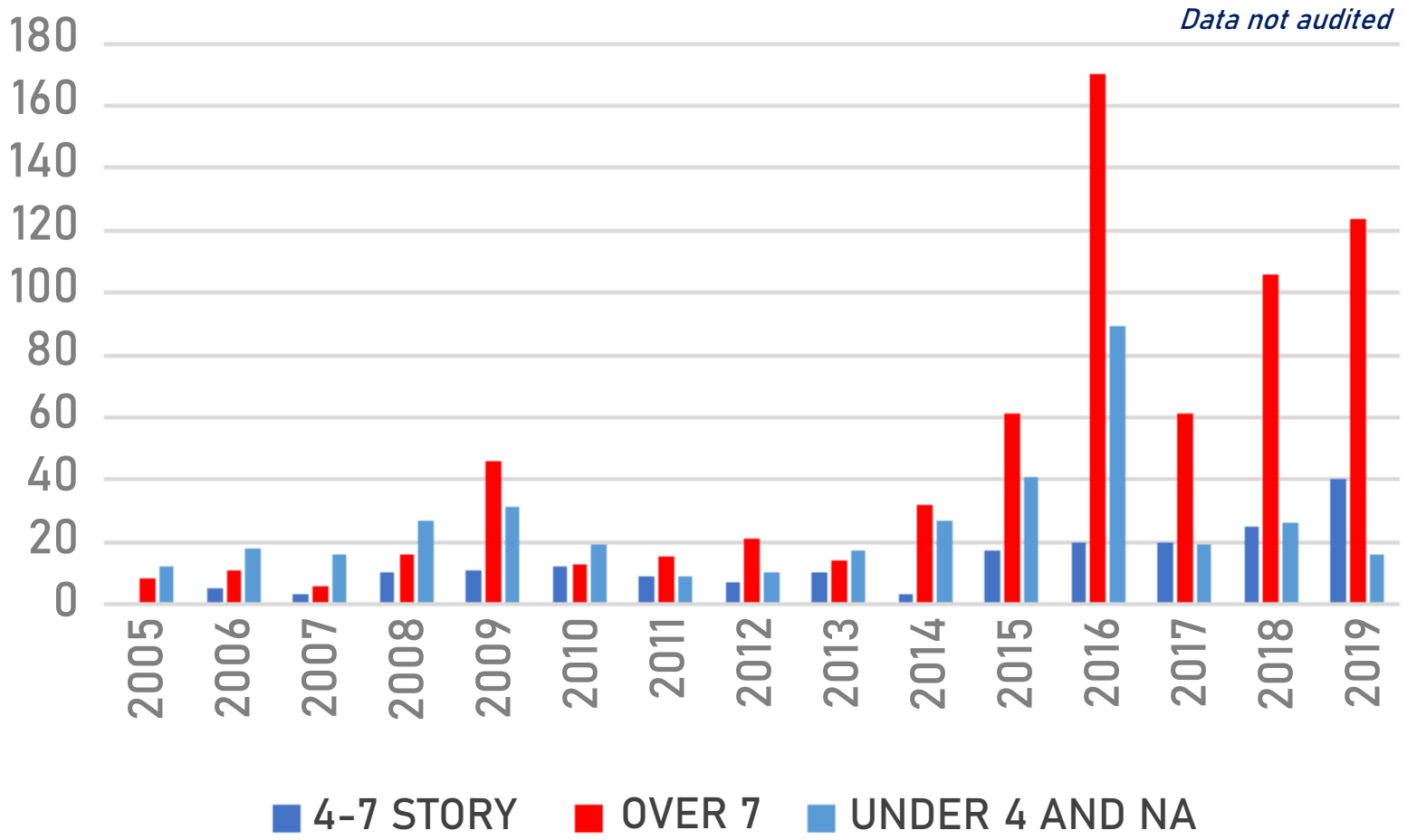
Accident. An occurrence directly caused by construction or demolition activity or site conditions that result in one or more of the following:

1. A fatality to a member of the public, or
2. Any type of injury to a member of the public; or
3. A fatality to a worker; or
4. An injury to a worker that requires transport by emergency medical services or requires immediate emergency care at a hospital or onsite medical clinic; or
5. Any complete or partial structural collapse or material failure; or
6. Any complete or partial collapse or failure of pedestrian protection, scaffolding, hoisting equipment, or material handling equipment; or
7. Any material fall exterior to the building or structure.

WORKER FALLS & INATTENTION SSM CALLS & INCIDENTS



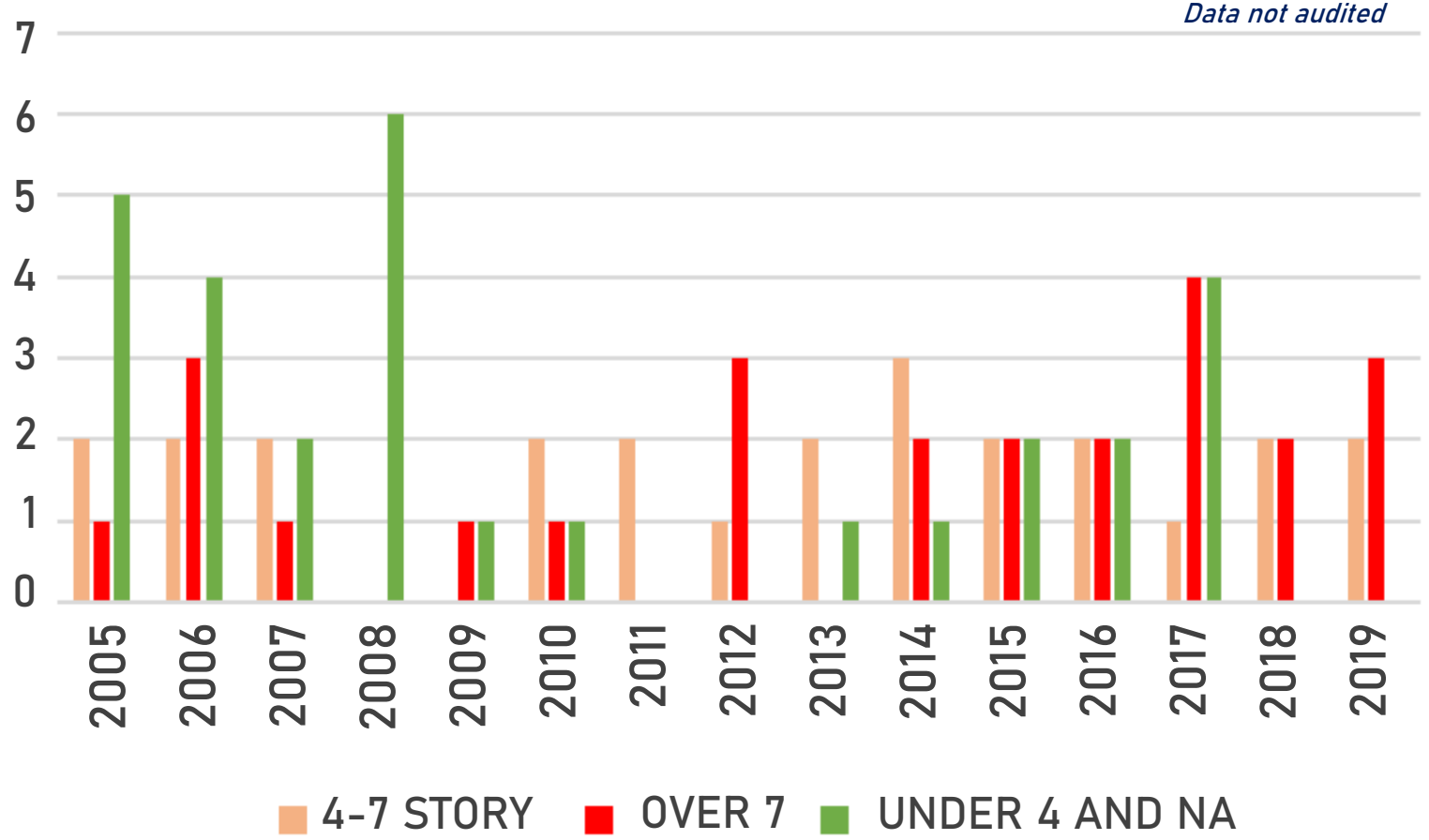
WORKER FALL & FAILURES SERIOUS INJURIES PER FLOOR



NYC Buildings

WORKER FALL FATALITIES PER FLOOR

Data not audited



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RELEVANT CAUSES WORKER FELL & INATTENTION

YEAR	medical	moving loading installing	saw cut drill	scaff shed	slip tripped missed step	stripping	Fall Off Ladder Baker Scaf.	shaft hole	fell
2009	6	8	7	23	13	1	25	7	37
2010	38	13	8	20	20	1	18	6	24
2011	15	8	5	13	11		10	5	23
2012	28	9	4	15	23		17	6	20
2013	45	6	15	7	18	5	16	3	27
2014	51	20	14	13	27	6	21	8	27
2015	81	51	32	18	67	12	37	10	44
2016	61	80	41	22	84	26	44	7	69
2017	106	84	39	26	72	13	59	14	65
2018	97	95	56	30	84	20	51	13	95
2019	44	67	41	23	72	13	41	9	55
Grand Tota	572	441	262	210	491	97	339	88	486

NYC Buildings

UNSAFE HUMAN BEAHVIOR

(from literature)

- Failed to secure and warn
- Failed to wear personal protective equipment
- Horseplay
- Operated at unsafe speed
- Personal factor
- Remove safety device
- Took unsafe position or posture
- Used defective tool or equipment
- Unsafe act of another person(s)
- Disregard known prescribe

SITE SAFETY PERSONNEL 2008

Site Safety Manager is responsible for monitoring compliance on major buildings:

- New Construction
- Full Demolition
- Façade Alterations needing a sidewalk shed
- Partial Demolition
- Exception Interior Partial Demo using only hand tools
- Site Safety Managers and/or Coordinators are not required for SOME Façade Alterations of buildings.

Site Safety Coordinator can be substituted for a Site Safety Manager for New Construction and Partial Demolitions of Major Buildings:

- Less than 15 stories, and
- Less than 200 feet in height, and
- Less than 100,000 square feet of lot coverage.

2008 MAJOR BUILDINGS BC 3310

Filing of a Site Safety Plan

Assignment of Site Safety Manager or Coordinator to monitor compliance with safety requirements.

CHANGES TO THE DEFINITION OF MAJOR BUILDING

New NYC Construction Code (Building Code Section 3310.2)	*Current* NYC Building Code (Rules & Regulations Chapter 26 Appendix A)
• 10 or more stories, or • 125 feet or more in height, or • 100,000 ft^2 or more of lot coverage regardless of height, or • Any other building as designated by the commissioner	• 15 or more stories, or • 200 feet or more in height, or • 100,000 ft^2 or more of lot coverage regardless of height, or • Any other building as designated by the commissioner

MAJOR BUILDINGS SUPERVISION

MAJOR BUILDINGS (15+ Stories or 100,000+ sq ft)				
		Contractor Requirement	Superintendent Requirement	Site Safety Requirement
NB Alt [1] [2] DM	Current	Safety registration number or insurance tracking number[3]	None[4]	Site Safety Manager

MAJOR BUILDINGS (10 to 14 Stories)				
		Contractor Requirement	Superintendent Requirement	Site Safety Requirement
NB Alt [5] [6] DM	Current	Safety registration number or insurance tracking number[7]	None[8]	Site Safety Manager or Coordinator

NYC Buildings

NON-MAJOR BUILDINGS SUPERVISION

NON-MAJOR BUILDINGS (1-9 Stories) excluding 1-, 2-, 3-Family				
		Contractor Requirement	Superintendent Requirement	Site Safety Requirement
NB Alt [9] [10] DM	Current	Safety registration number or insurance tracking number[11]	Construction Superintendent	None

MAJOR BUILDINGS (10 to 14 Stories)				
		Contractor Requirement	Superintendent Requirement	Site Safety Requirement
NB	Current	General Contractor	None	None
Alt [5] [6] DM	Current	Safety registration number or insurance tracking number[14]	Construction Superintendent	None

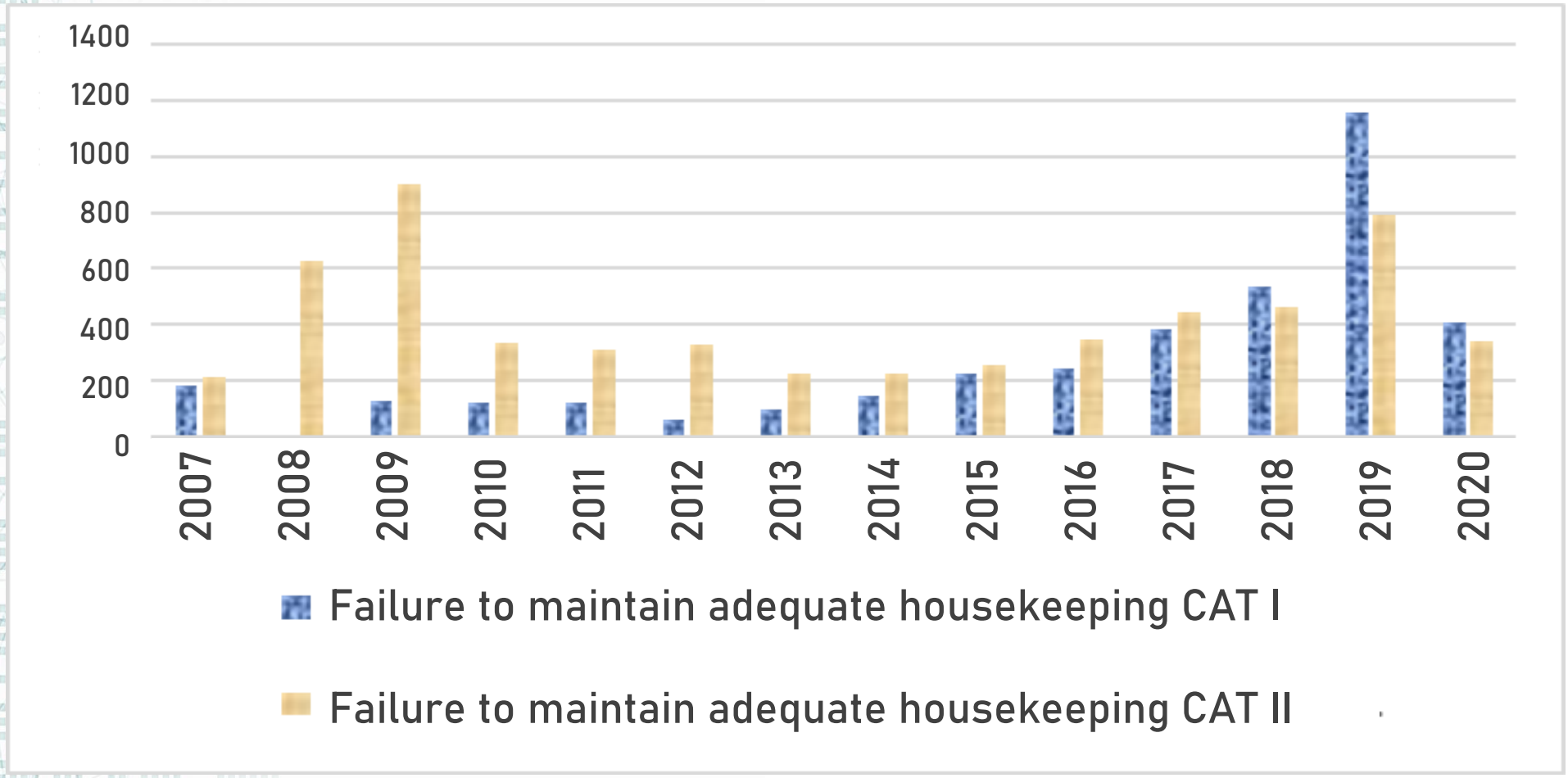
NYC Buildings

SAFE SITE

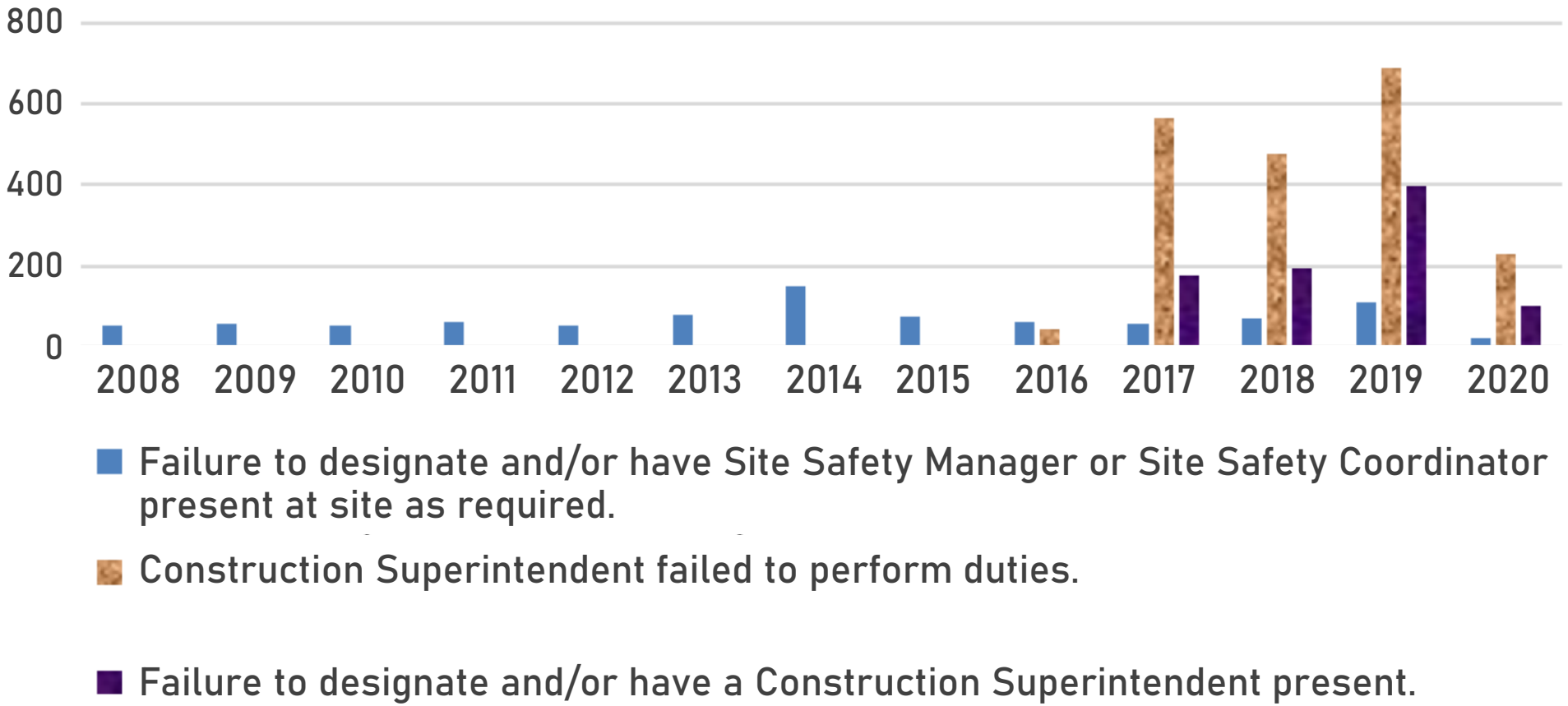
(from literature)

- Reliable and clean work condition
- Using safeguard at high level
- Using skilled worker
- Enough training for worker
- Provide reliable inspection
- Availability of emergency aid
- Availability of protective equipment

HOUSEKEEPING



ECBs SUPERVISION



SAFETY CONSIDERATIONS

- Nature of the project, new construction –renovation, demolition
- Uncertainty, complexity of threats
- Construction method, conventional – prefab Manual operations
- Construction site, restrictions, congestion
- Project duration Time pressure
- Design complexity Construction complexity
- Sub-contractors, fragmentation of workforce
- Height, low–high rise Working at a height

After P. Wuste

NYC Buildings

TRAINING REQUIREMENTS

- Scaffold works 2001 – Rule 9 of the 1968 Code required individuals on suspended scaffolds to complete training
- Local Law 52 of 2005 required training for individuals on most supported scaffolds.
- Local Law 41 of 2008 introduced the requirement that workers at major buildings complete OSHA 10 training.
- Local Law 196 of 2017 expanded this to the present site safety training (SST) requirements

TRAINING REQUIREMENTS

(continued)

- For cranes and rigging, Local Law 44 of 2008 required training for those engaged in tower crane assembly/jumping/dismantling.
- 2014 NYC Building Code required training for all workers engaged in general rigging work.

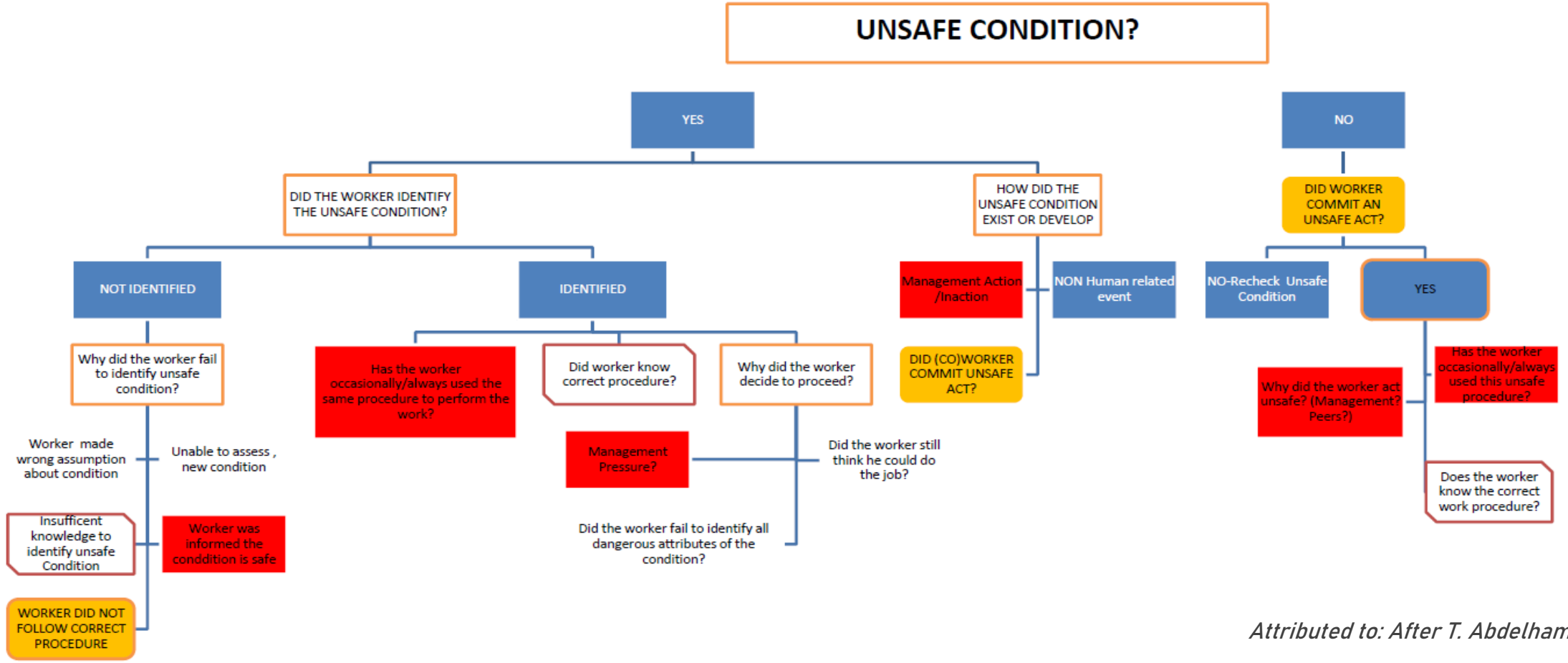
NYC Buildings

MANAGERS TO OBSERVE & REDUCE UNSAFE CONDITIONS

- Defects of accident source
- Dress or apparel hazard
- Environmental hazard
- Fire hazard
- Hazardous arrangement
- Hazardous method
- Housekeeping hazard
- Improper assignment of personnel
- Inadequately guarded
- Public hazard
- Other unsafe conditions—physical factors
- Undetermined

NYC Buildings

ROOT CAUSE?



Attributed to: After T. Abdelhamid

OWNERS & DESIGNATED MANAGERS

- Identify safety rules and guidelines that the contractor must comply.
- Providing a permit system regarding the potentially hazardous tasks.
- Force the contractor to allocate an accountable supervisor to coordinate safety on the site.
- Discuss about safety issue at regular meetings between owner and contractor.
- Develop safety monitoring during construction.

OBSERVING & PREVENTING

- The precursor is defined as the signs that always seem to precede the accidents caused by this kind of safety hazard on construction sites.
- Immediate factors are defined as the failure in the interaction between the work team, workplace, equipment and materials, which are important exacerbating factors of accidents on construction sites.
- A near miss is defined as an event in which no damages or injuries actually occurred but, under slightly different circumstances, could have resulted in harm.

EOR ROLE

Should

- Review designs
- Create design documents
- Assist the owner in procuring construction
- Review submittals
- Inspect work in progress

Attributed to: After J. Gambatese

Problems

- Lack of safety expertise
- Lack of understanding of construction processes
- Typical contract terms
- Professional fees

THANK YOU

NYC Buildings