19TH CENTURY CORNER LOT BUILDING

PRESENTED BY

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20 build safe live safe DIGITAL CONSTRUCTION 21 SAFETY CONFERENCE

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PRESENTATION OVERVIEW

- As NYC's 19th Century occupied buildings age and are modified to suit different usage, structural components wear out and break, becoming defective and unsafe. In order to protect the health safety and welfare of building occupants and general public, property owners must maintain their buildings safe and Code-complaint. This presentation brings into focus an often overlooked small but challenging group of occupied and vacant buildings; corner lot buildings.
- Corner lot buildings abut two publicly accessible sidewalks, one of which is typically a heavily trafficked avenue. Any defective façade elements; be it an old wood cornice, deteriorated brownstone, or leaning walls, can lead to serious ramifications to public safety and the overall structural stability of the building. These 19th Century corner lot buildings can be found in every neighborhood in the City, providing much needed convenience stores and food service on the ground floor with apartments on the floors overhead.



PRESENTATION OVERVIEW

(continued)

- The original structural configuration comes with serious wear and tear challenges to the ground floor, as most of the structure was originally omitted to allow for the large store front windows and doors. This type of structure, where the upper building rests on two beams and a corner column, engineers call soft stories. In such scenarios, the original minimal ground floor structure is comprised of cast iron columns and large steel lintels supporting the building overhead. Critical Watch Out factors will be discussed that recognize and evaluate soft story corner lot buildings.
- How critical *plumb*, straight and true walls and columns are for this small but challenging population of buildings ae reviewed. The long-term corrosion of the steel lintel beams and how this impacts the support of upper floors are addressed. As the ground floor stores are basically open plans, we will discuss the effects of typical rotting and deterioration of 2nd floor wood framing apartments, the stability of store columns and beams. Additionally important, are the negative effects that construction poses on or next to a soft story corner lot building.



FOCUS

Avoiding one time catastrophic structural event leading to full or partial collapse of a publicly occupied structure by discussing:

- Examples of recent partial and full collapses leading to demolition of tenanted buildings;
- Emerging patterns of structural deterioration with 19th Century corner lot and end wall tenements and converted dwellings; and
- HPD Old Law Tenements, heretofore converted dwellings



19TH CENTURY CORNER LOT & END WALL TENEMENT

- Full collapses of existing buildings are rare, however, partial collapses of exterior walls and floors are frequent occurrences and not so random.
- Research has shown that structural incidents occur most frequently in 19th Century corner lot and end wall tenement buildings. These account for +/-13K 19th Cent corner lot/end wall tenements amongst New York City's 800K occupied buildings. These buildings are classified by HPD as Old Law Tenements (OLT), New Law Tenements (NLT) and Heretofore Converted (HTC) occupied buildings.



19TH CENTURY CORNER LOT & END WALL TENEMENT

As buildings age, structural components wear out, or, were modified to suit different occupancy needs, the structural stability issues with corner lot buildings pose an increased risk to occupants and public safety as these buildings **typically** have:

- high pedestrian traffic bordering streets and avenues
- have stores or food on the ground floor
- have a ground floor soft story comprising large store front windows and doors
- have unrestrained bearing walls.



19TH CENTURY CORNER LOT & END WALL TENEMENT

In this presentation, technical guidance will be provided to recognize unsafe components such as:

- loose and failed cornices
- cracked, delaminated and out of plane masonry bearing walls (critical)
- deteriorated and unrestrained cast iron corner columns and 2nd FI steel lintels (critical)
- deteriorated and unrestrained stone lintels over windows (critical)
- negative impact to the building from adjacent demolition and foundation construction (critical).



Outlining what we mean by **19th Century** unreinforced masonry corner lot tenements and end wall buildings

- Generally built between 1840s and 1901 typically 1850's
- Prescriptively designed brick bearing wall buildings located on the corner of a block exposed on a street on one side and an avenue on the other.
- Downtown areas/dense urban environment
- Generally four stories: three stories of regulated tenants over commercial ground floor (convenience stores / food service)
- Three walls exposed to the elements long side walls are bearing walls. All exposed walls are unrestrained, free to deform.
- Ground FI structure comprises cast iron corner column supporting steel lintel beams at 2nd floor supporting building = soft story.
- Ground floor is open space for mixed use 2nd floor transfers all the partitions, stairs and can be very overloaded





3rd, 4th, 5th and 6th floors transferred over 2nd floor lintel beam – SOFT STORY at ground floor

3rd floor transferred
over 2nd – SOFT
STORY

2nd floor transferred over 3rd – SOFT STORY





19TH CENTURY BUILDING: 1850s SOFT STORY GROUND FLOOR



BEFORE



AFTER 2020

Recent collapse of in-service corner lot three story 1850s **soft story** ground floor

- Unrestrained and buckled street line bearing wall
- Code required:
 28-301.1 Owner to maintain safe.



19TH CENTURY BUILDING: 1850s MID BLOCK 4-STORY BUILDING



BEFORE



AFTER 2020

Recent collapse of permitted, mid block 4-story 1850s building

- Roof open; demolition of adjacent building; underpinning of bearing wall
- Code required:
 28-301.1 Owner to maintain safe.



BROOKLYN RESIDENTIAL COLLAPSE



- Occupied multiple dwelling 1850's
- Adjacent rowhouse demolished 1960's
- End building unrestrained party wall

BEFORE

AFTER





MANHATTAN RESIDENTIAL COLLAPSE



- Entire collapse of 1870s rowhouse
- Adjacent buildings demolished 20 years prior
- Unrestrained end/bearing walls



MANHATTAN PARTIAL COLLAPSE



 Partial collapse of soft story during 2011 demolition



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MANHATTAN OLT COLLAPSE



- 2008 corner lot OLT collapse of soft story ground floor – façade on cast iron cols
- Previous demolition of adjacent tenement
- Tenants vacated by owner



COMPONENT FAILURES – COMMON RATE OF DECAY SLOW – IMPERCEPTIBLE

- Failure of 140 year old wood cornice very common dangerous
 - Remove and restore straight forward work
- Separation of the exterior 4" of running bond walls from the backup 8" thick walls and buckling of the bearing walls – common and will lead to partial collapse. Rate of decay slow.
 - Time consuming and onerous work involving shoring and reconstruction in kind
- Front to back stair well walls (relieving walls/3rd bearing walls) are critical as they redistribute floor loads to the cellar. Open plan mixed use on the ground floor omits these relieving walls greatly impacting the structural performance of the second floor joists which can seriously deform and fail pulling the upper floors with them
 - Time consuming and onerous work involving shoring and reconstruction





Corner cast iron column struck by vehicle Cast iron column shattered 2021



12" displacement Full fracture and loss of Cl col







 3 steel beams at 2nd floor bearing on 12" square cast iron column w/o bolts
 Front wall

Front wall above 2nd floor built directly on steel beams without connections



8" bearing wall separated from joist ends 4" No mechanical ties from joist ends to wall Wall 12" out of plane

4" gap





Collapse of Wood Cornice & Face Brick

Original wood cornice collapse and delamination of face brick; very common with running bond walls







1840s FederalEra tenementrowhouse with4" deformationacross façade



Brownstone cornice over doors and window collapsed – 1870s tenement converted dwelling







POSSIBLE TO SHORE, PARTIALLY DEMOLISH & RECONSTRUCT IN-KIND





RECONSTRUCTION





- End bearing wall pulled away 8" from joists
- Outside 4" brick layer pulled free from 8" backup
- Wall to be reconstructed 2019



RECONSTRUCTION



1830s Federal Era tenements: partial uncontrolled collapse of 4 buildings; around corner all reconstructed in kind



RECONSTRUCTION





- Double depth cellar undermined
- Building leaned to the site 18"
- 10 years to reconstruct



DETERMINING STRUCTURAL RISK BY THE NUMBERS FOR NYC'S CORNER LOT BUILDINGS





ORIENTATION: NUMBERS

New York City's Building Population : 1,100,000 existing buildings (800,000 occupied)

- 550,000 1 and 2 Family dwellings
- 140,000 Multiple Dwellings (over 3 families): <- interested in this sub-population</p>
- 16,000 apartment and commercial buildings over 6 stories
- 100,000 Commercial, Public, Other

Corner Lot Buildings: 130,000 total

 Only interested in 19th Century unreinforced masonry multiple dwellings and mixed use buildings problem population



ORIENTATION: NUMBERS

Pre 1901 Old Law Tenements –3,400 corner lot buildings **<- Problem population** 1901 – 1929 New Law Tenements –7,600 corner lot buildings **<- Problem population** Pre 1929 Converted Dwellings – 1,700 corner lot buildings **<- Problem population** Post 1929 Converted Dwellings – 1,700 corner lot buildings Post 1929 Apartments – 6,500 corner lot buildings

To focus our research, start with the 13K buildings that have

- Commercial on the ground floor and residential overhead
- Complaints for Failure to Maintain (BIS Complaint Categories 10, 30, 73)
- BIS violations issued for Hazardous Conditions
- Lack of evidence of owner repairs BIS filings and similar



CORNER LOT SURVEY: ONGOING

Two rounds of Inspection surveys of 400 buildings

- Old Law Tenements and Converted dwelling corner lots with commercial ground floor
 - Pre-1900 old-law tenements,
 - buildings 4 stories or less,
 - buildings on corner lots with **failure to maintain** complaints
 - commercial use on ground floor
 - Approximately **400** corner-property locations of interest throughout the City.





CORNER LOT INSPECTIONS: OLT, NLT, HTC WITH MIX ON GROUND FLOOR

Failure to Maintain, Hazardous Violations

U	$U46$ \checkmark : \times \checkmark f_x																			
	A	В	с	D	E	F	G	н	1	J	к	L	м	N	0	Р	Q	R		
1	Address	Boro	Block	Lot	bin	СВ	# floors	Vacate Order	swo	OT Work	cnstrct yr	Complaint #	# Date of Inspection	Inspector Name/ Badge	Compl Disp	NOV issued Y/N	NOV #(s)	Emgncy Order Issued Y/N -	ту	
2	1033 LOWELL STREET	BX	2757	66	2006286	202	3	NO	NO	YES	1930	2305333	8/25/2020	Dupree/2771	A8	Y	35475623N	Ν		
3	4801 8 AVENUE	BK	778	10	3012814	312	3	NO	NO	YES/2017	1934	3765343	9/2/2020	Butler/2770	12	N		Ν		
4	486 DEAN STREET	BK	1136	8	3027812	308	4	NO	NO	YES/2017	1930	3765345	8/25/2020	Butler/2770	12	N		N		
5	788 FRANKLIN AVENUE	BK	1178	53	3029603	308	4	YES	YES	YES/2019	1925	3765347	8/25/2020	Butler/2770	12	N		Ν		
6	108 ALBANY AVENUE	BK	1210	39	3030210	308	4	NO	YES	YES/2016	1931	3765348	8/25/2020	Butler/2770	12	N		N		
7	374 RALPH AVENUE	BK	1344	125	3035746	308	4	NO	YES	YES/2019	1910	3765349	8/25/2020	Butler/2770	12	N		Ν		
8	1116 BEDFORD AVENUE	BK	1974	25	3056579	303	4	NO	YES	NO	1930	3765350	8/24/2020	Butler/2770	12	N		Ν		
9	682 BEDFORD AVENUE	BK	2224	34	3335316	301	3	NO	NO	NO	1931	3765351	8/24/2020	Butler/2770	12	N		Ν		
10	1549 DEKALB AVENUE	BK	3237	1	3073631	304	4	NO	NO	NO	1931	3765352	9/14/2020	Butler/2770	A8	Y	39028615Y	Y	IED f	i
11	2253 STRAUSS STREET	BK	3597	6	3082249	316	2	NO	NO	NO	1930	3765353	9/9/2020	Butler/2770	12	N		Ν		
12	120 RIVERDALE AVENUE	BK	3598	34	3082284	316	3	NO	NO	NO	1930	3765355	9/9/2020	Butler/2770	A8	Y	39028338P	Ν		
13	868 THOMAS S BOYLAND ST	BK	3599	1	3082296	316	3	NO	NO	NO	1930	3765356	9/9/2020	Butler/2770	12	N		Ν		
14	515 VERMONT STREET	BK	3791	1	3084515	305	3	NO	NO	YES/2018	1910	3765357	8/24/2020	Butler/2770	12	N		Ν		
15	41 NEW LOTS AVENUE	BK	3855	38	3085859	316	3	NO	NO	YES/2018	1930	3765358	9/14/2020	Butler/2770	12	N		Ν		
16	2718 PITKIN AVENUE	BK	4233	17	3095083	305	3	NO	NO	YES/2018	1925	3765359	8/24/2020	Butler/2770	A8	Y	39027451M/52Y	Ν		
17	876 BELMONT AVENUE	BK	4245	17	3095291	305	2	NO	NO	YES/2017	1925	3765372	8/31/2020	Butler/2770	12	N		Ν		
18	894 BELMONT AVENUE	BK	4245	24	3095298	305	2	NO	NO	NO	1925	3765375	8/31/2020	Butler/2770	12	N		Ν		
19	247 LINDEN BOULEVARD	BK	5085	68	3116689	317	4	NO	YES	YES/2017	1931	3765376	8/25/2020	Butler/2770	12	N		N]
20	863 FLATBUSH AVENUE	BK	5089	11	3116853	314	4	NO	YES	NO	1931	3765377	9/4/2020	Butler/2770	12	N		N		
21	1800 CHURCH AVENUE	BK	5099	39	3339384	314	4	NQ	NO	NO	1916	3765379	9/4/2020	Butler/2770	A8	Y	39028208R	Y	IED f	1
	▲ ▶ NLT-1034 OL [*]	T-1035	HC-3	311	NA-1741	1	NLT-CC30CC	73-46 Ins	pection	Master	OLT-CC300	с73-59 Но	C-CC30CC73-10	NA-CC3 (+)	E 4				Þ	



MANHATTAN CORNER LOT BUILDING



 Corner lot building from 1830, built by JJ Astor





MANHATTAN MIXED-USE BUILDING



FILE DATE	JOB #	DOC #	Job Type	JOB STATUS	STATUS DATE	LIC #	APPLICANT	IN AUDIT	ZONING APPROVAL
01/20/2015	<u>122245702</u>	01	A2	P APPROVED	06/17/2015	0012075 RA	SCHWARZ		NOT APPLICABLE

RENOVATE VACANT BLDG AS PER PLANS. REPLACE/REPAIR ROOF & PARAPET. REPAIR & Work on Floor(s): CEL,ROF 002 thru 005

04/05/2010 120311171 01 A1 H P/E IN PROCESS 02/14/2012 0068130 PE CHIFFERT PENDING TO RENOVATE AND ENLARGE EXISTING 5 STORY MIXED USE RESIDENTIAL BUILDING WI Work on Floor(s): CEL,0PH 001 thru 006



MANHATTAN OLT BUILDING



- Corner of building on street/avenue with major cracks throughout
- 12 DHCRs
- OLT owner moved all tenants out
- Owner/Carita has all four contiguous lots; emptying lots in pieces



MANHATTAN 1830S OLT BUILDING





1830s OLT

- Severely buckled bearing walls
- Some upgrades to foundations



FAILURE TO MAINTAIN OVERVIEW

50% received at least one Class 1 hazardous violation.

- Most common violating conditions observed include crack in façade, leaning building, and failure to maintain (i.e. serious threat to public safety).
- 20 were considered structurally compromised and immediately referred to DOB's Forensic Engineering Unit. Chief Engineer contacts building owners to see how they plan to commence the repairs to make the buildings safe; 2 under repair right now
- **10** buildings received orders for sidewalk sheds to be erected immediately
- **5** training sessions for inspectors
- Out of approximately 400 sites, 200 received violations for Failure to Maintain, only 20 owners filed repairs, sheds were placed on at least 20 buildings



CODES, CALCULATIONS & REFERENCE DOCUMENTS

- 19th Century NYS, NYC and Brooklyn prescriptive building Codes were scant on details as to how these buildings were to be designed and detailed.
- Template existing drawings were not provided in the Codes and as built drawings rarely exist for buildings



2014 NYC ADMINISTRATIVE CODE

Broad, general language; nothing specific as to the typical deteriorated conditions

Objective: Avoid one time catastrophic structural event leading to collapse of a publicly occupied structure

Structural Failure comes in two flavors:

- 1. Component failure
- 2. Entire structural failure





2014 NYC ADMINISTRATIVE CODE & BUILDING CODE

§28-101.2 Intent. The purpose of the New York city construction codes is to provide reasonable minimum requirements and standards, based upon current scientific and engineering knowledge, experience and techniques, and the utilization of modern machinery, equipment, materials, and forms and methods of construction, for the regulation of building construction in the city of New York in the interest of public safety, health, welfare and the environment, and with due regard for building construction and maintenance costs. 2014 NYC Administrative Code

Comment: Prior Codes used refer to one time catastrophic collapse leading to fatalities

§28-301.1 Owner's responsibilities. All buildings and all parts thereof and all other structures shall be maintained in a safe condition... Whenever persons engaged in building operations have reason to believe in the course of such operations that any building or other structure is dangerous or unsafe, such person shall forthwith report such belief in writing to the department. The owner shall be responsible at all times to maintain the building and its facilities and all other structures regulated by this code in a safe and code-compliant manner and shall comply with the inspection and maintenance requirements of this chapter

Comment: Owners and Engineers must immediately report in writing unsafe/Code compliance issues to the Department.





2014 NYC ADMINISTRATIVE CODE & BUILDING CODE

1604.1 General. Building, structures and parts thereof shall be designed and constructed in accordance with strength design, load and resistance factor design, allowable stress design, empirical design or conventional construction methods, as permitted by the applicable material

Comment: deformations in existing buildings was allowed for in the Prior Codes -> contemporary computer calcs don't work deformations in existing foundations are critical – often bring down an entire building.





 Codes did not specifically identify corner lot buildings as requiring special attention from regular tenements or rowhouses as to design or construction.

Contemporary Codes do not address corner lot buildings requiring special attention.

Codes had an absolute requirements for all walls to be plumb, straight and true. (This is one of the most serious structural issues at large and frequently incorrectly assessed, ignored and repaired).

Contemporary Codes has more stringent requirements for wall ties and plumbness.

Codes had a requirement for tying running bond face brick to the backup wall. (Delamination of the outside layer of brick is one of the most serious structural issues at large and frequently incorrectly assessed, ignored and repaired).

Contemporary Codes has more stringent requirements for wall ties and plumbness.



(continued)

 Codes did not specify robust and sturdy connections between the cast iron corner columns and 2nd floor and 3rd floor beams – (this is a serious structural issue frequently incorrectly assessed, ignored and repaired.

Contemporary Codes has more stringent requirements for wall ties and plumbness.





§ 1. The outside and party-walls of all dwelling-houses, Farty-walls store-houses, and other buildings, hereafter to be erected or built within the fire limits of the city of New York, as the same now exist and may hereafter be extended, which shall exceed thirty feet in height, from the level of the sidewalk to the foot of the rafter, shall not be less than twelve inches thick.

§ 8. In every building the floor shall be of sufficient strength to bear the weight to be imposed upon them, exclusive in all cases of the weight of the material used in their construction; and if at any time the said building shall be loaded over the said weight, it shall be at the risk of the occupant, whether the same be the owner or not. 1887 Manhattan: Party walls 12"

1860 Manhattan: Floor strength not specific



walls. And all outside or party walls of every such Materials, dwelling house, store, store-house, or other building, shall be constructed of stone, brick or iron; and all walls shall be built to a line, and shall be carried up plumb and straight, and shall be built with close joints. No swelled brick or refuse brick shall be allowed in any wall; and all walls shall be started and built upon foundations of stone, brick or concrete; and in all cases where the ground is either swampy, marshy or made ground, before the foundations are put down there shall be either piles driven or good foundation timbers, of sufficient size and thickness, to prevent the building from settling; and the top of the piles or timbers in all cases shall be laid below

1860 Manhattan: walls built plumb straight true upon stone brick concrete foundations

The dimensions of each piece or combination of Calculations for strength materials required shall be ascertained by computaof materials. tion, according to the rules given in Trautwine's Treatise for Engineers, or the treatises of other authors now or hereafter used at the United States Military Academy at West Point, on the strength of The factors of safety shall be as one to materials. three for all beams, girders and other pieces subject to a transverse strain; and as one to six for all posts, columns, and other vertical supports subject to a compressive strain; and as one to six for tie-rods, tie-beams, and other pieces subject to a tensile strain.

1882 Manhattan: Calculations of floors based on F of S = 3

Columns and vertical supports and columns on F of S = 6



MASONRY ERECTION TOLERANCES





CALCULATING LOADS & STRESSES IN EXISTING 19TH CENTURY CORNER LOT AND END WALL BUILDINGS

 Original buildings prior to the late 1880s comprised of wood and masonry and some cast and wrought iron. Plumb, straight and true walls were critical and was prescriptively specified in the Codes.

Contend with these large out of plumb and buckled bearing walls.

Walls and floors were required to be tied together with wrought iron straps at 6' on center. Many contiguously built party wall buildings omitted straps, and ties are missing at stairs and chimneys.

Contend with end and side walls separating from floors creating large buckles.





CALCULATING LOADS & STRESSES IN EXISTING 19TH CENTURY CORNER LOT AND END WALL BUILDINGS

(continued)

- Deformation of floors and walls due to foundation settlement, plastic behavior of brick and lime mortar masonry, and permanent sagging and shrinkage of wood joists were well understood and were accommodated by relieving walls and a lowering the allowable high factor of safety of the building.
 - Contend with large deformations in the buildings well in excess of any allowable deflection numbers typically built into structural evaluation programs and engineering stress strain theory masonry/wood components conform to plastic theory, not elastic.



 Our new Existing Building Code focuses on alterations. However, evaluating existing buildings, in particular, mixed use corner lot tenement leads to all types of misadventures with site and numerical evaluations.

Possible some specifications will be included in the proposed Existing Building Code.

As walls buckle outwards, this released significant load across the whole cross section of the wall thickness as joints open up.

Compression loads just moved towards the remaining bits of wall which remained in compression forcing higher compression loads in the mortar reducing the F of S from 4, down to 1. This also effects the unbraced length of the wall where floor restraint lengthens the unbraced height to almost two stories.



 Codes did not provide engineering design standards for lateral loads or limits on deformations. Existing Buildings: Factor of Safety based

Contemporary codes have stringent engineering requirements for calculations and lateral wall ties and plumbness.

Codes did not specify how long a building should last or what should be done with diminishing Factors of Safety = 4.0 less than or equal to 1.0.

Contemporary Codes still do not address this issue.





(continued)

Codes did not prohibit transferring the entire bearing walls and upper floors to the 2nd floor over the store -> creates soft story which greatly impacts the structural stability of the building.

Out of plane movement is critical for the stability of a soft story. Contemporary codes somewhat address this issue through engineering design.

 Codes did not specifically address mechanical ties between floor joists to end walls, street and avenue walls – critical issue.

Contemporary Codes somewhat address this issue through engineering design.

 Codes did not specify, with sketches or calculations, exactly how these prescriptive buildings were built.

Contemporary Codes still do not address this issue.



THANK YOU

NFERENCE

