





























Preserving History, Ensuring Safety

Creative Seismic Strengthening Solutions at Historic Benson Polytechnic









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Creative Seismic Strengthening Solutions at Historic Benson Polytechnic

Kevin J. Nadolny, PE, SE

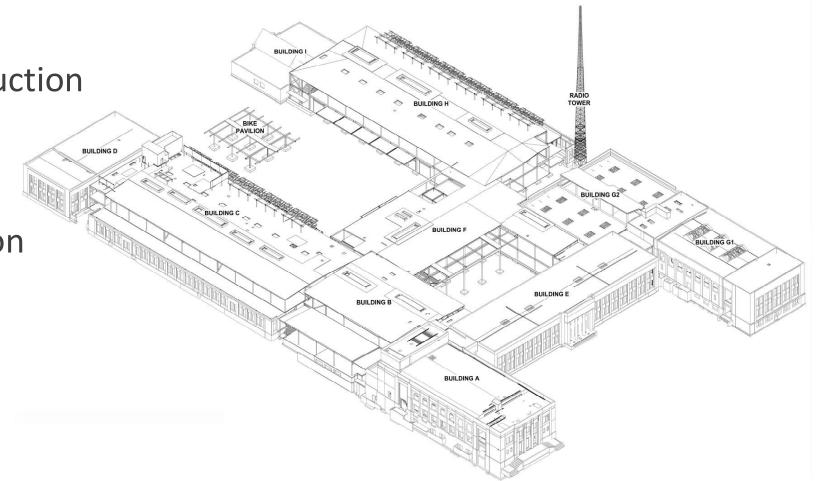
- Associate KPFF Consulting Engineers
- Kevin.Nadolny@kpff.com
- 20 Years Experience





BPHS Project Team

- Client: PPS
- Architect: Bassetti Architects
- Contractor: Andersen Construction
- Structural Engineer: KPFF
- Building Area: 386,600 SF
- Total Project Cost: \$320 million
- 10 Buildings (6 existing)
- Bike Shelter
- Retrofit of a Radio Tower

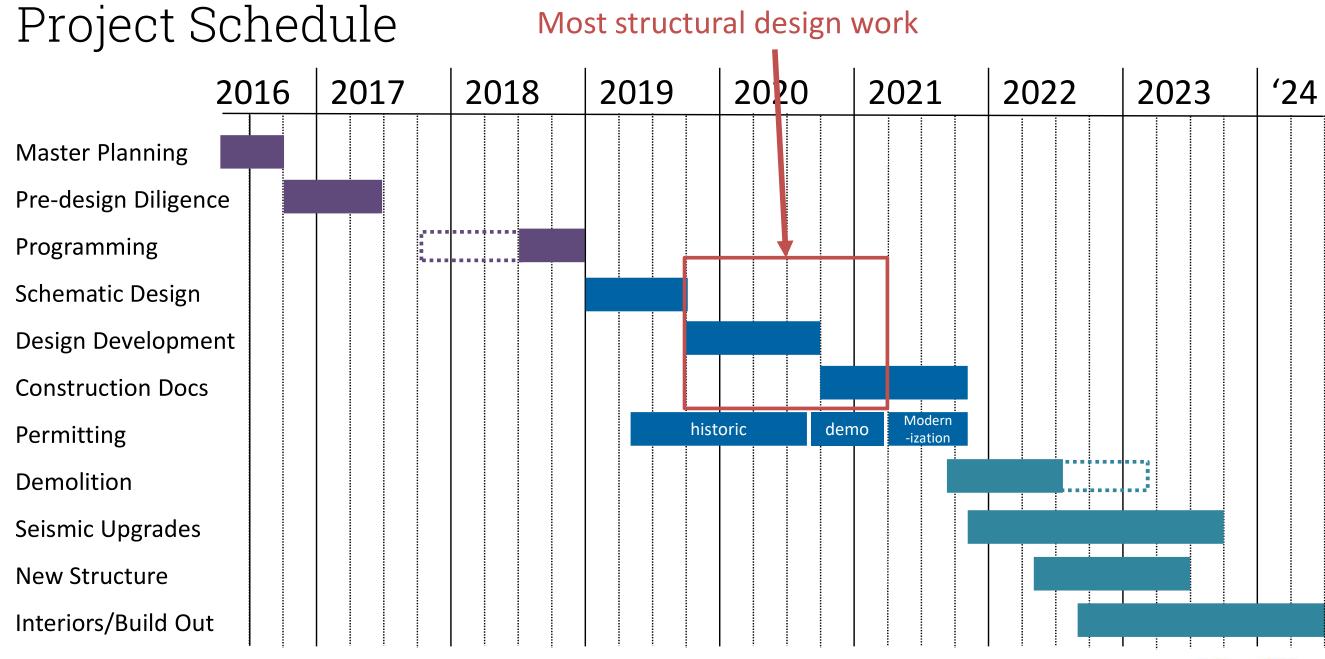




Presentation Outline

- 1. Introduction to Benson Polytechnic High School
- 2. Why Strengthen URM
- 3. Case by case examples of Retrofit Solutions:
 - 1. Façade Preservation Only
 - 2. Historic Admin Building
 - 3. Historic Gym Preservation
 - 4. Historic Foundry
 - 5. Historic Auditorium
 - 6. 1960s Gym Addition Retrofit
- 4. Questions



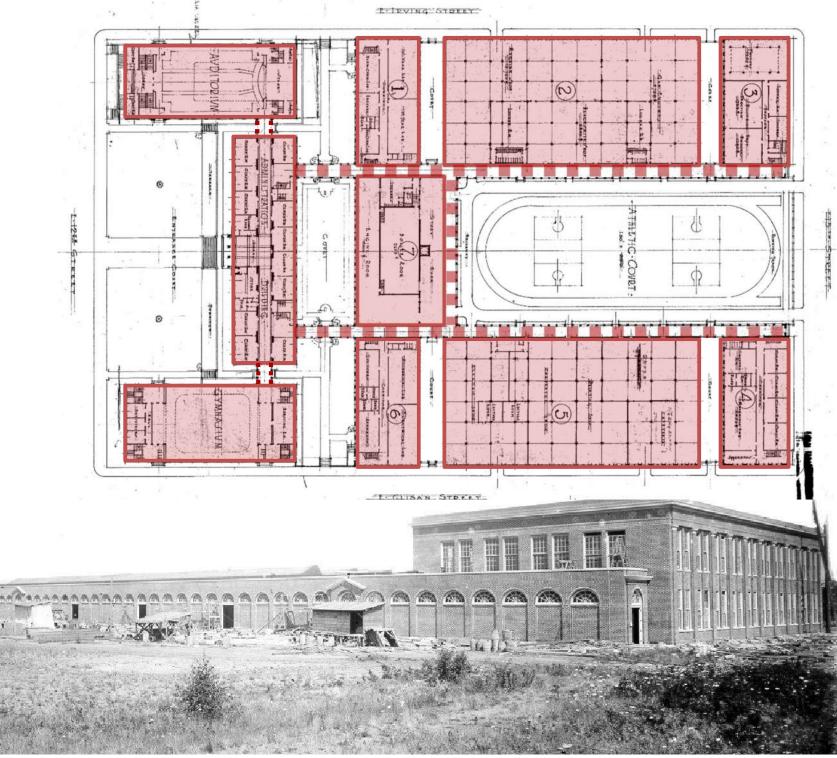




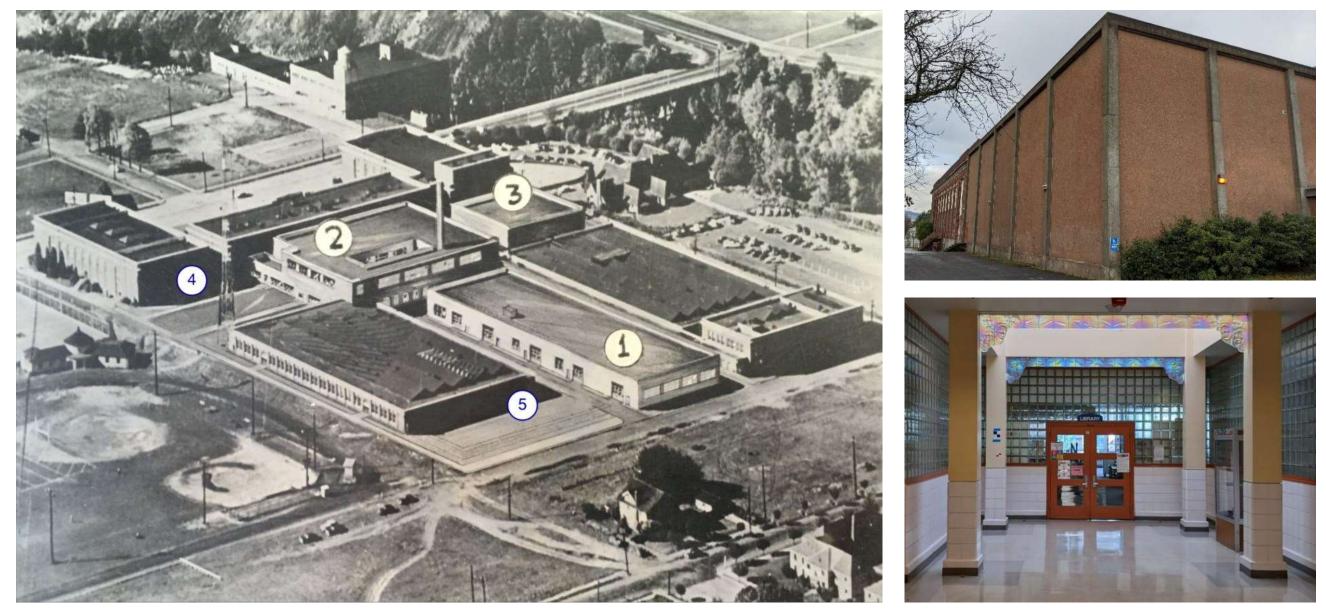
1916 Master Plan



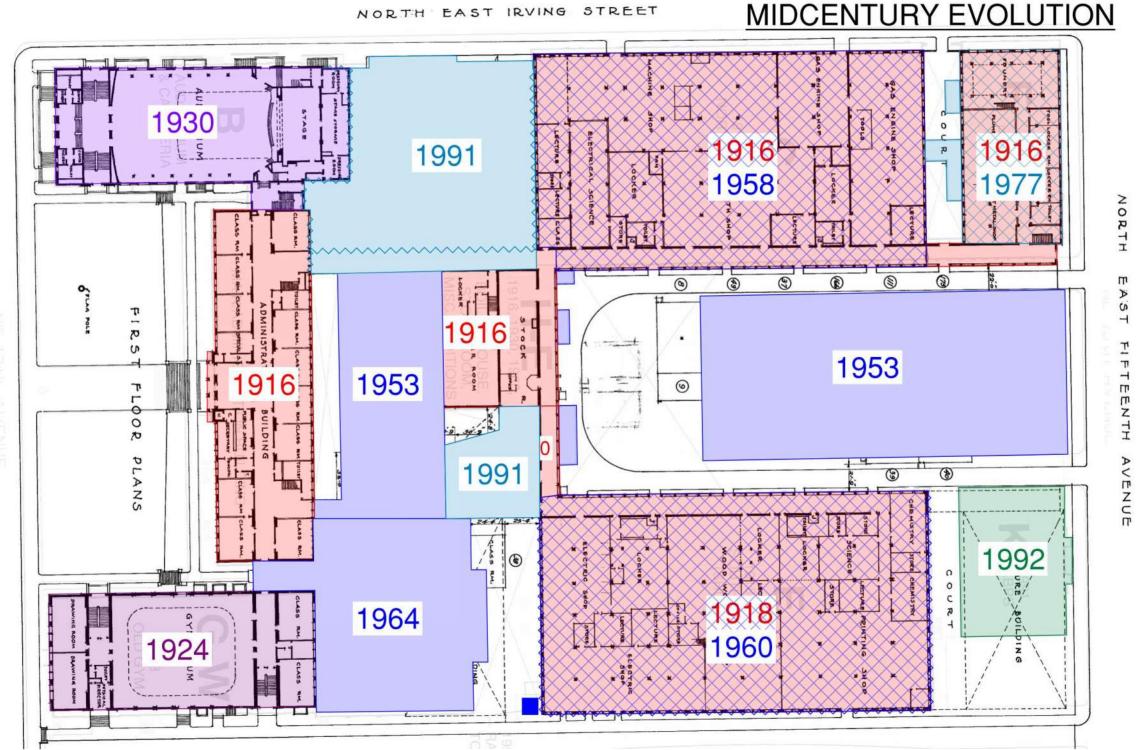
Real #1



Midcentury & Later Additions



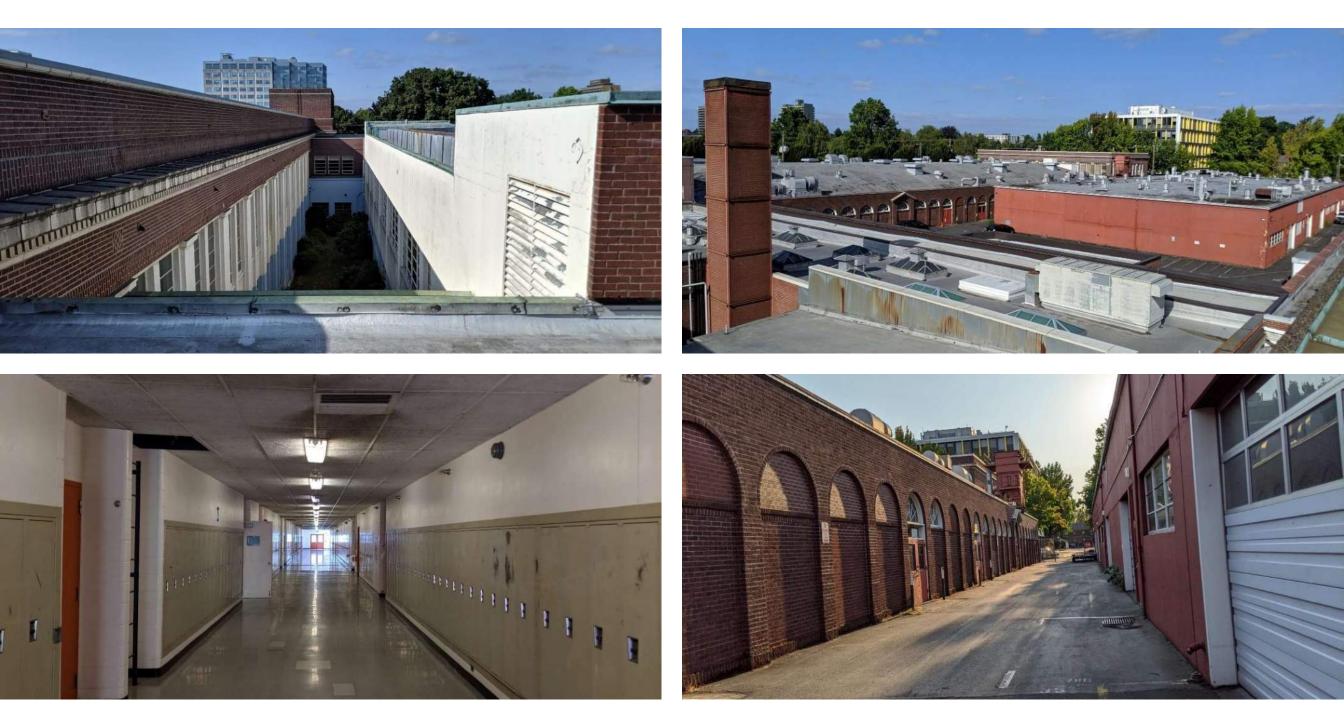




Benson Polytechnic High School **Construction History Sequence**

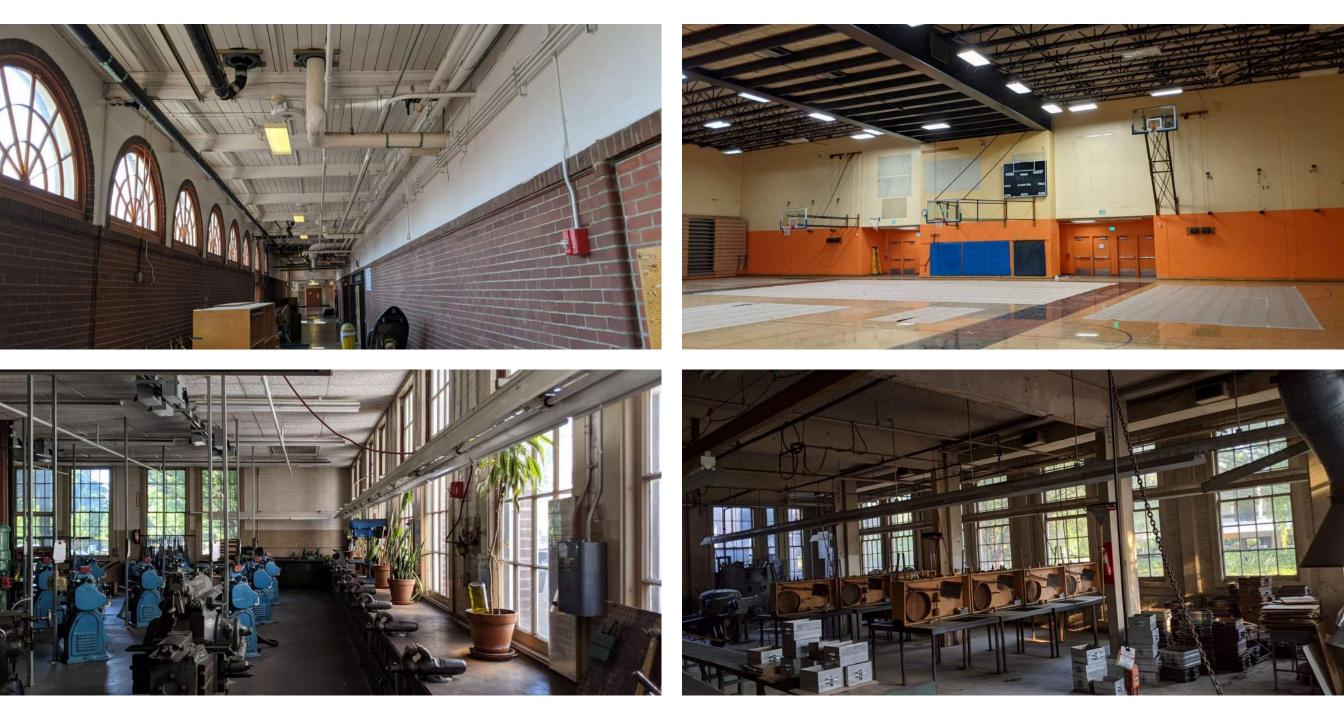


NORTH EAST TWELFTH AVENUE



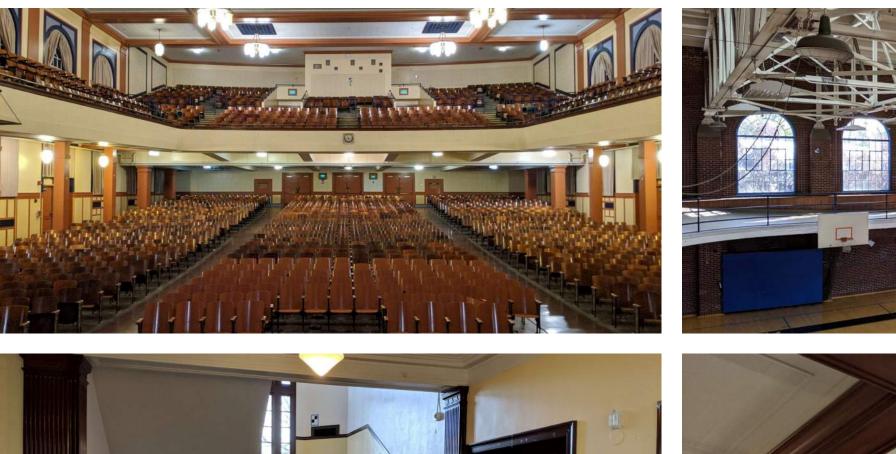
Benson Polytechnic High School – Existing Conditions





Benson Polytechnic High School – Existing Conditions



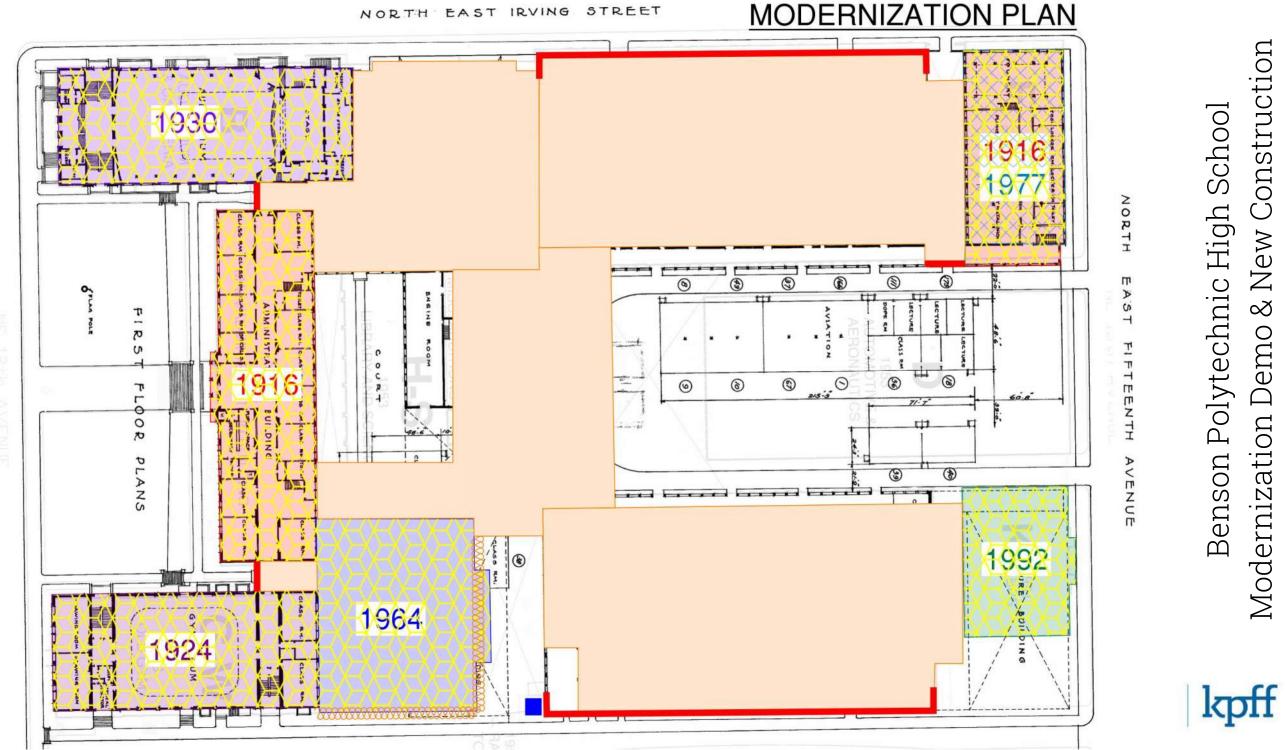


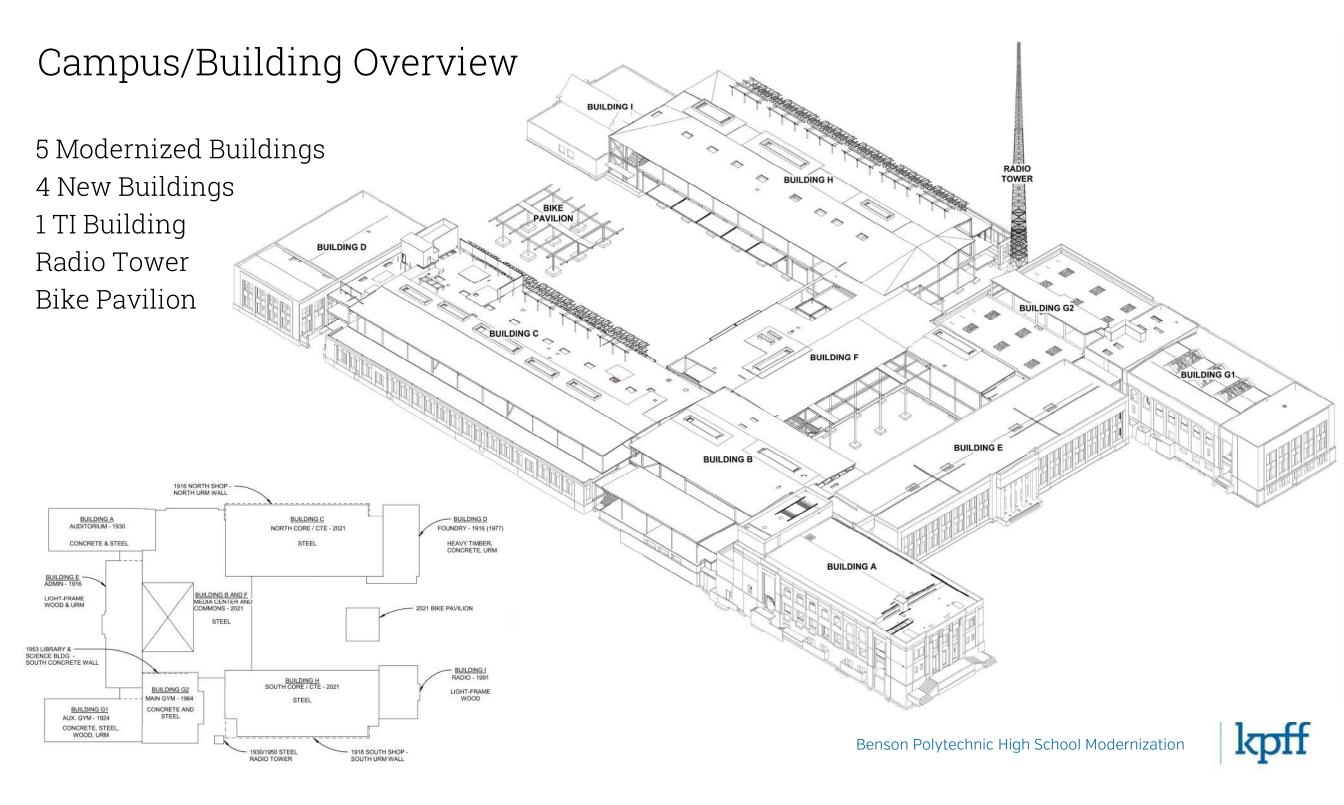




Benson Polytechnic High School – Historic Interiors







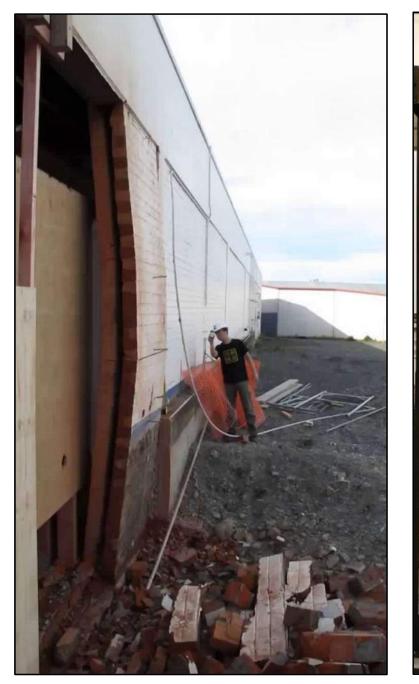
Building Cost & Scope Comparison

BLDG	AREA	APPROX. CONSTRUCTION COST	APPROX. STRUCTURAL COST	
А	42,260 SF	\$20,700,000 (\$490 / SF)	\$4,900,000 (\$120 / SF)	
B+F	80,420 SF	\$36,200,000 (\$450 / SF)	\$6,800,000 (\$85 / SF)	
C+H	145,880 SF	\$61,700,000 (\$425 / SF)		etrofit = 2x new
D	17,960 SF	\$10,700,000 (\$595 / SF)	\$2,100,000 (\$120 / SF)	nstruction cost
E	30,660 SF	\$19,600,000 (\$640 / SF)	\$5,100,000 (\$165 / SF)	
G1	38,820 SF	\$17,500,000 (\$450 / SF)	54.500.000	y G2 Retrofit < construction \$
G2	30,590 SF	\$11,200,000 (\$365 / SF)	\$1,900,000 (\$65 / SF)	
Totals	386,600 SF	\$232,000,000 (\$590 / SF)	\$36,800,000 (\$95 / SF)	lzoff



Why Strongback Walls?

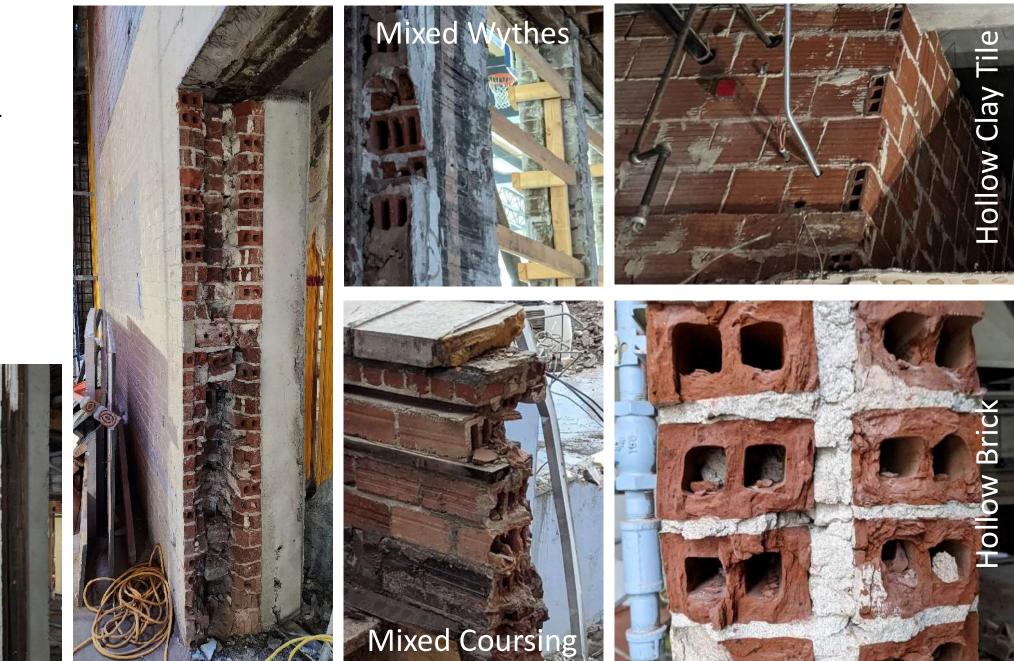






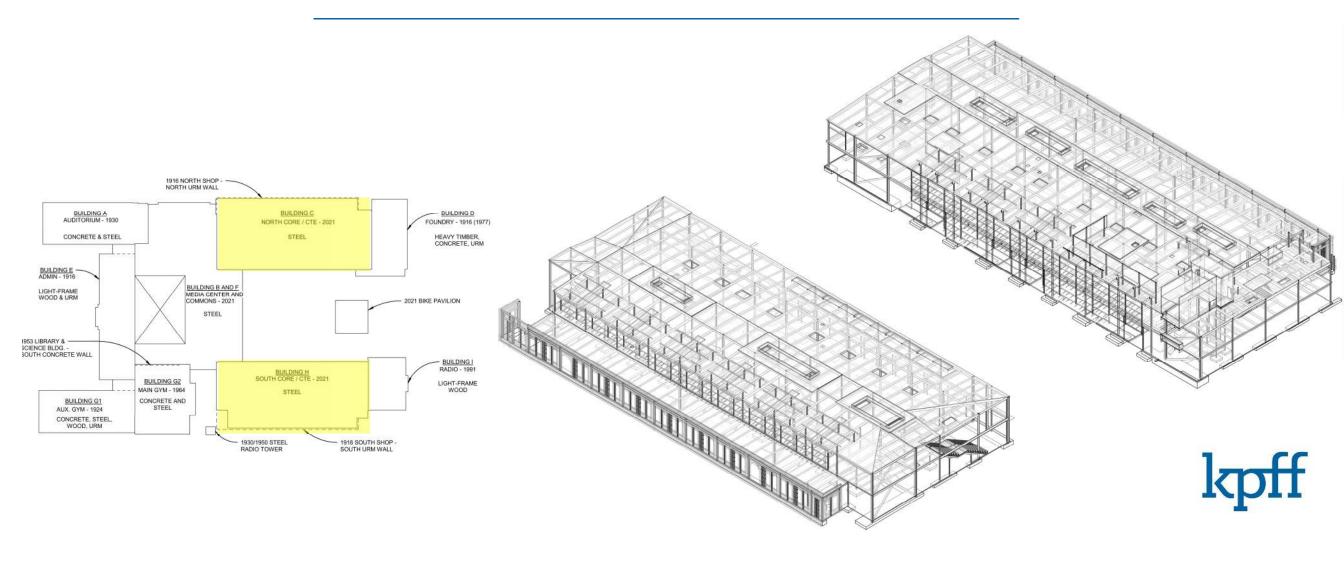


Example URM Wall Sections

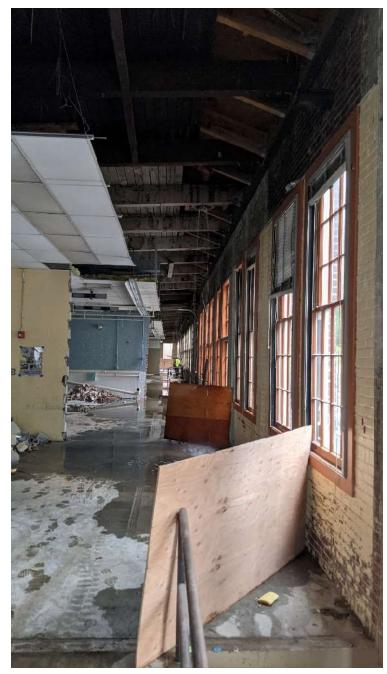


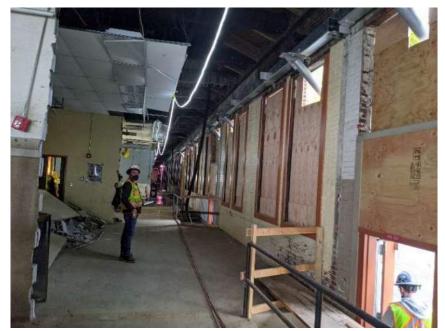


Building C & H – New CTE Shops & Classrooms Steel Framed w/ (E) URM "Remnant" Walls

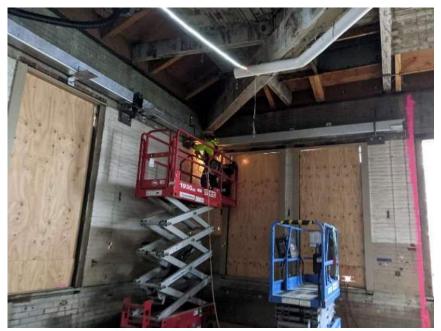


Building C &H – Existing URM Wall Salvage













Building C & H – Existing URM Wall to New Structure







Mass Demolition & Site Work | kpff



Building C & H Foundations | kpff





Building C & H Steel Erection | kpff

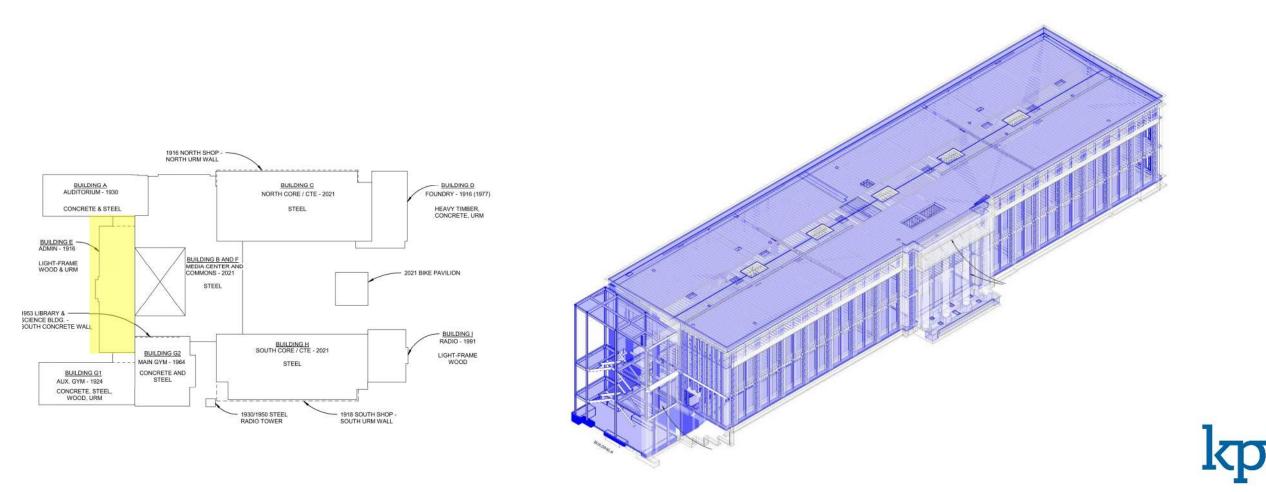




Building C & H – Steel Erection



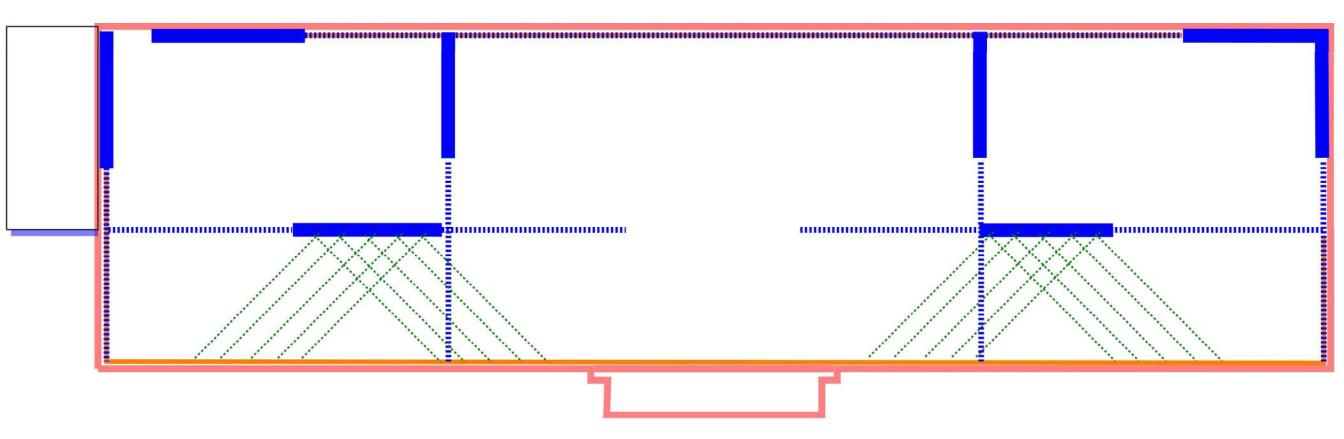
Building E – 1916 Main Building (URM & Light-Frame Wood)



<u>Building E</u>

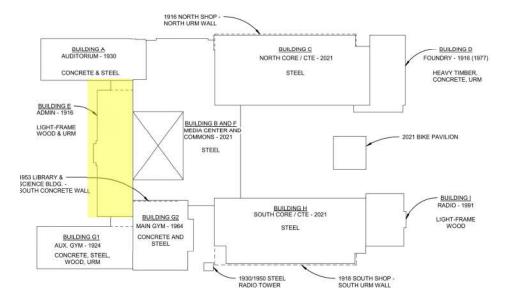
Lateral Plan Diagram

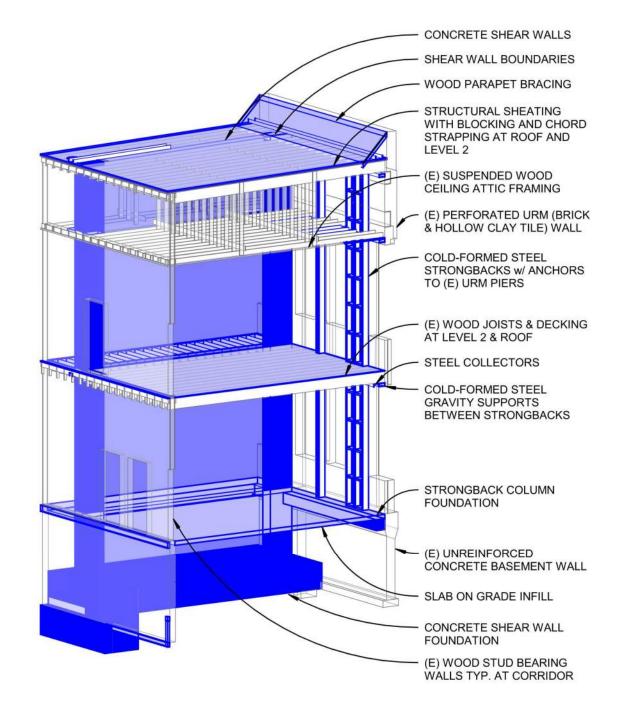




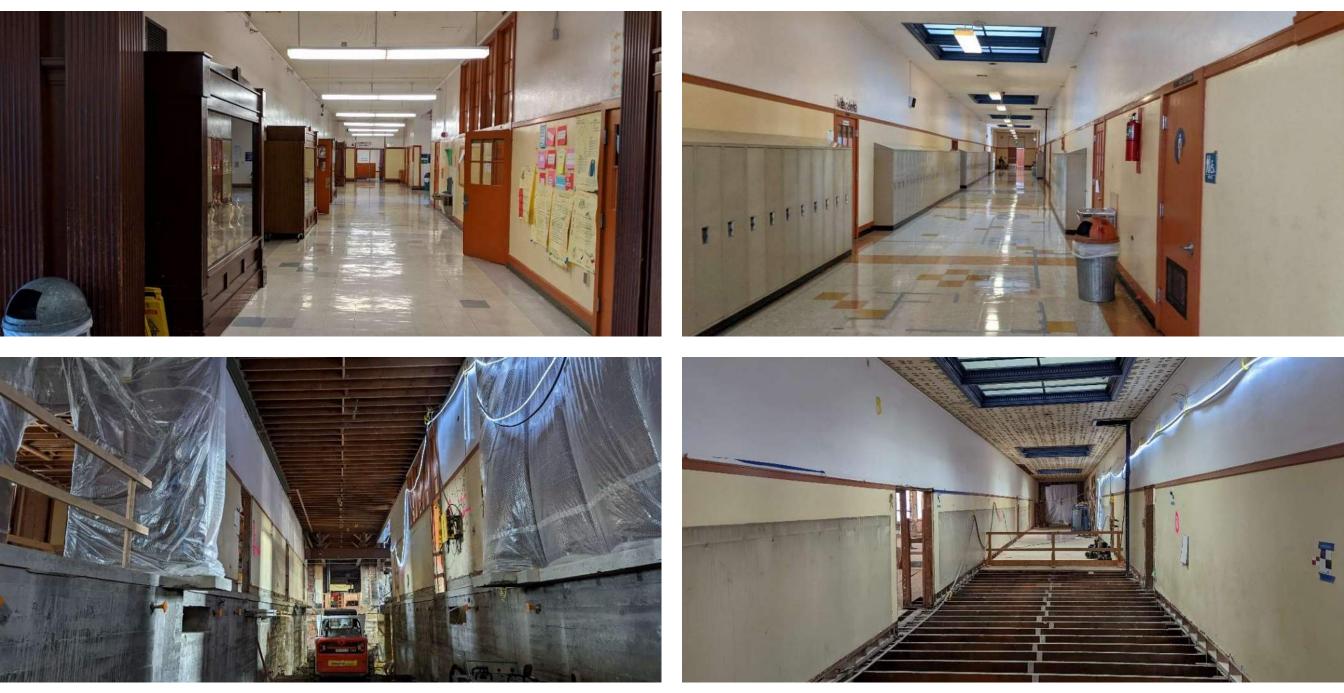
<u>Building E</u>

Representative Seismic Upgrade Axonometric



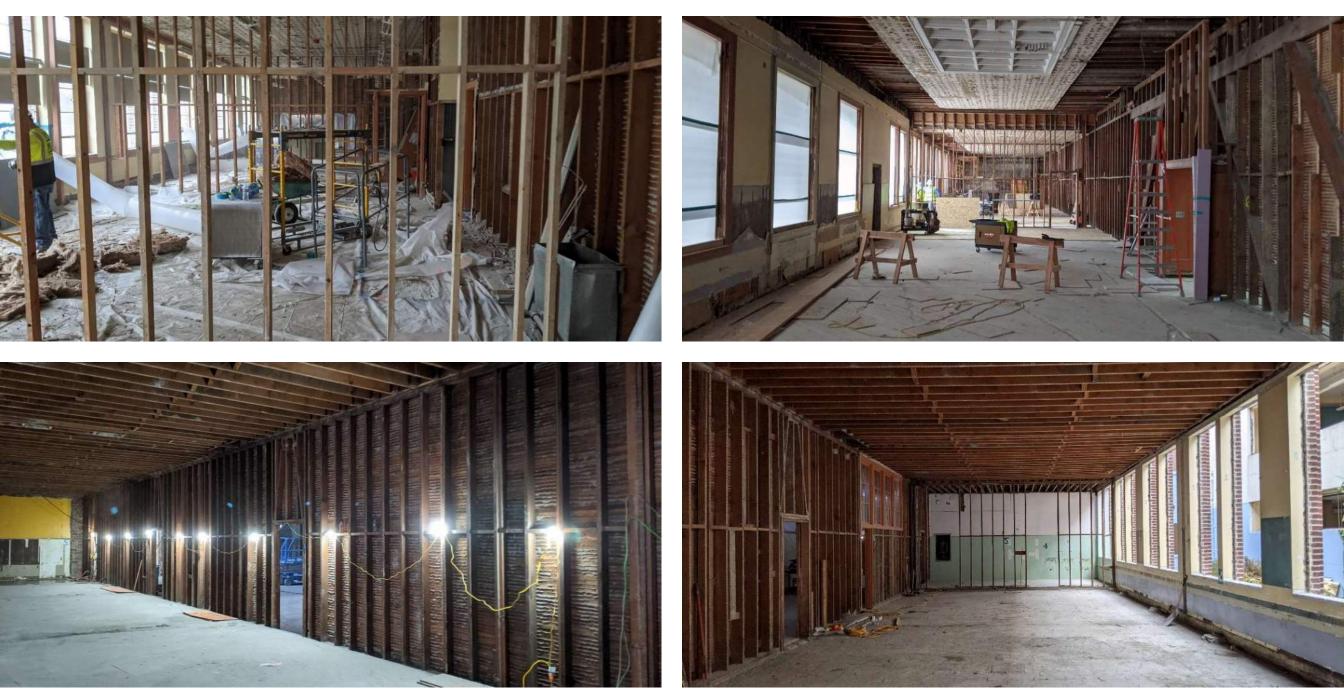






Historic Corridor & Mechanical Tunnel





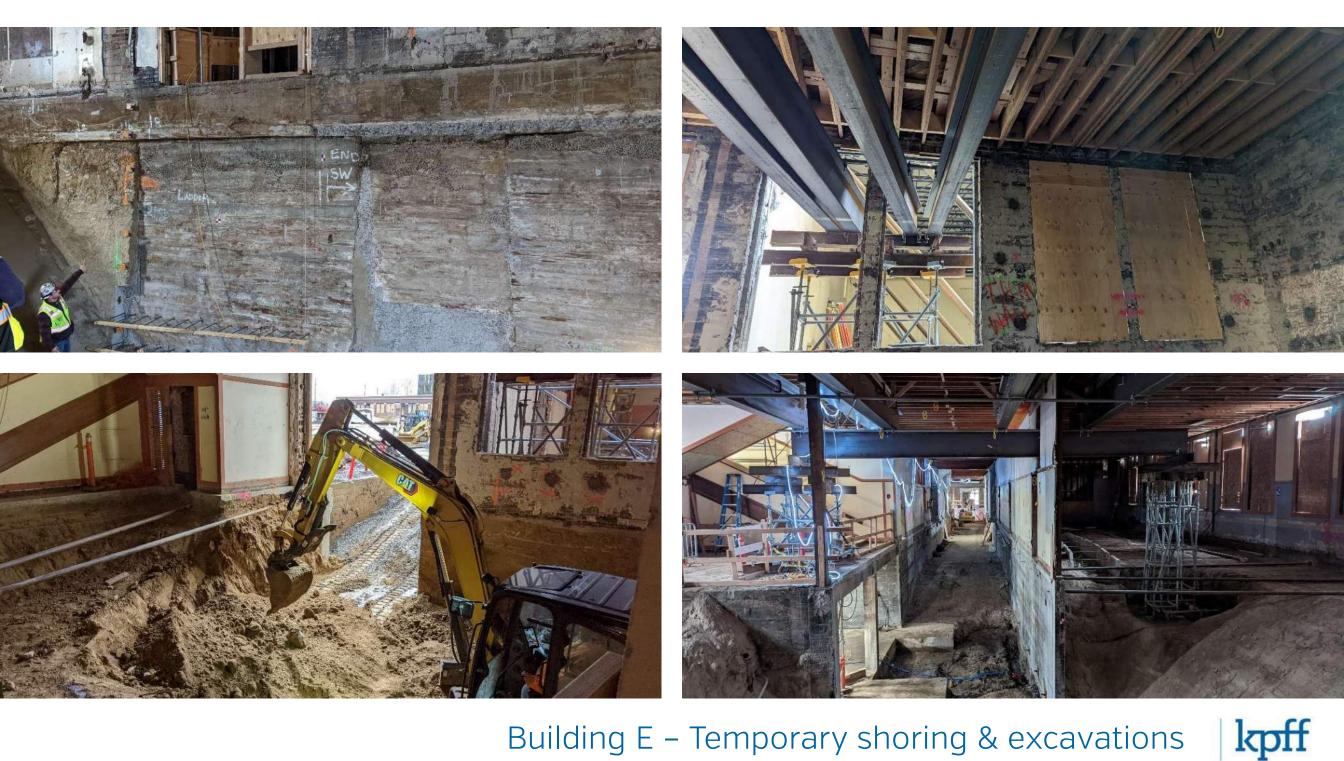
Historic Classroom Interior Demolition



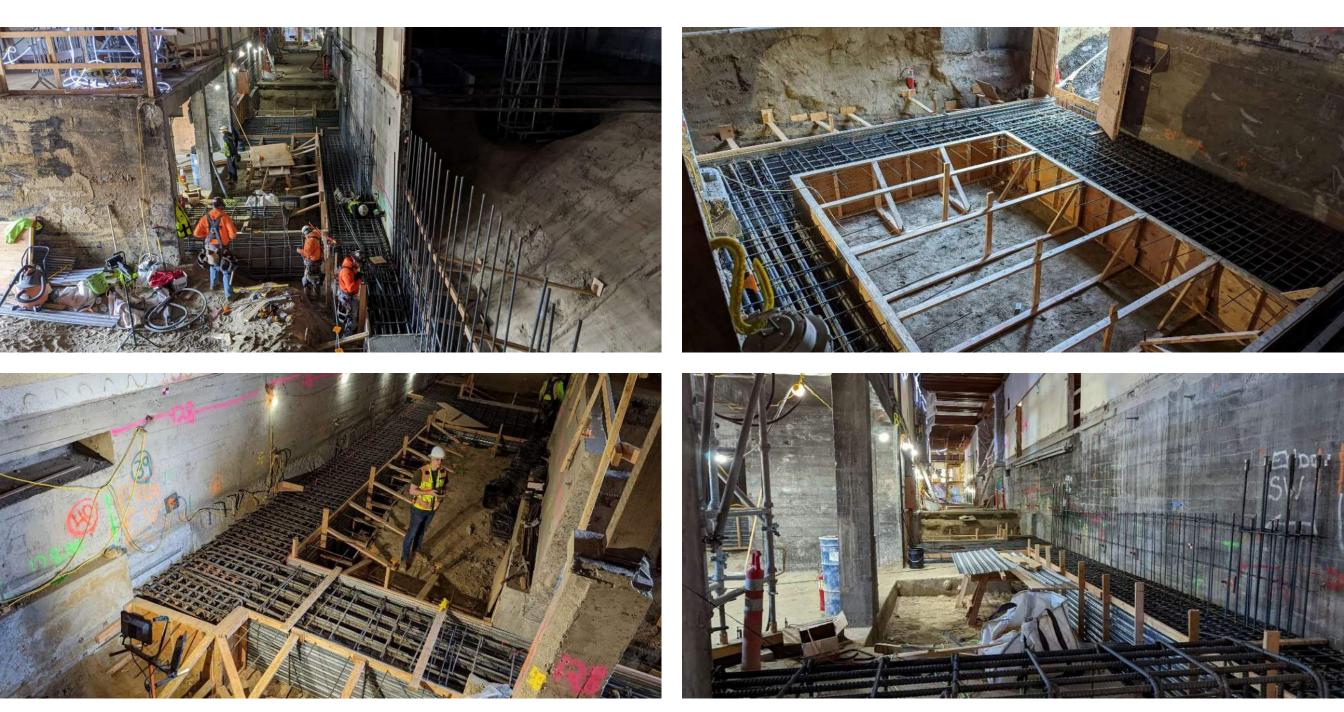


Building E – Wood Gravity Framing Alterations





Building E – Temporary shoring & excavations

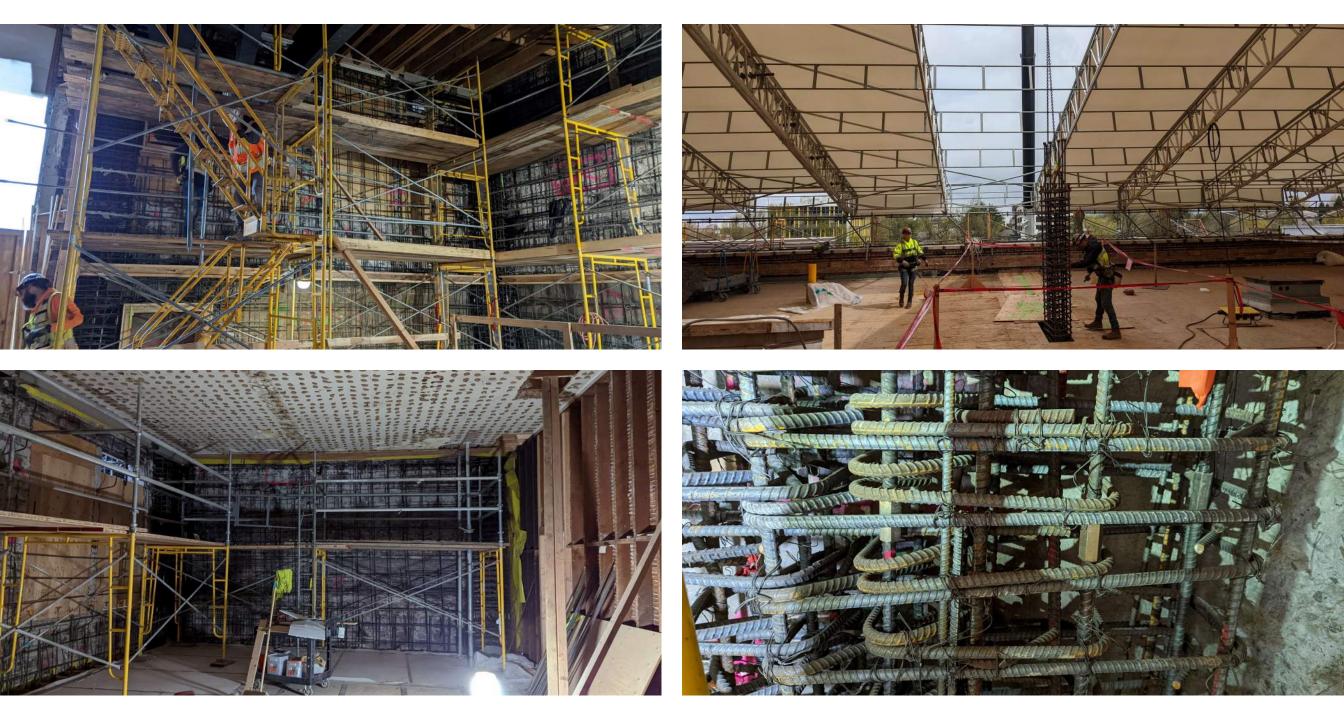


Building E – Shear Wall Foundations



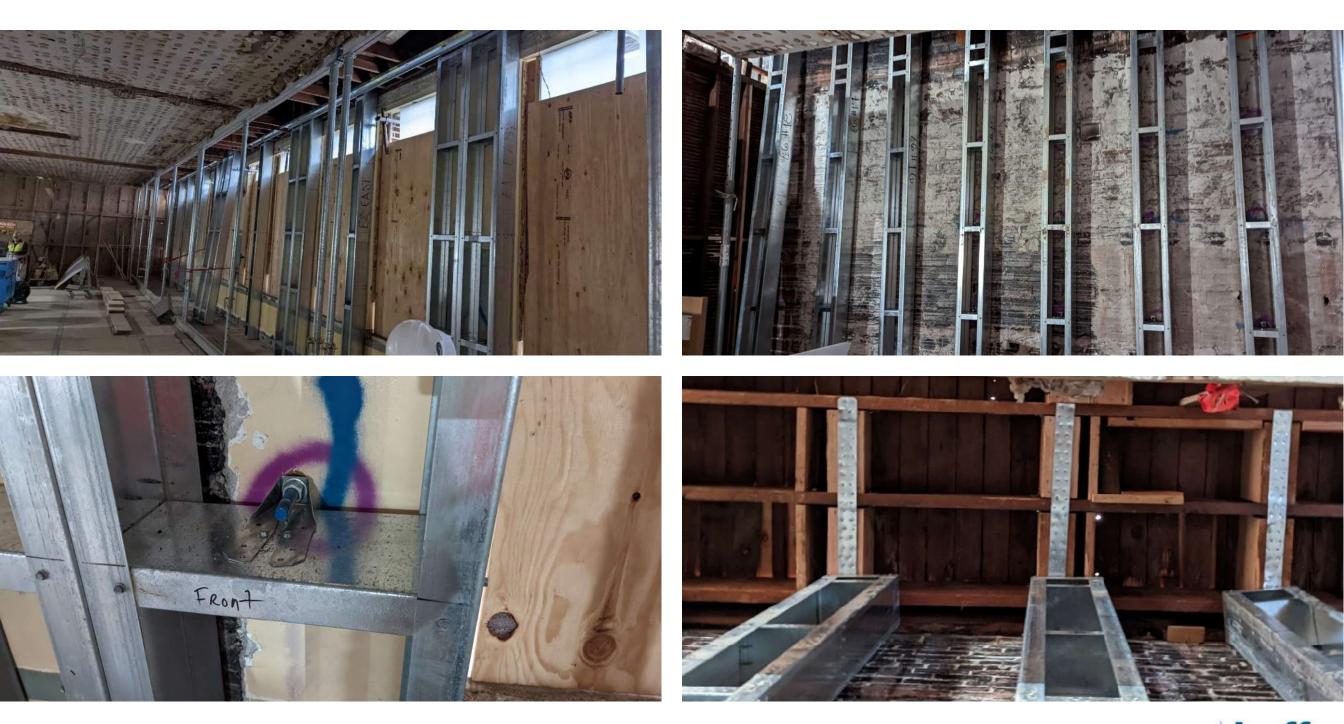


Building E – Shear Wall Anchors to (E) Walls

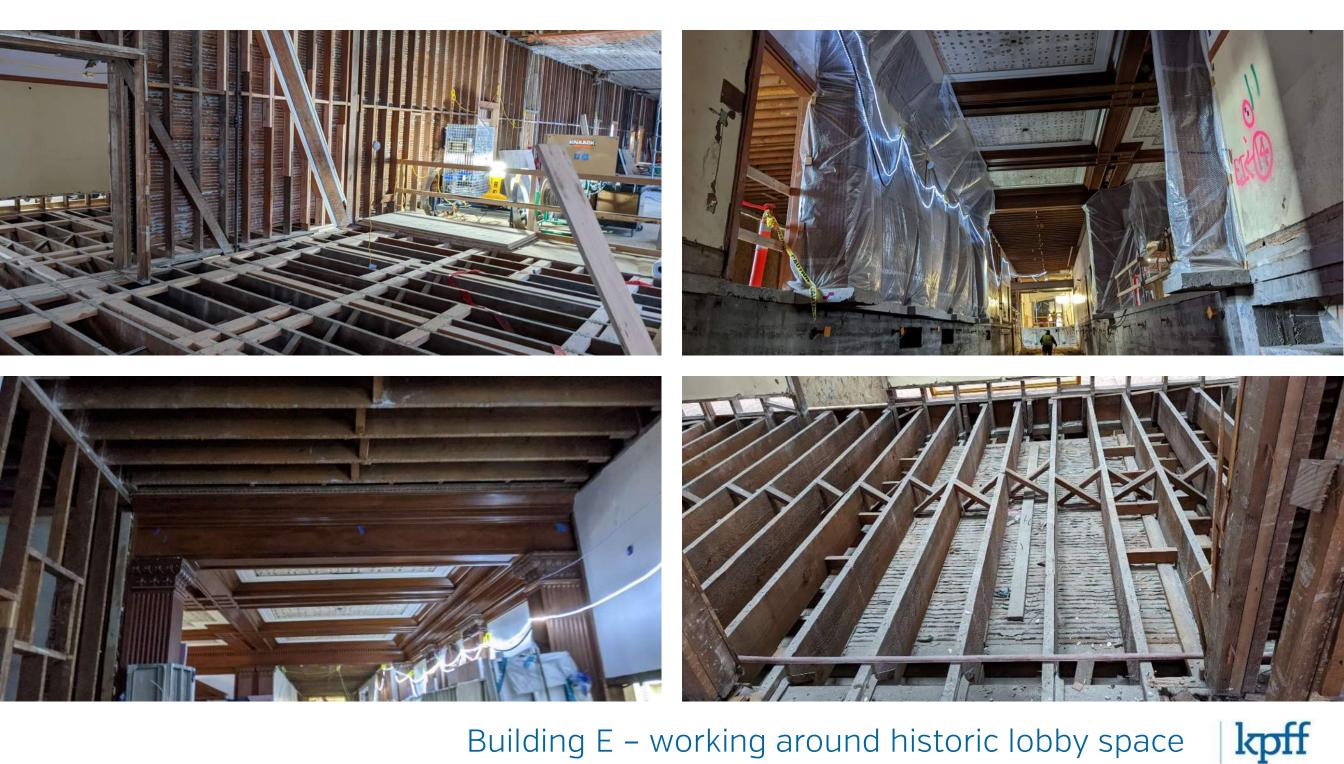


Building E – Concrete Shear Walls w/ prefab boundaries





Building E – CFS Strongbacks at URM | kpff



Building E – working around historic lobby space



Building E – Story-Deep Truss Retrofit | kpff



Building E Roof Tent



kpff



Building E – Wood Diaphragm Details | kpff







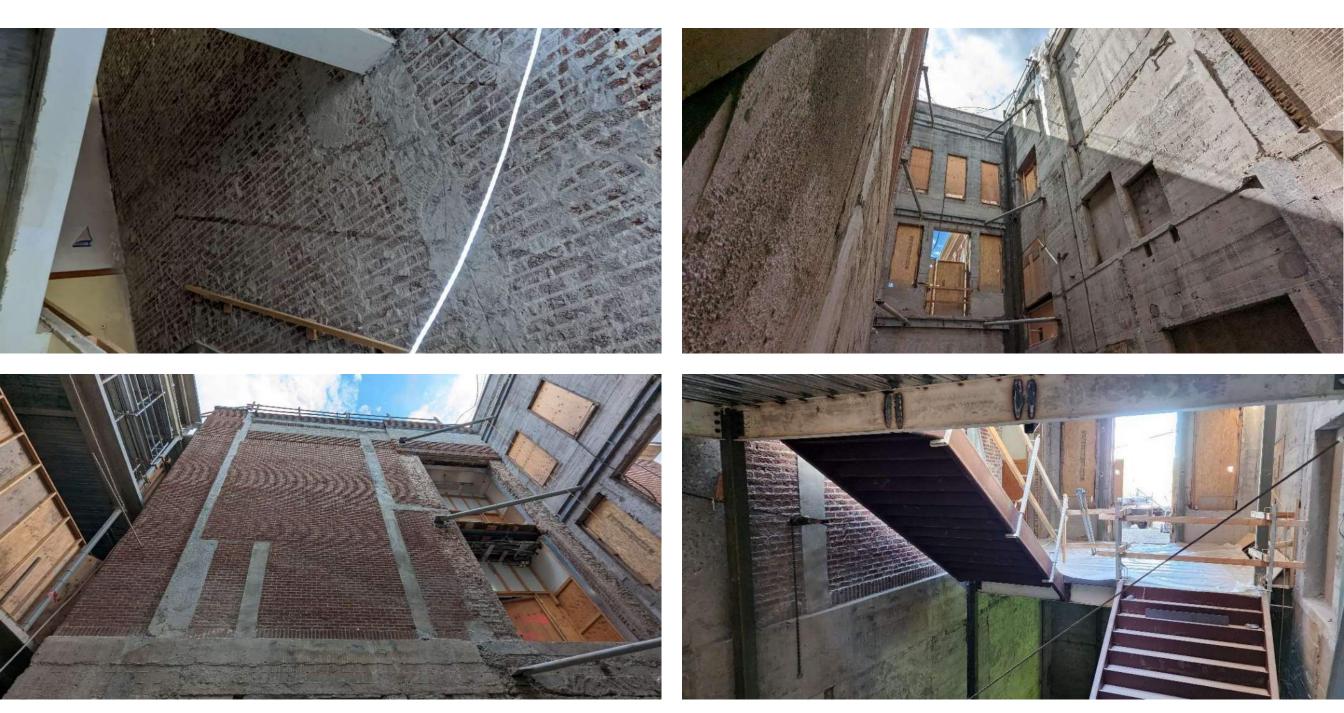


Building E – Collector Detailing | kpff

Building E Above-Roof Structure

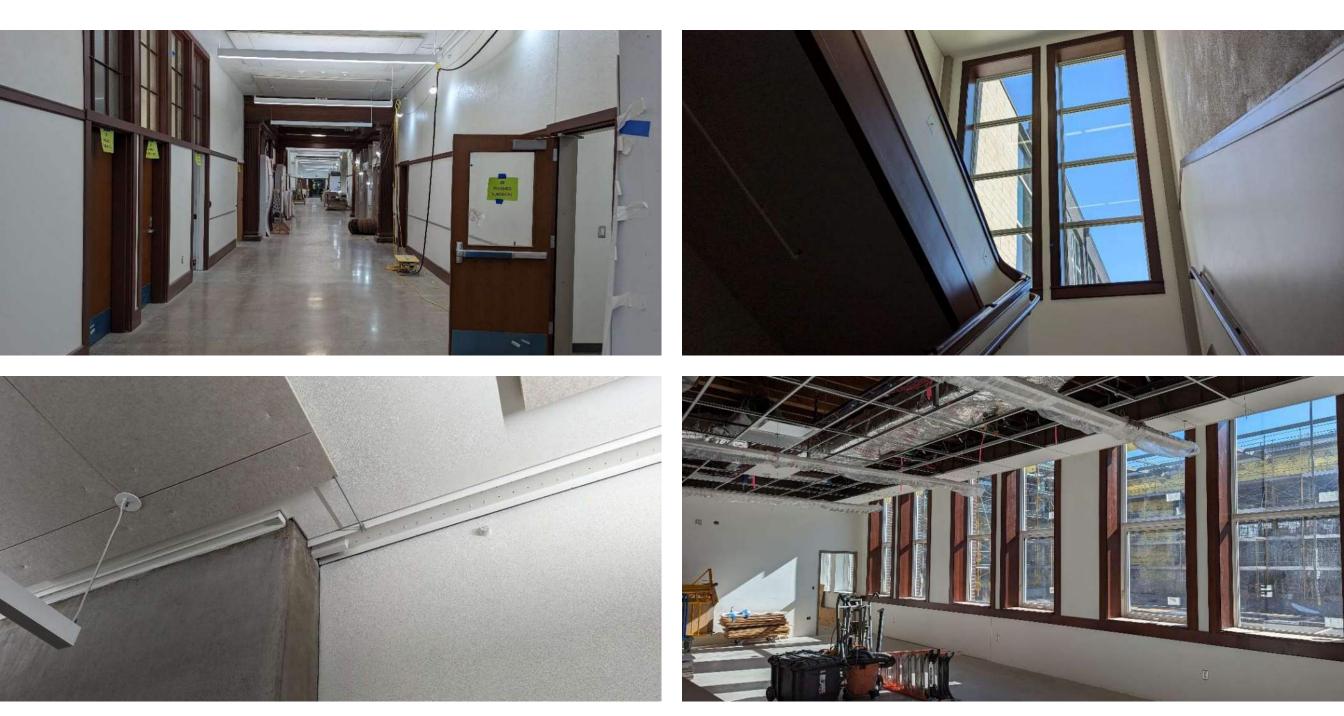






Building E to A Stair Vestibule





Building E – Finished Product | kpff





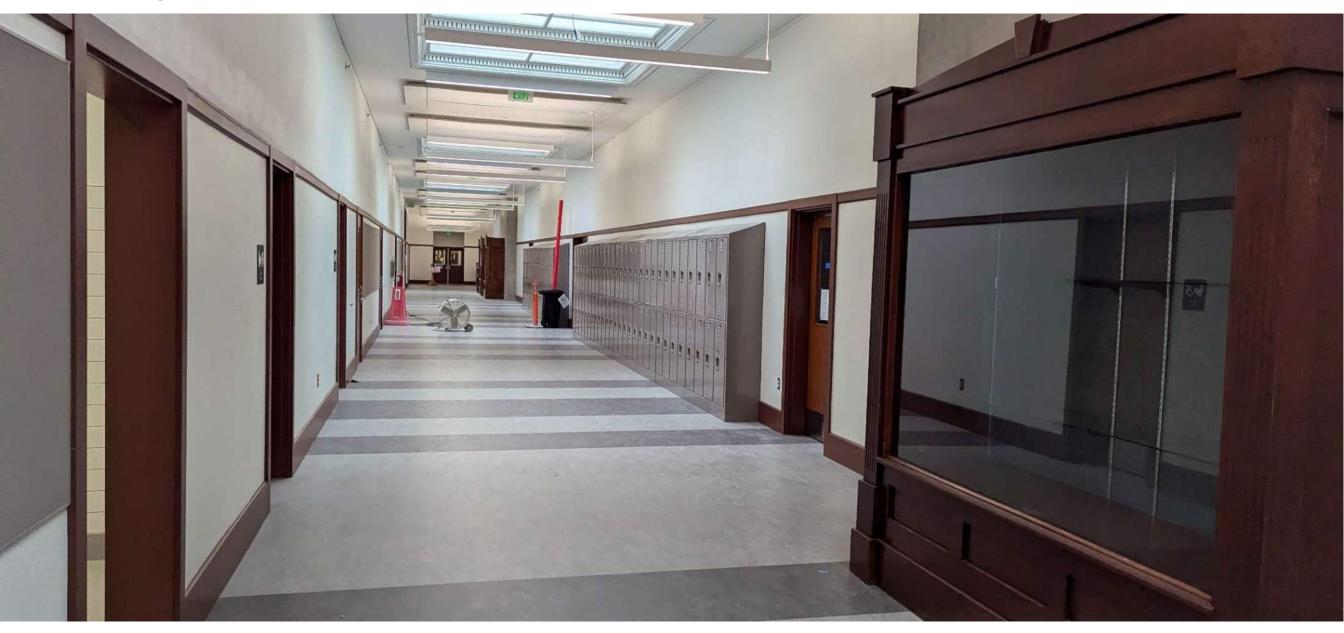
Historic Lobby w/ Security Screen



Benson Polytechnic High School Modernization

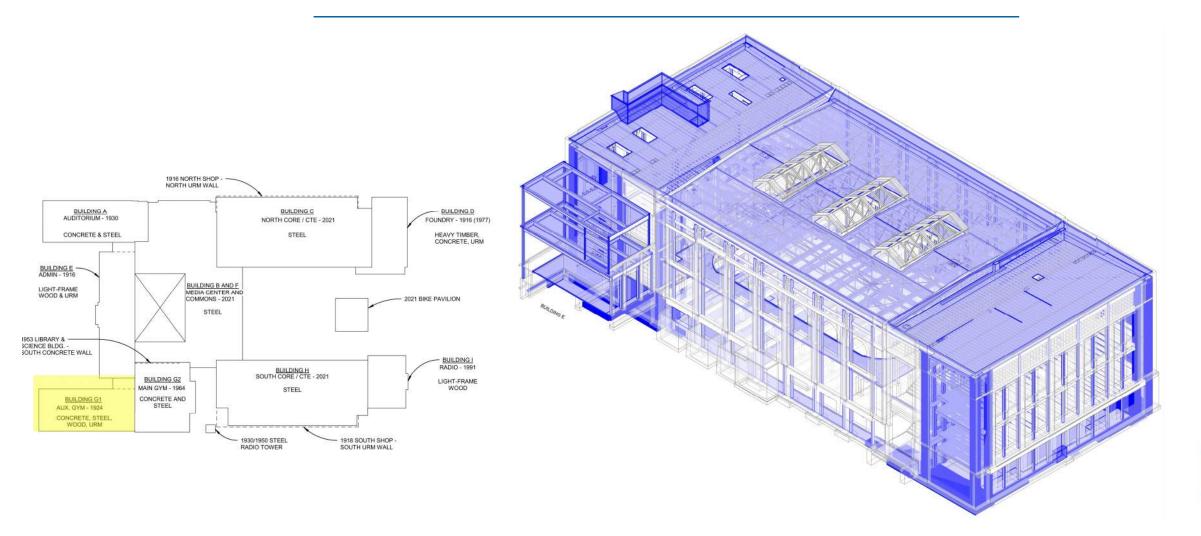


Building E – Historic Main Corridor





Building G1 – 1924 Gymnasium (URM, [Un]Reinforced Concrete, Steel, Wood)

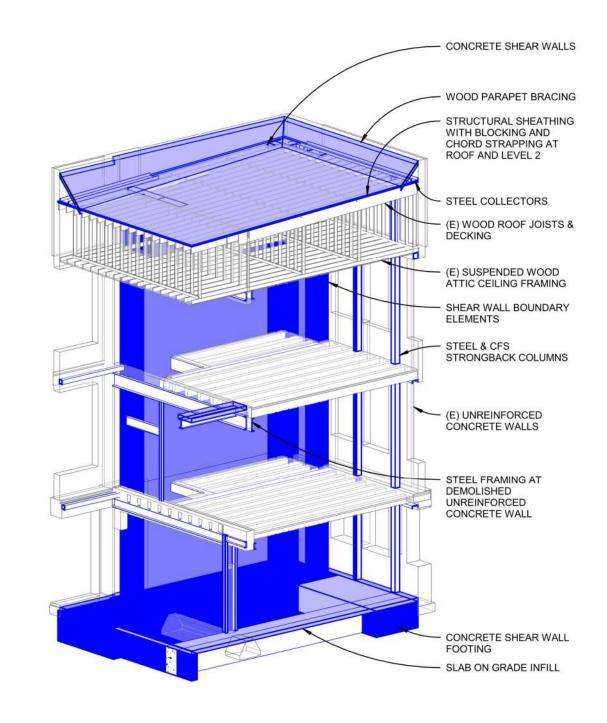


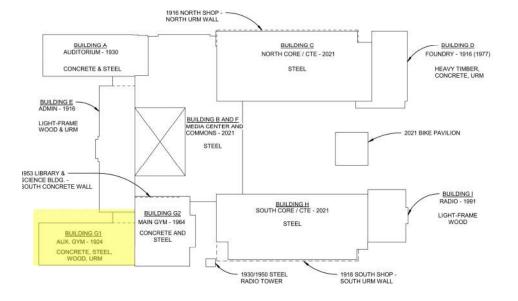


<u>Building G1</u>	 (E) URM WALLS	
Dunung GI	 (E) CONCRETE WALLS	
Lateral Plan	 STEEL & CFS STRONGBACKS	
	 CONCRETE SHEAR WALLS	
Diagram	 STEEL COLLECTORS	
	(E) WALL DEMOLITION	
		kpff

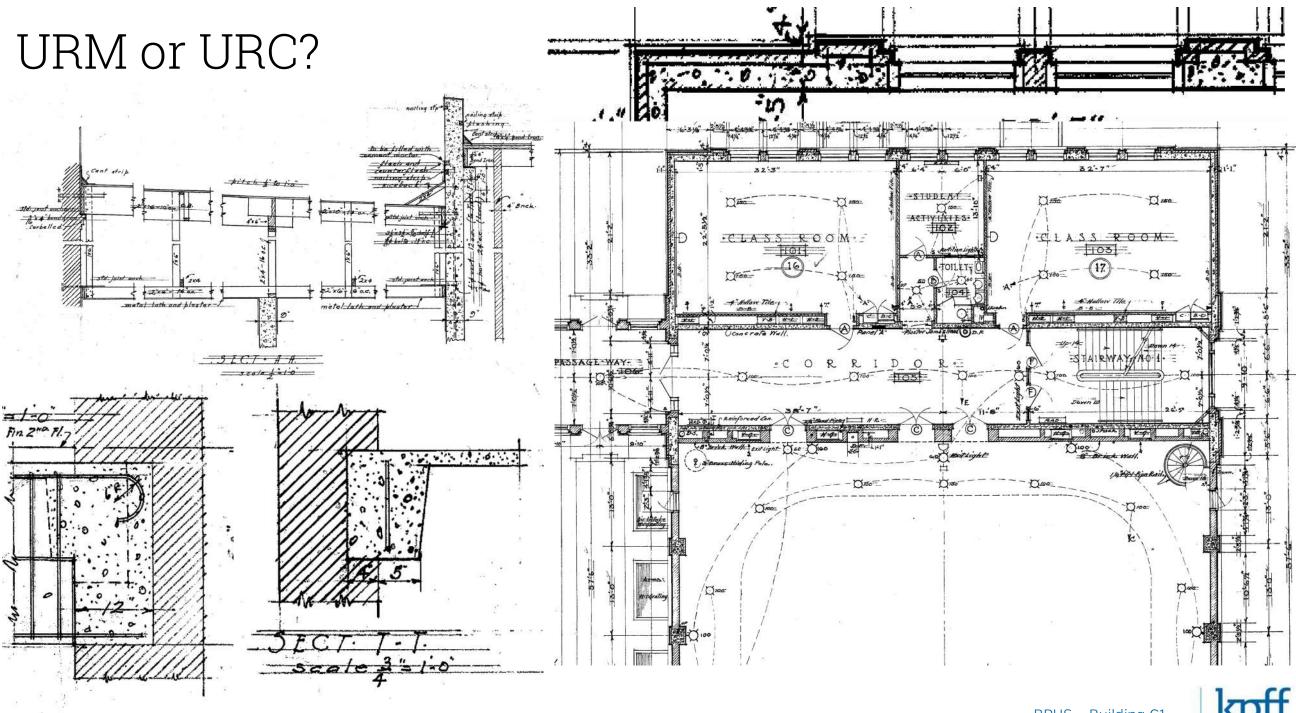
Building G1

Representative Seismic Upgrade Axonometric





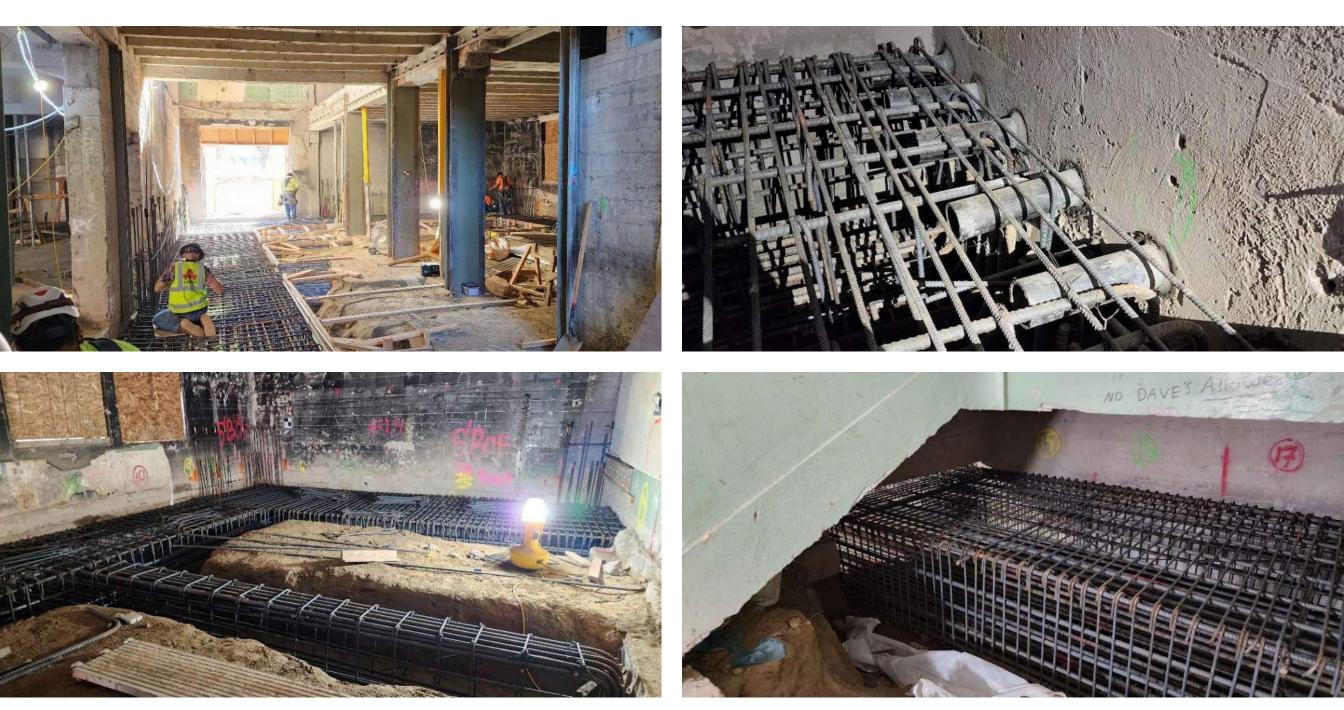
kpff



D

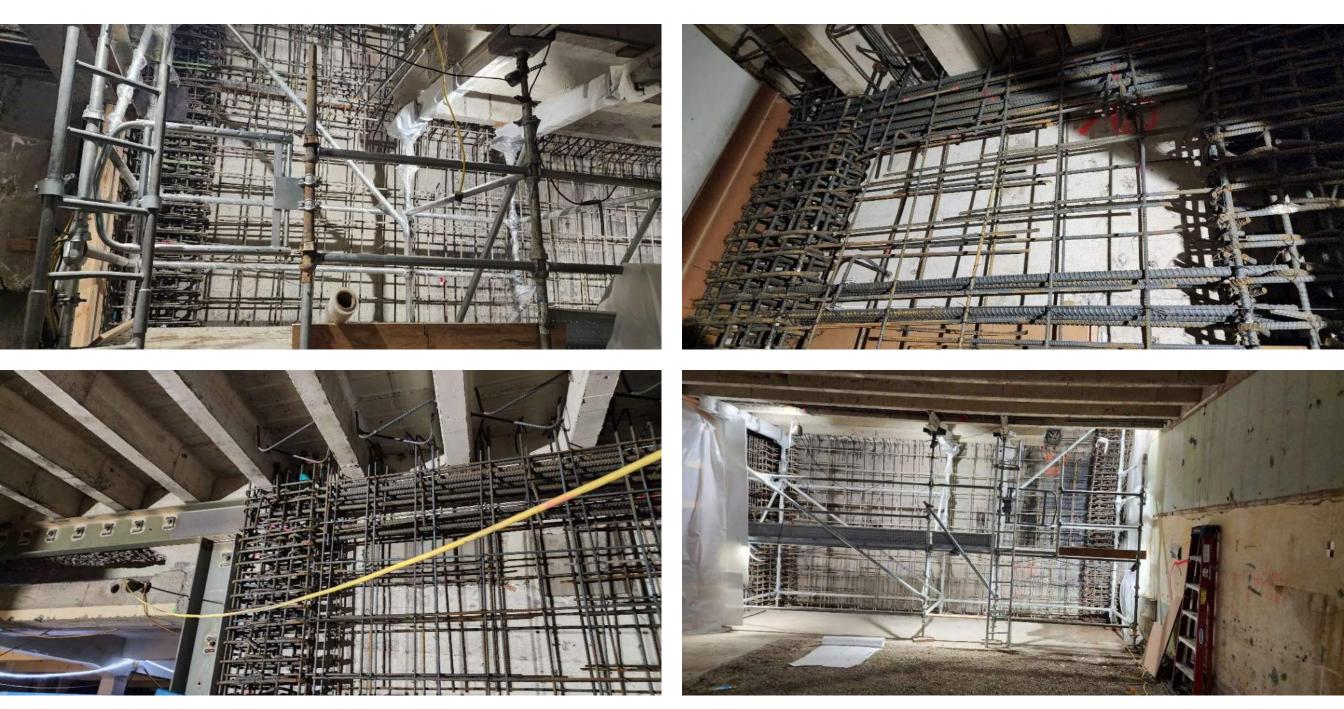
BPHS – Building G1





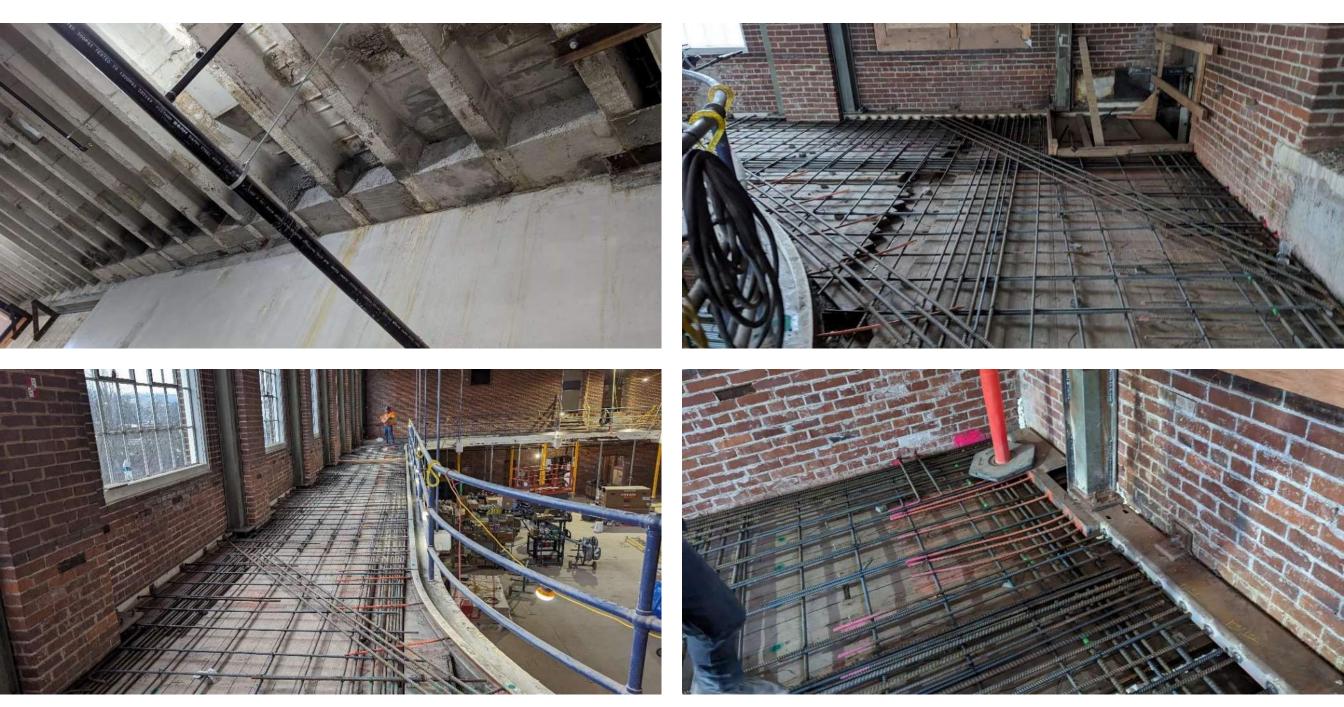
Building G1 – Shear Wall Foundations





Building G1 – Concrete Shear Walls





Building G1 – Diaphragms & Collectors | kpff



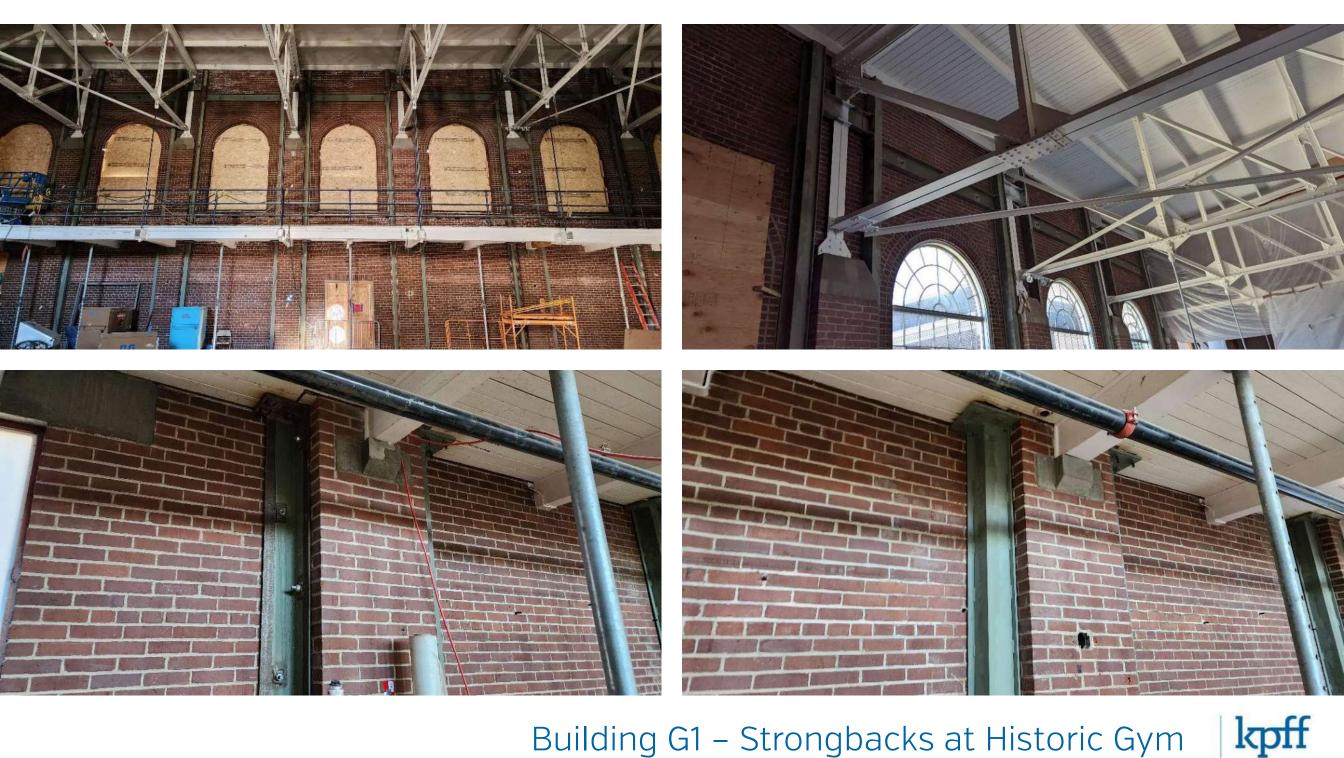


Building G1 – Roof MPP Diaphragms



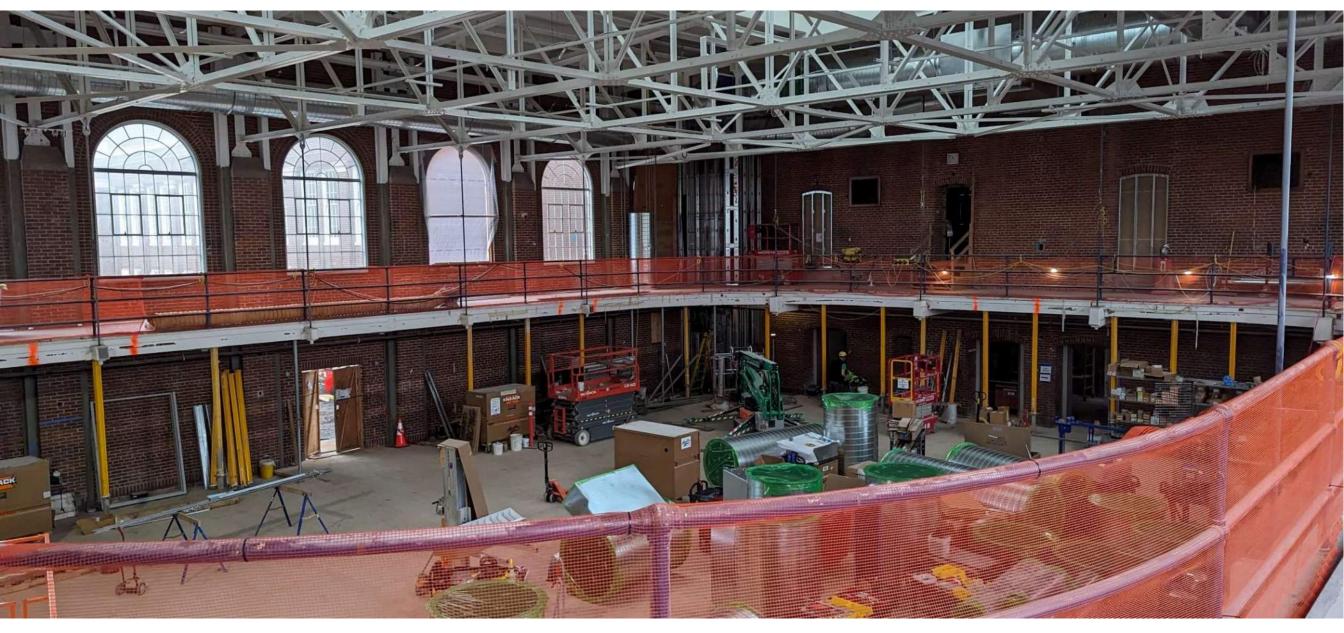
Building G1 – Strongbacks at Classroom Wings





Building G1 – Strongbacks at Historic Gym

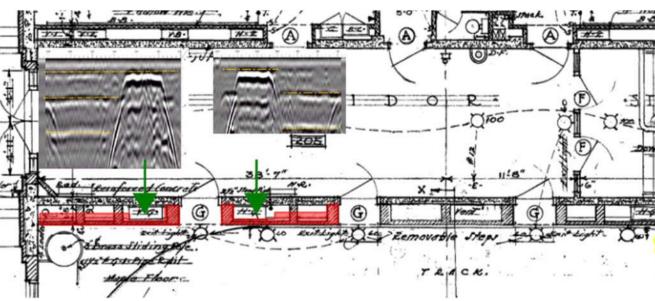
Building G1 – Strongbacks and Existing Trusses











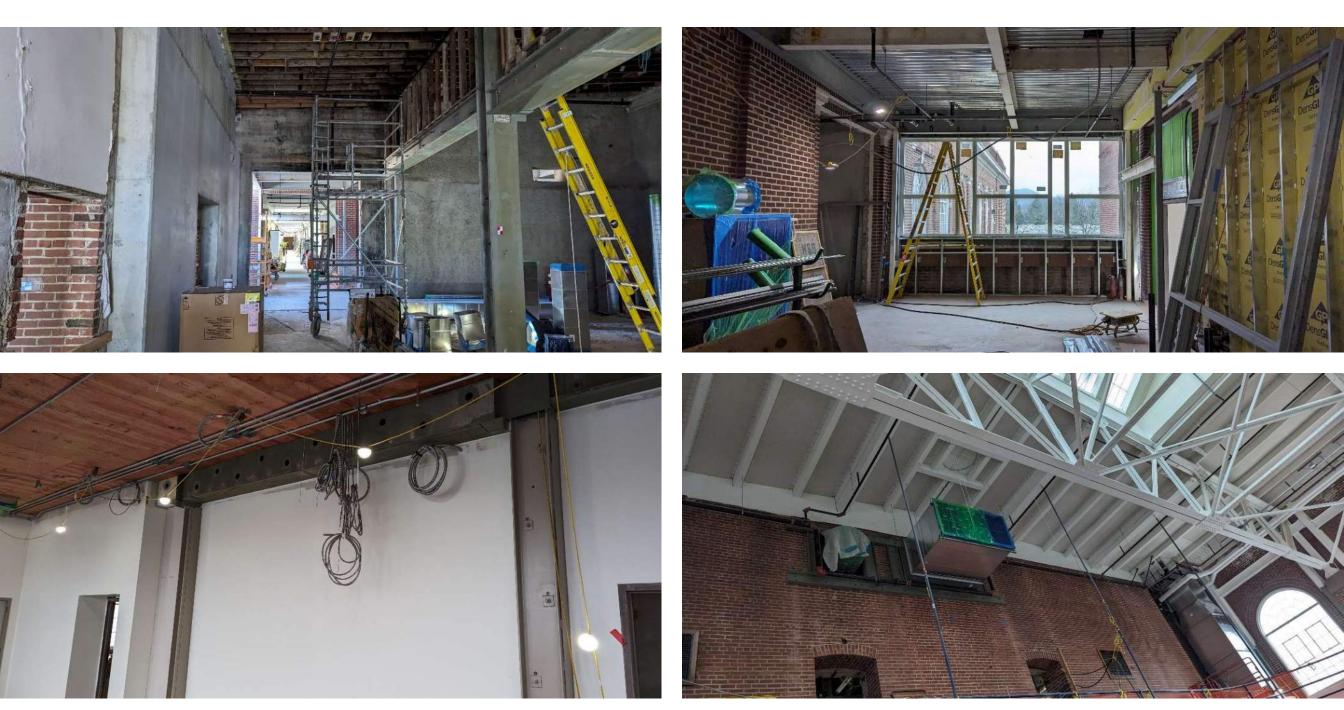
URM "Breather" Wall Retrofit





Building G1 – Unreinforced Wall Demolition





Building G1 – Completed Structure | kpff

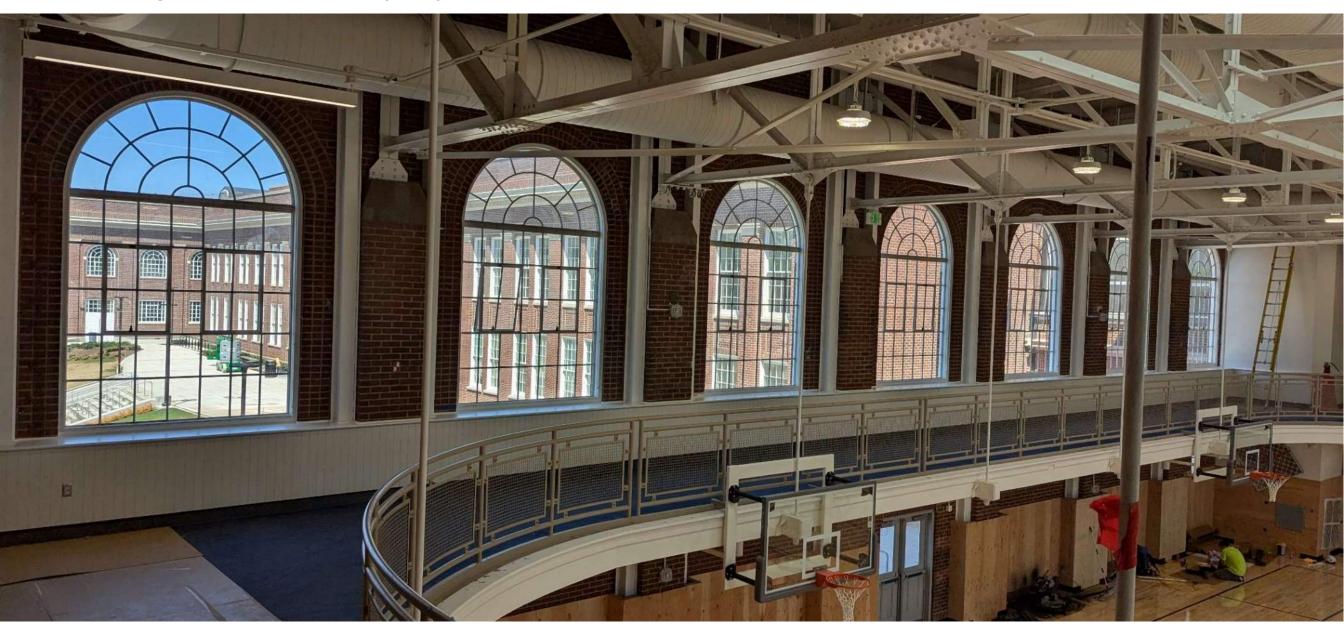


Building G1 – Classrooms



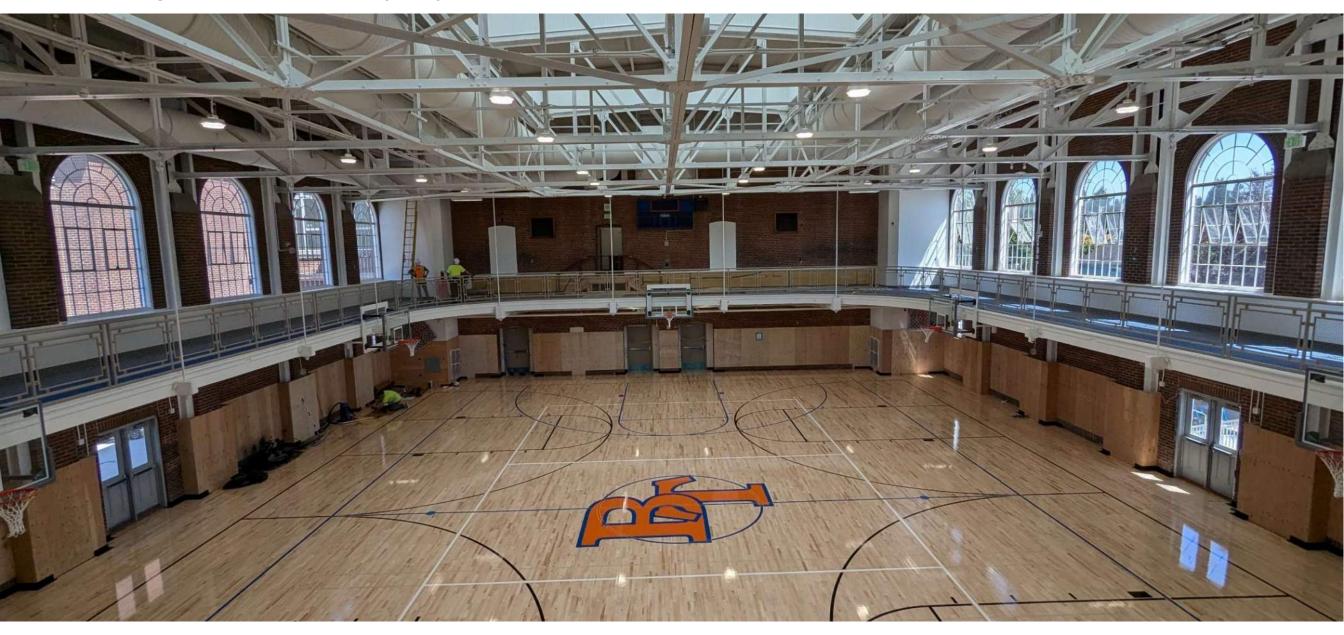


Building G1 – Auxiliary Gym



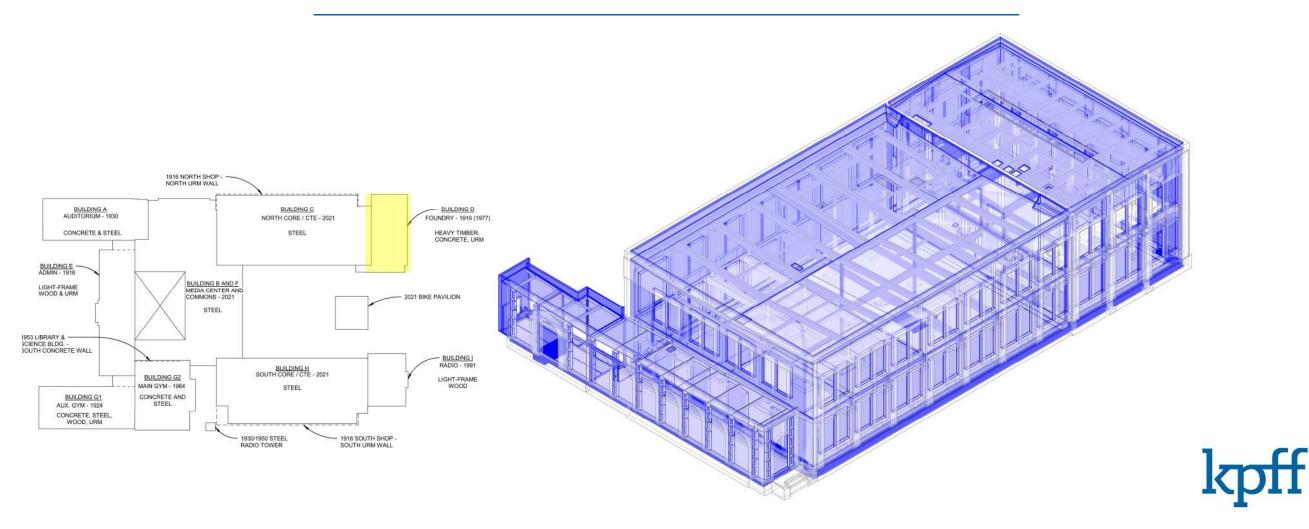


Building G1 – Auxiliary Gym





Building D – 1916 Foundry (URM, Heavy Timber & Concrete)



<u>Building D</u>

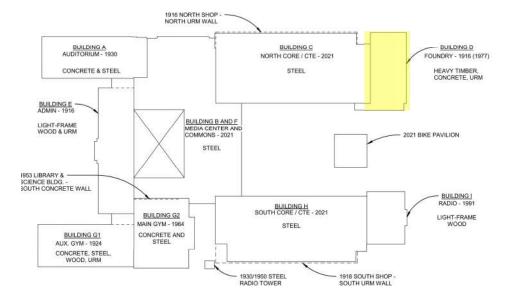
Lateral Plan Diagram

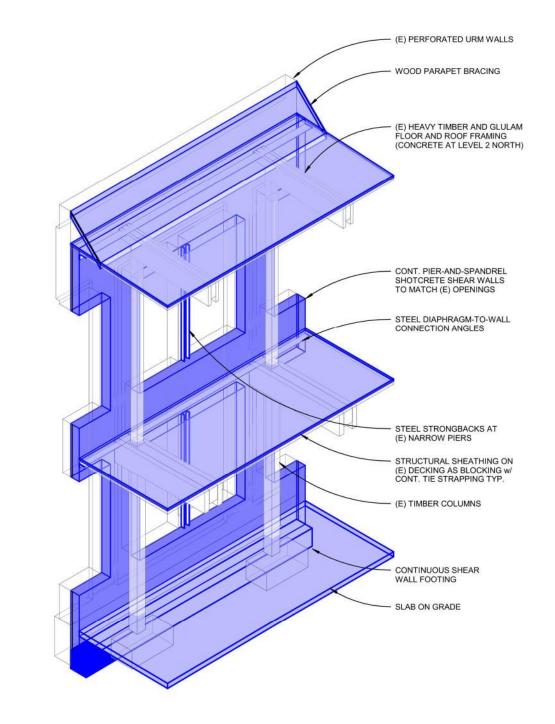




<u>Building D</u>

Representative Seismic Upgrade Axonometric









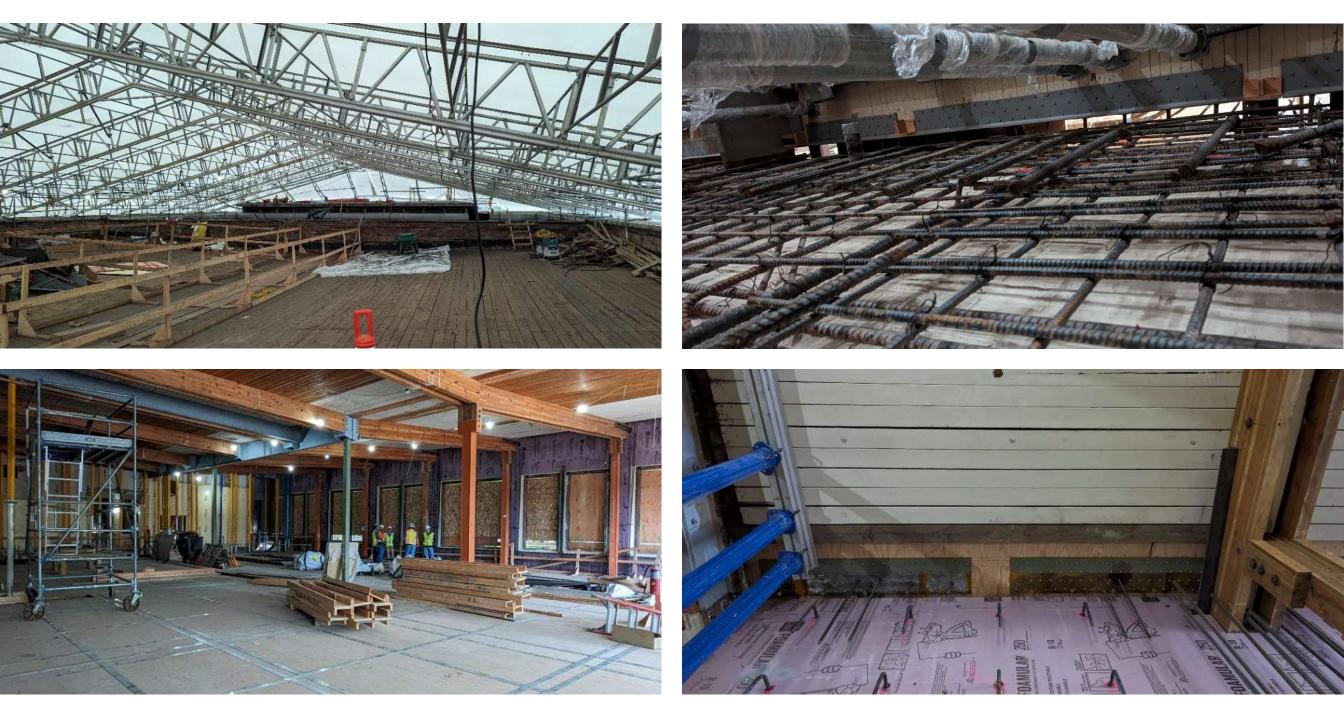






Building D – Gravity Reframing | kpff





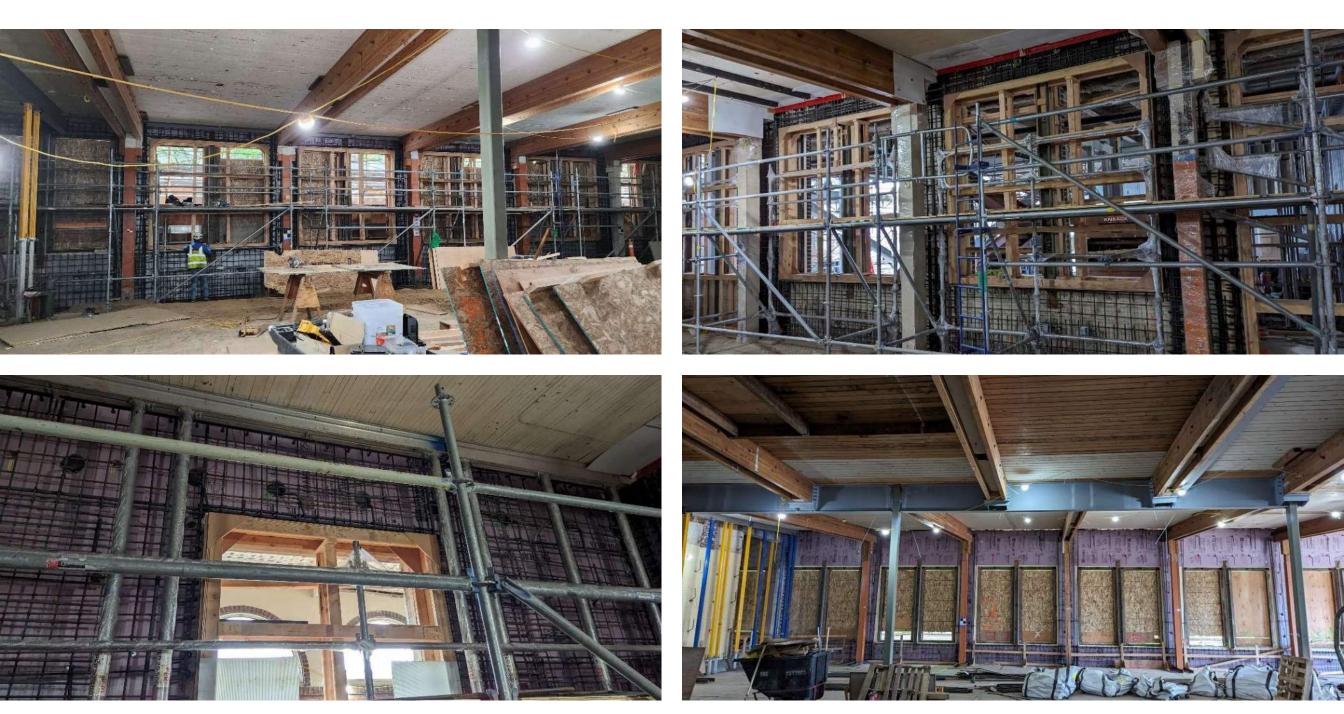
Building D – MPP Diaphragms





Building D – Continuous Shear Wall Strip Foundations



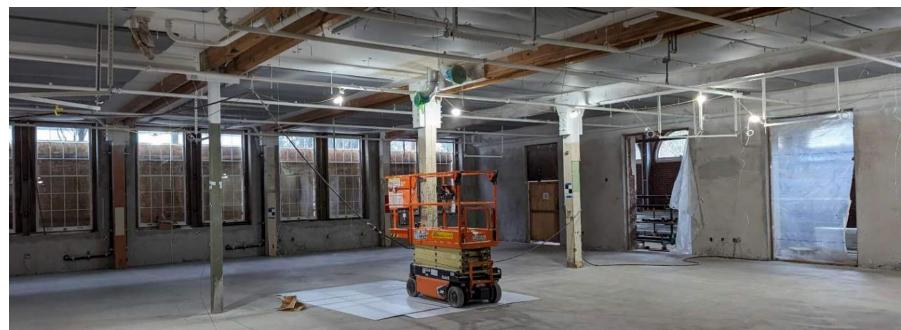


Building D – Continuous Shotcrete Shear Walls w/ Insulation









Building D – Finished Structure

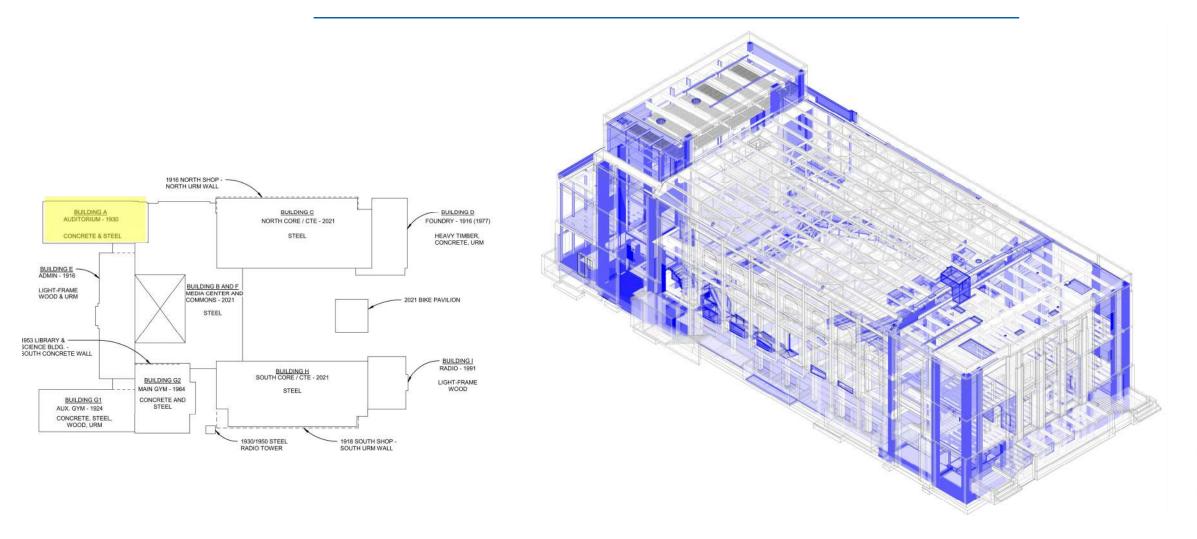


Building D Exterior with Building C





Building A – 1929 Auditorium (Semi-Reinforced Concrete & Steel)





<u>Building A</u>

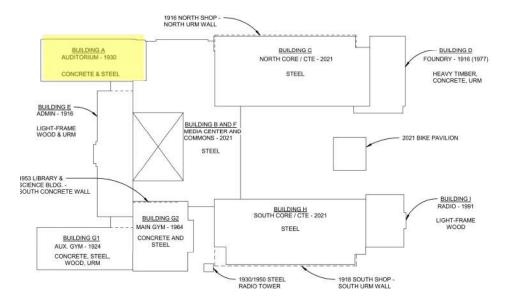
Lateral Plan Diagram

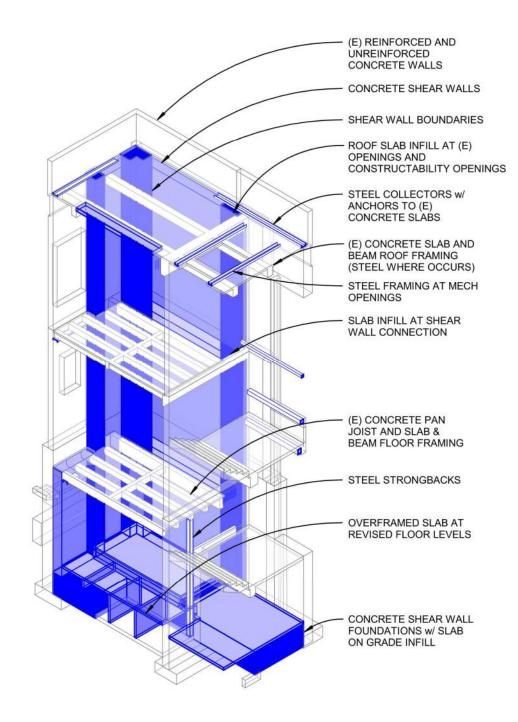
 (E) CONCRETE WALLS		
 STEEL STRONGBACKS		
CONCRETE SHEAR WALLS		
 STEEL COLLECTORS		
(E) WALL DEMOLITION		

kpff

<u>Building A</u>

Representative Seismic Upgrade Axonometric



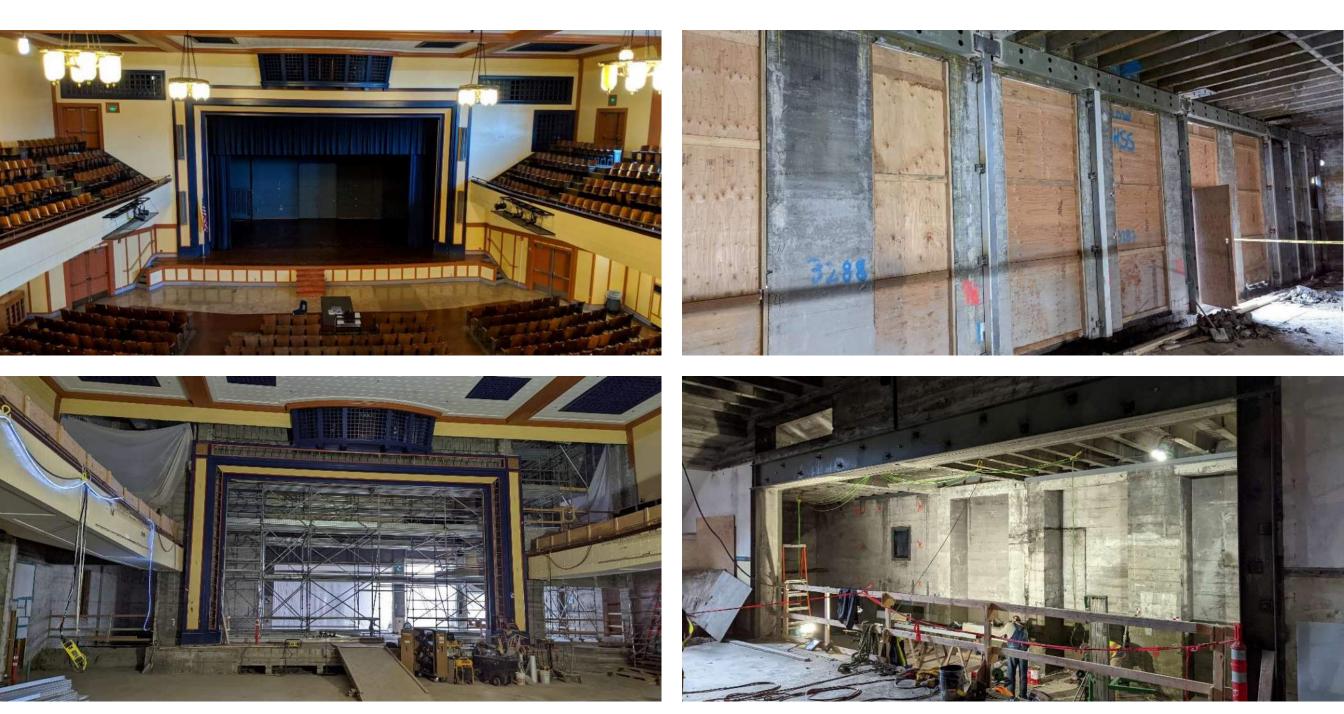






Building A – Existing Structure After Demolition





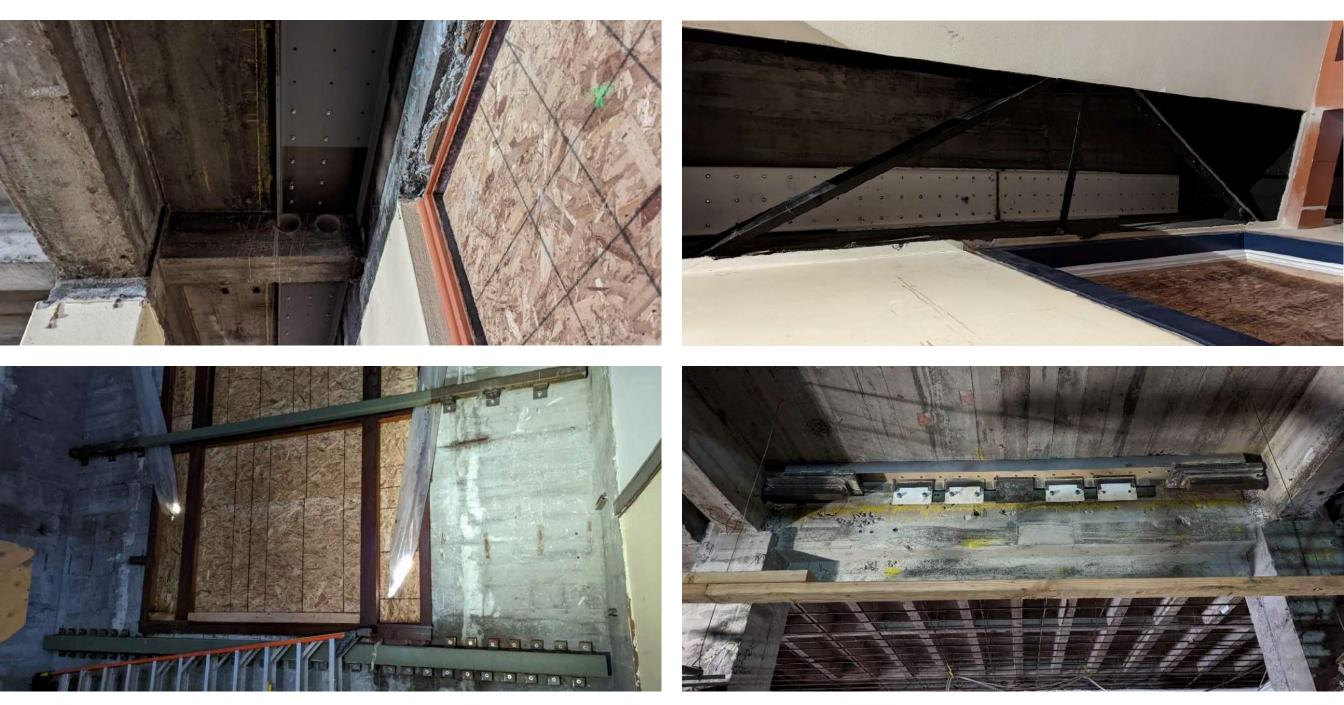
Building A – Strongbacks & Unreinforced Wall Demo



Building A – Strongbacks to Reduce OOP Demands on (E) Columns



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Building A – Collectors | kpff





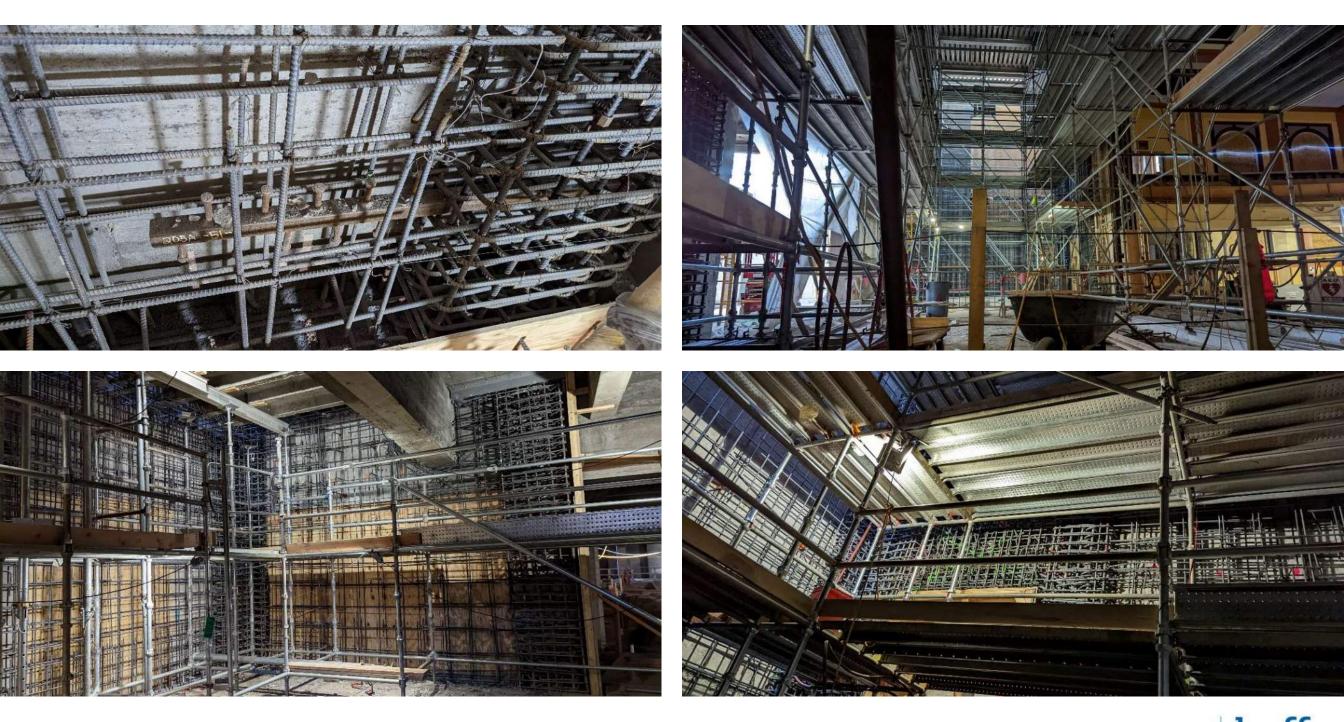
Building A – Roof Collectors | kpff



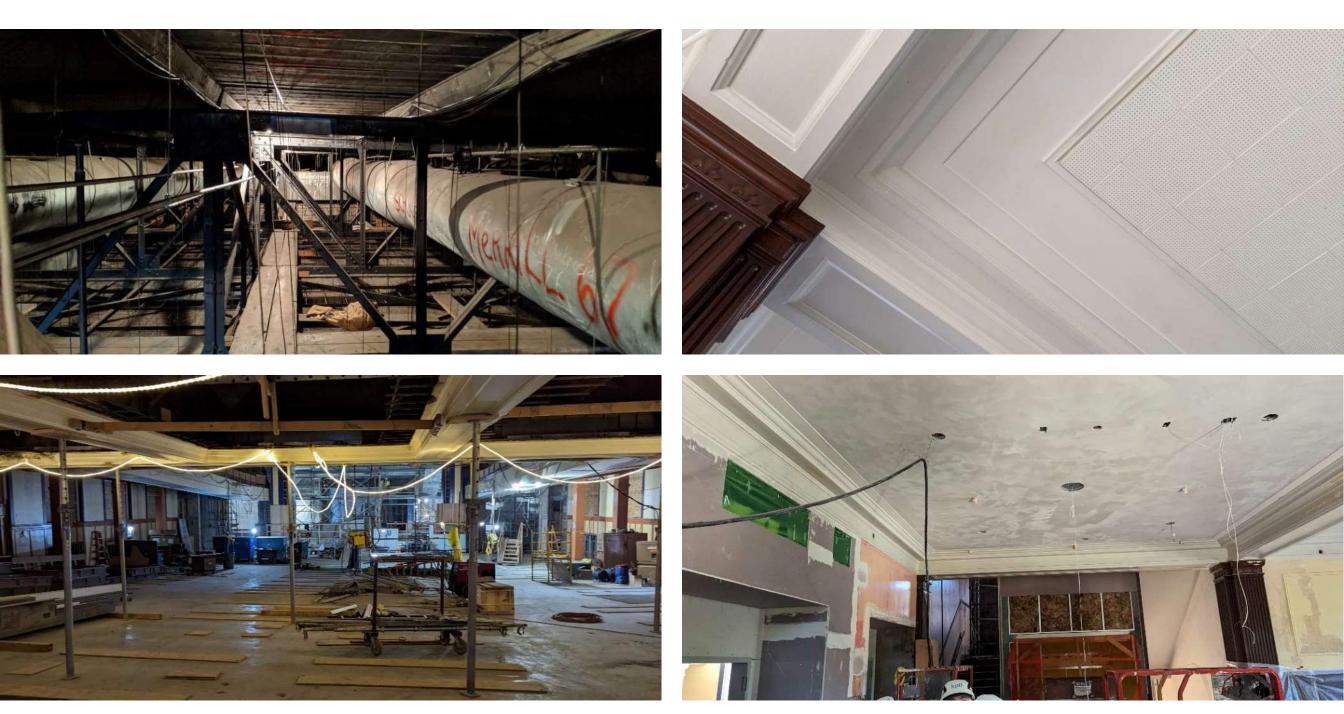


Building A – Shear Wall Foundations



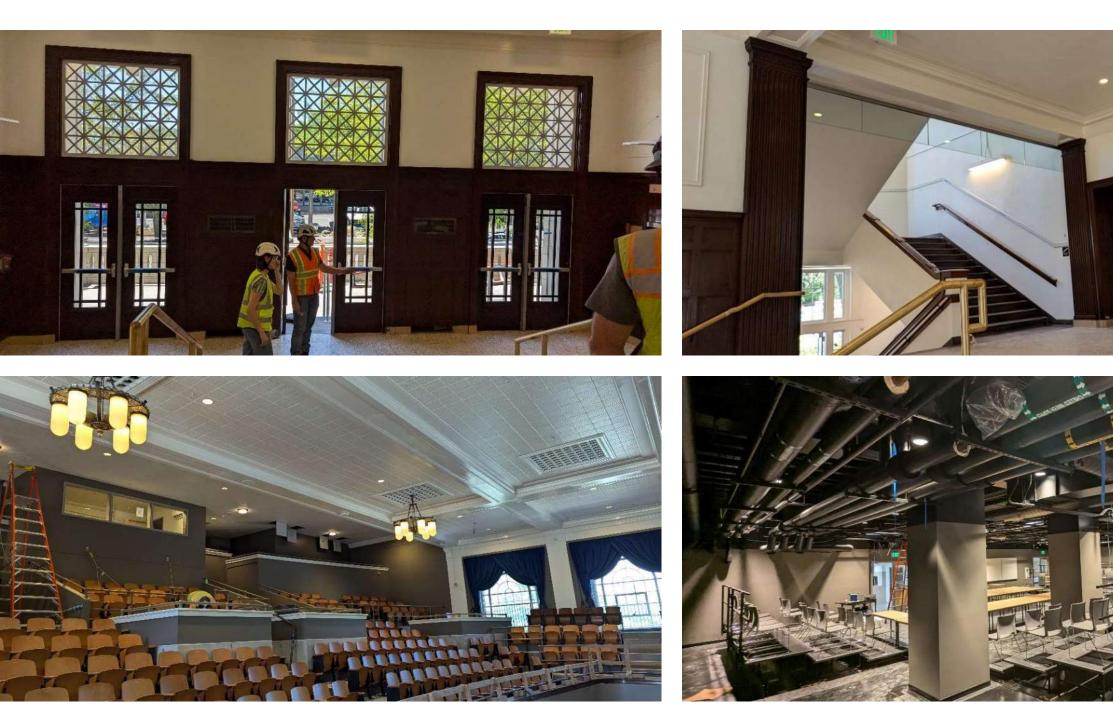


Building A – Shear Walls | kpff



Building A – Historic Plaster Preservation



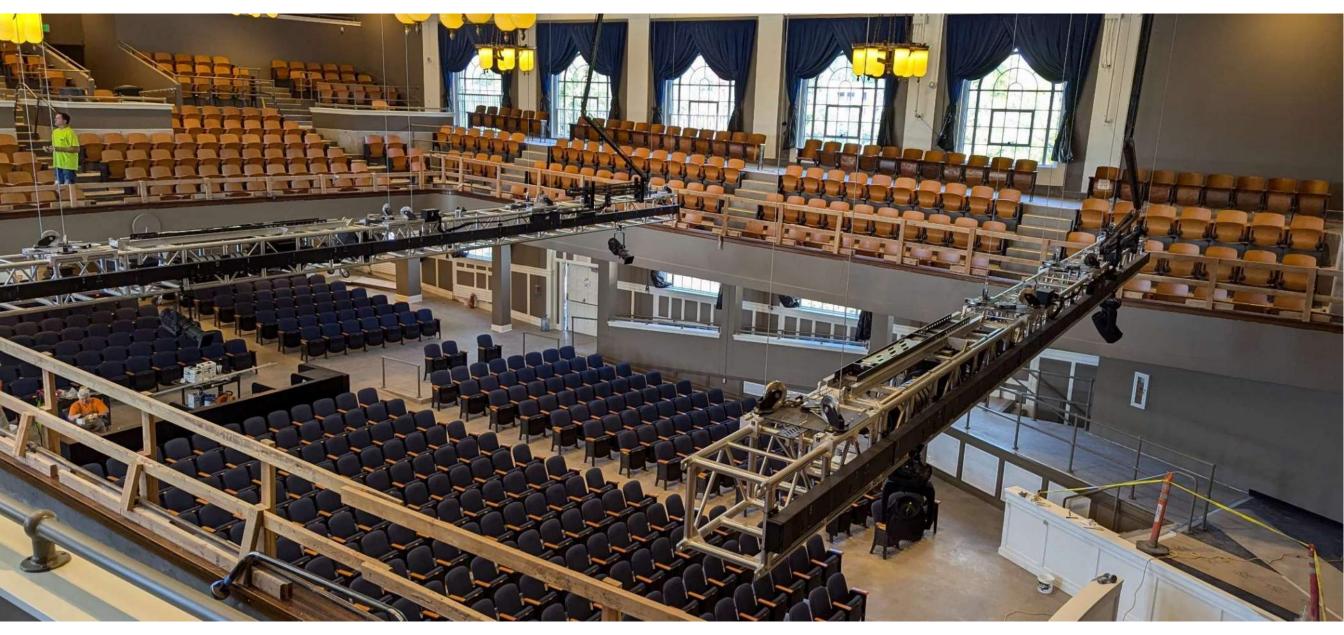


Building A – Finishes



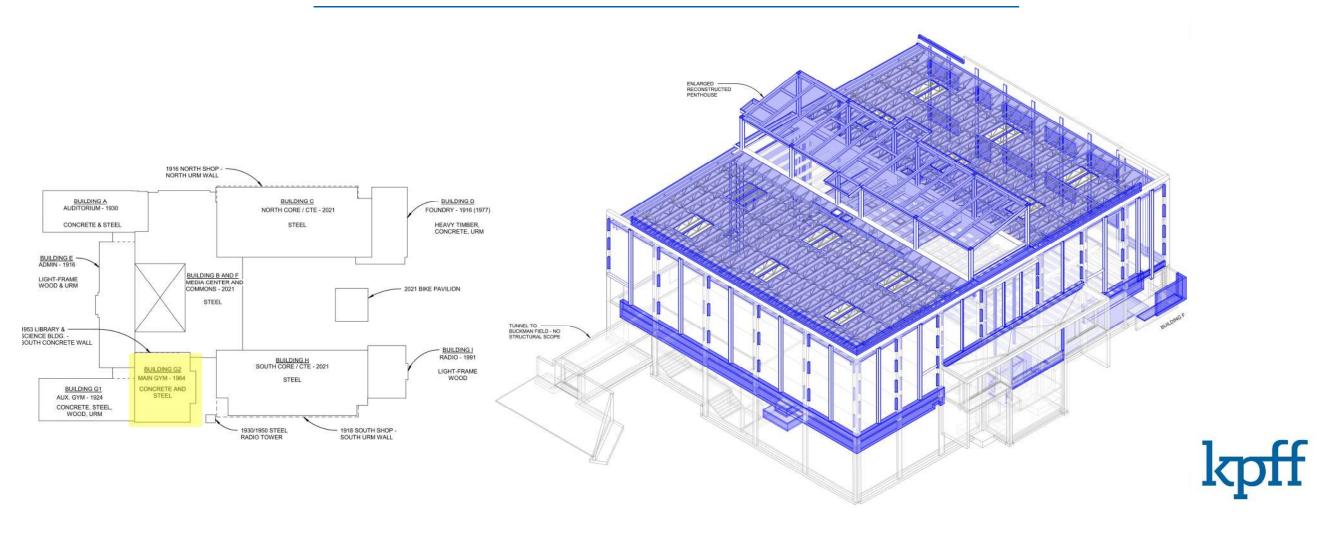
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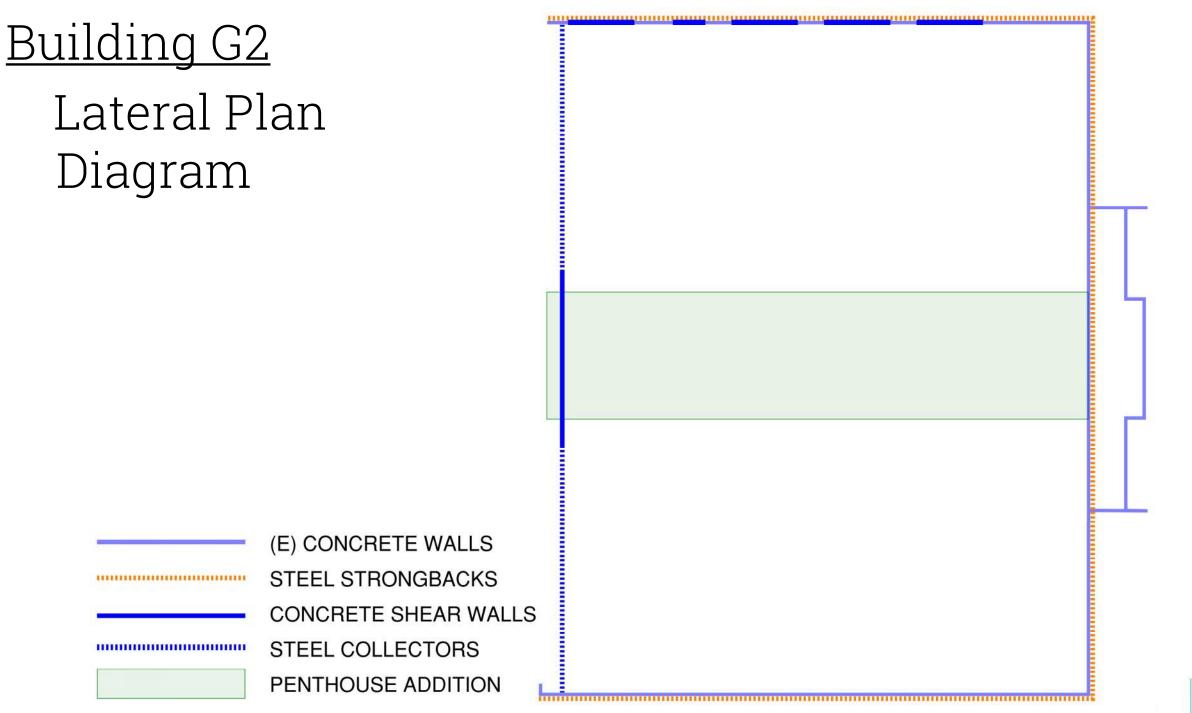
Auditorium Finishes





Building G2 – 1964 Gymnasium ([Un]Reinforced Concrete & Steel)

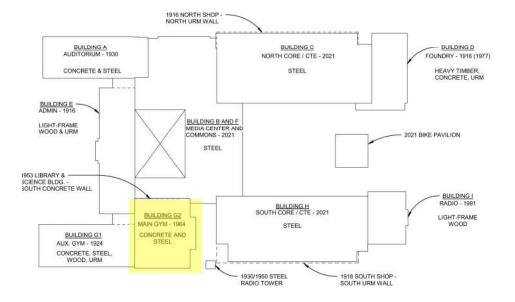


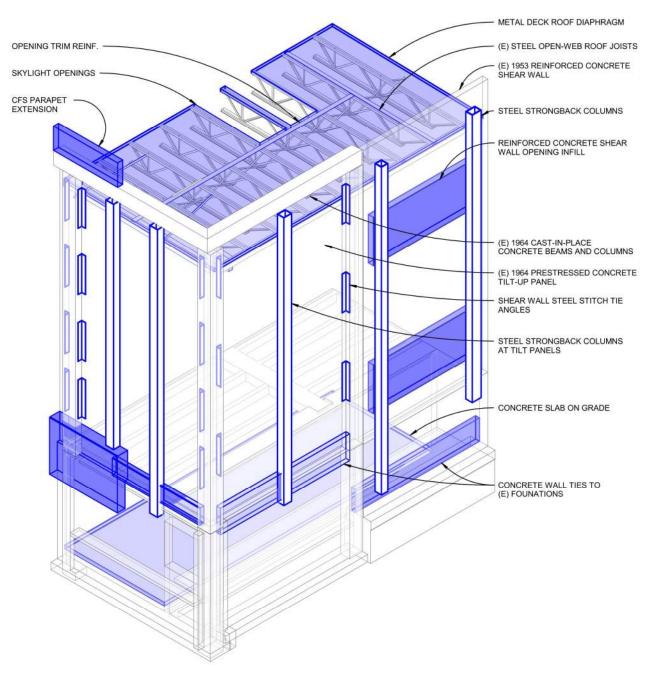




Building G2

Representative Seismic Upgrade Axonometric







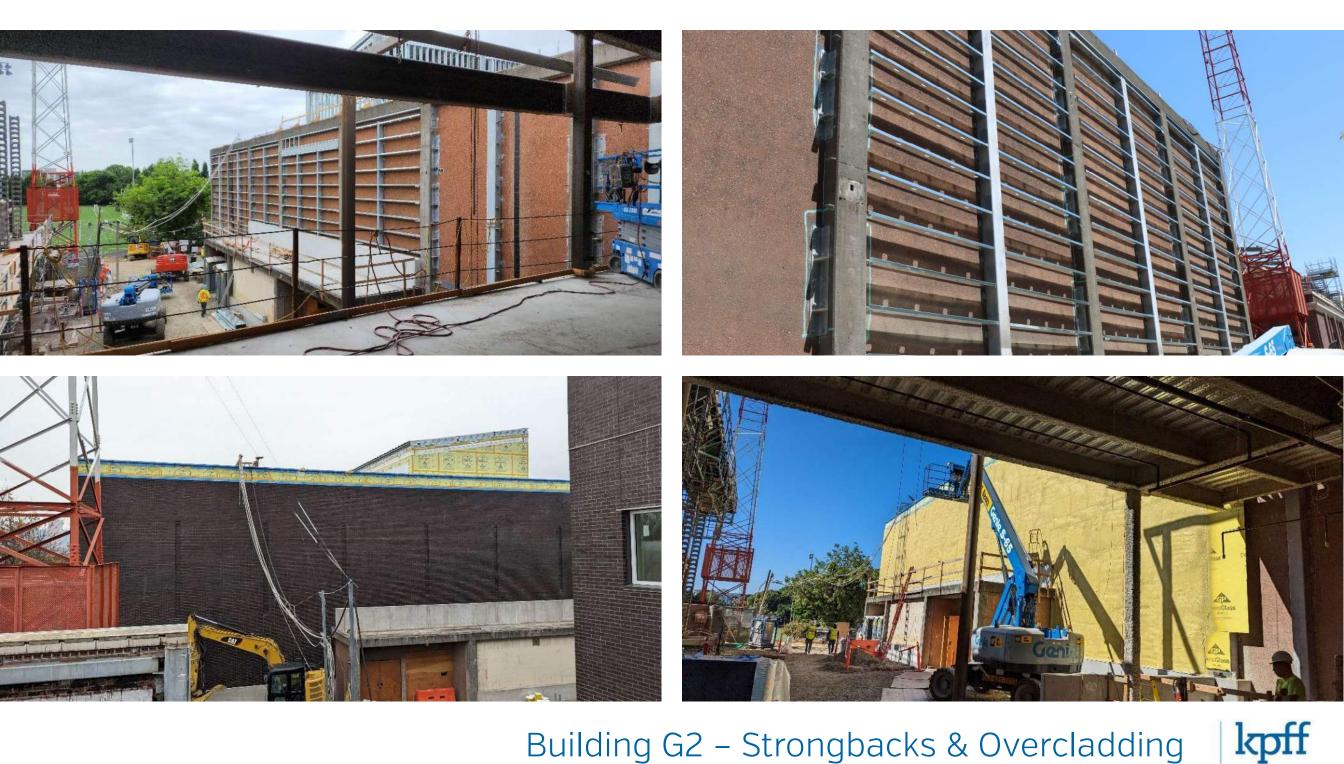


Building G2 – 1953 Wall Salvage

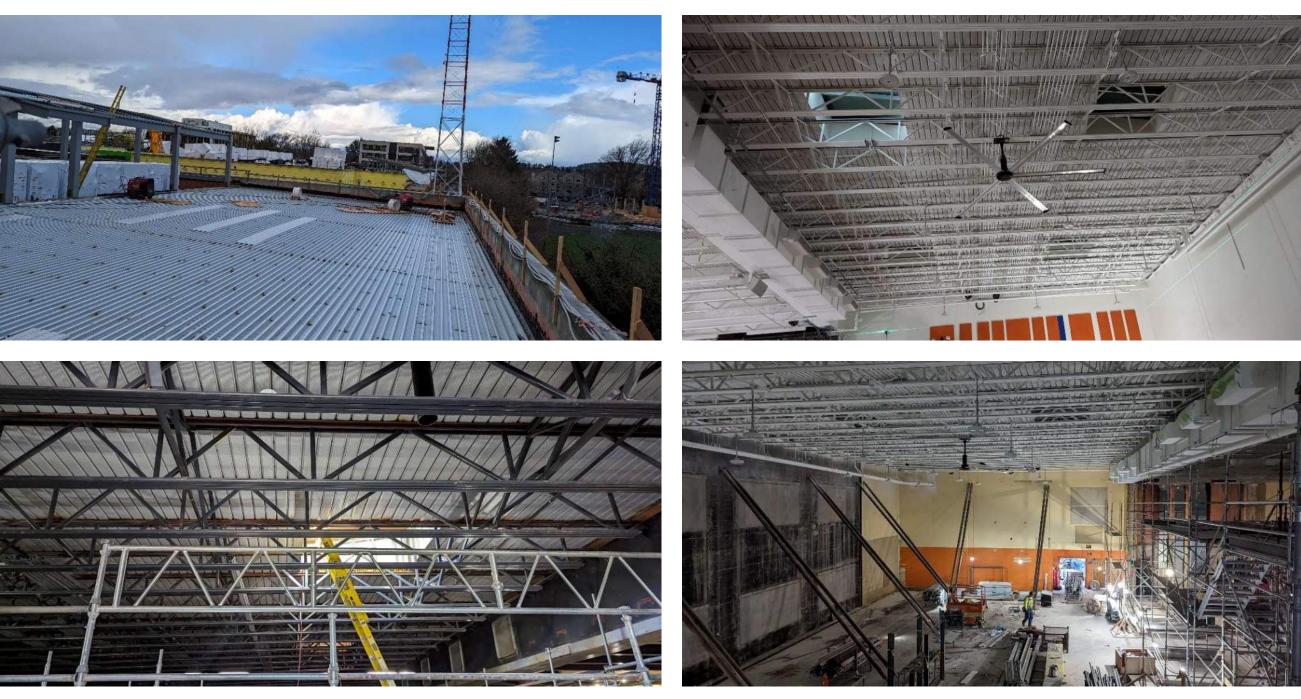




Building G2 – Strongbacks & Wall Ties | kpff



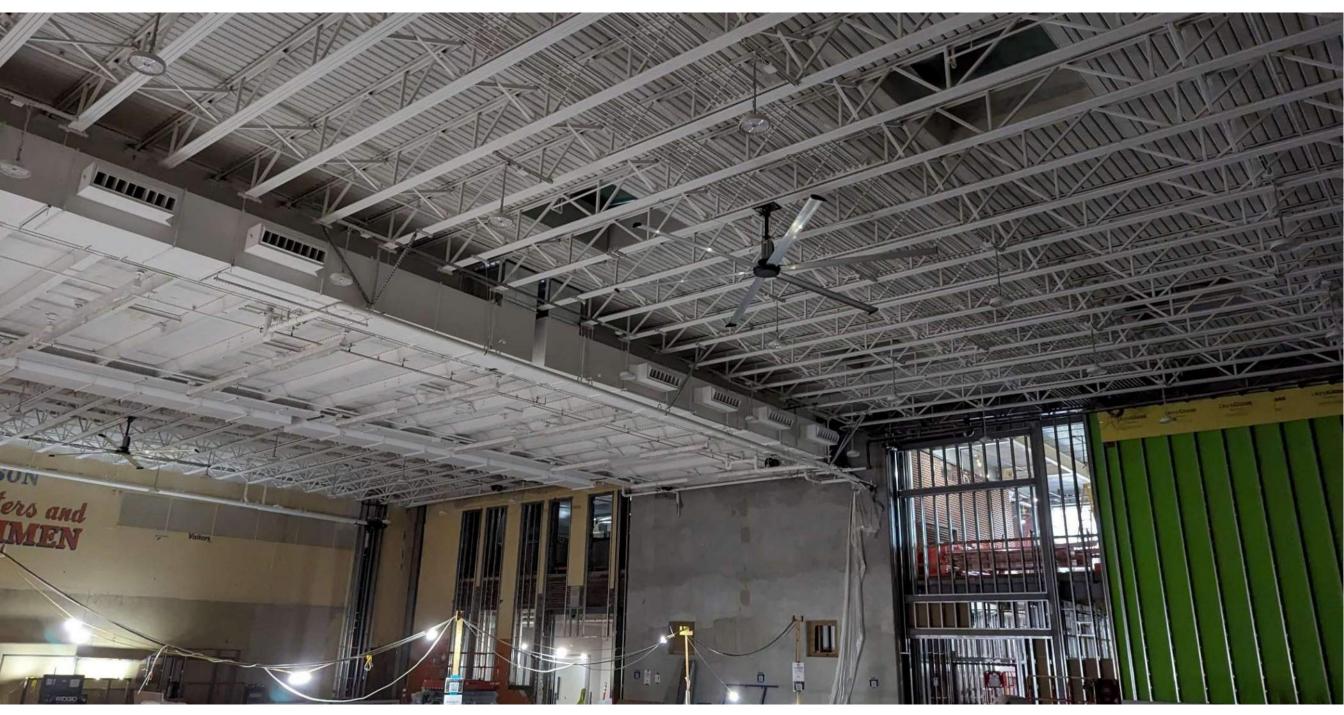
Building G2 – Strongbacks & Overcladding



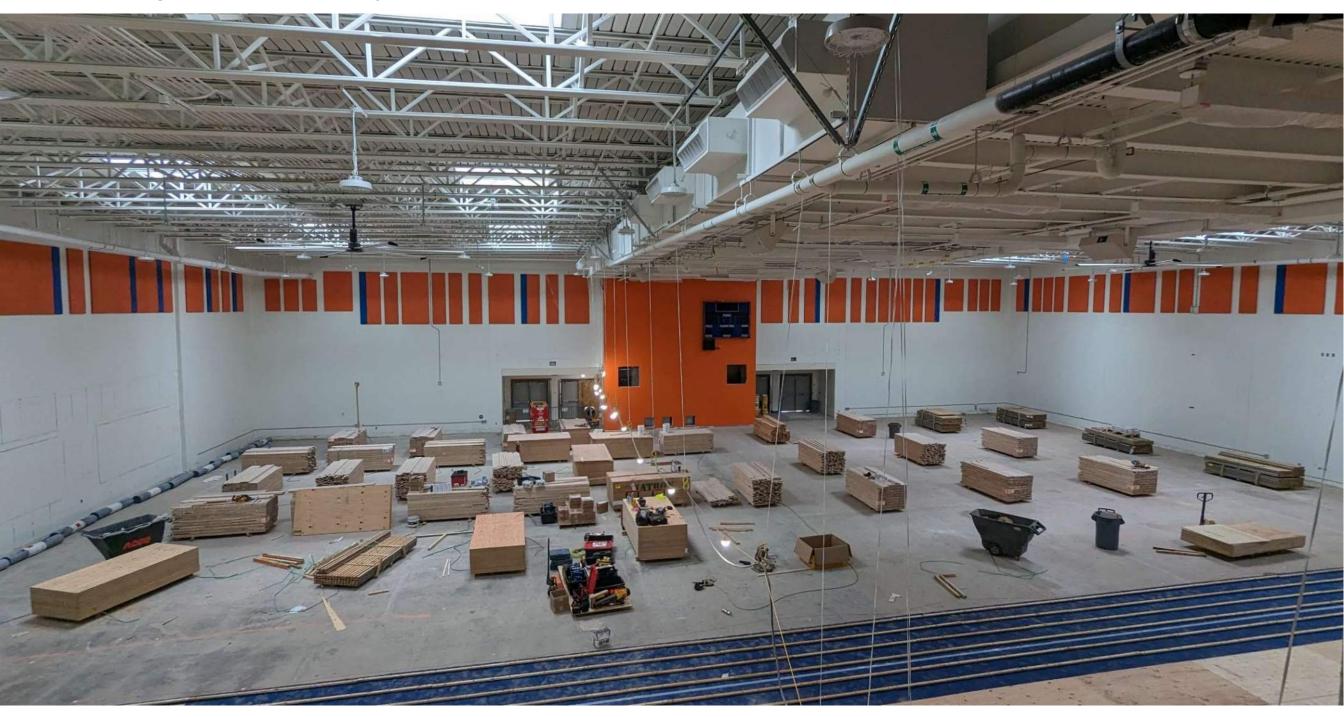
Building G2 – Roof Diaphragm



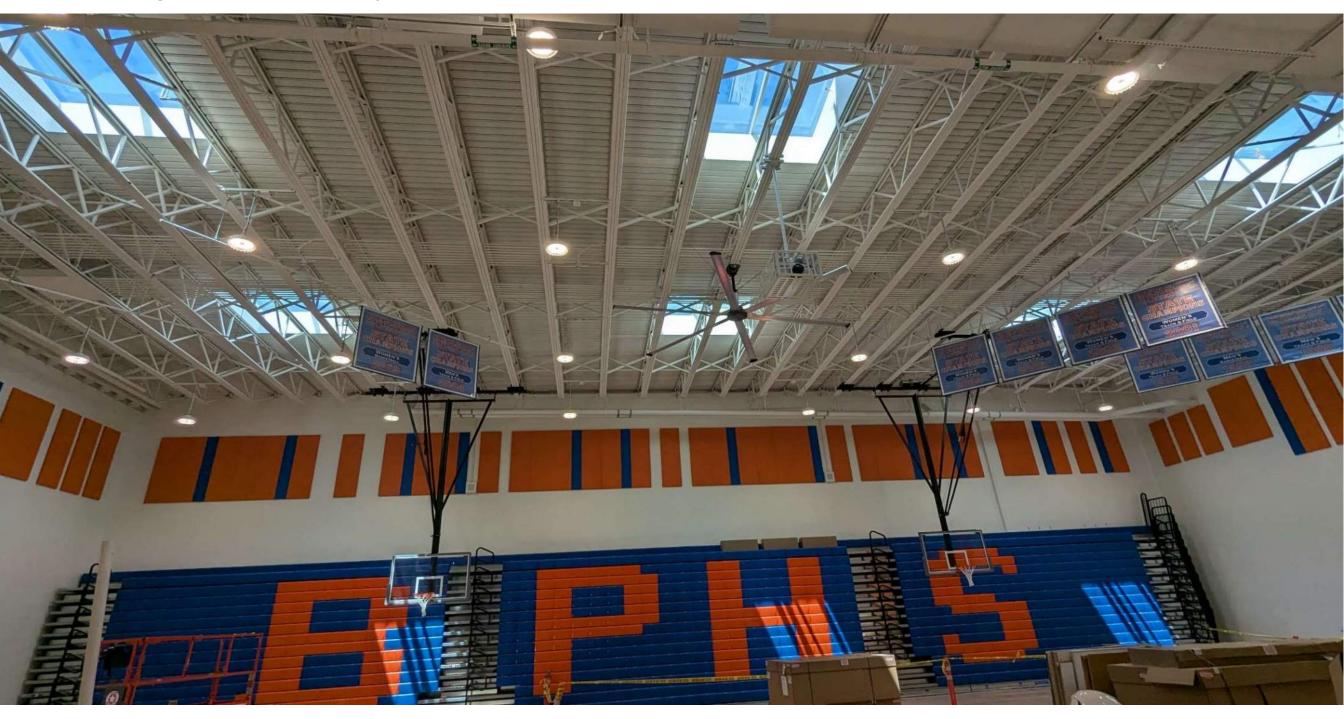
Building G2 – New Shear Wall & Seismic Joint



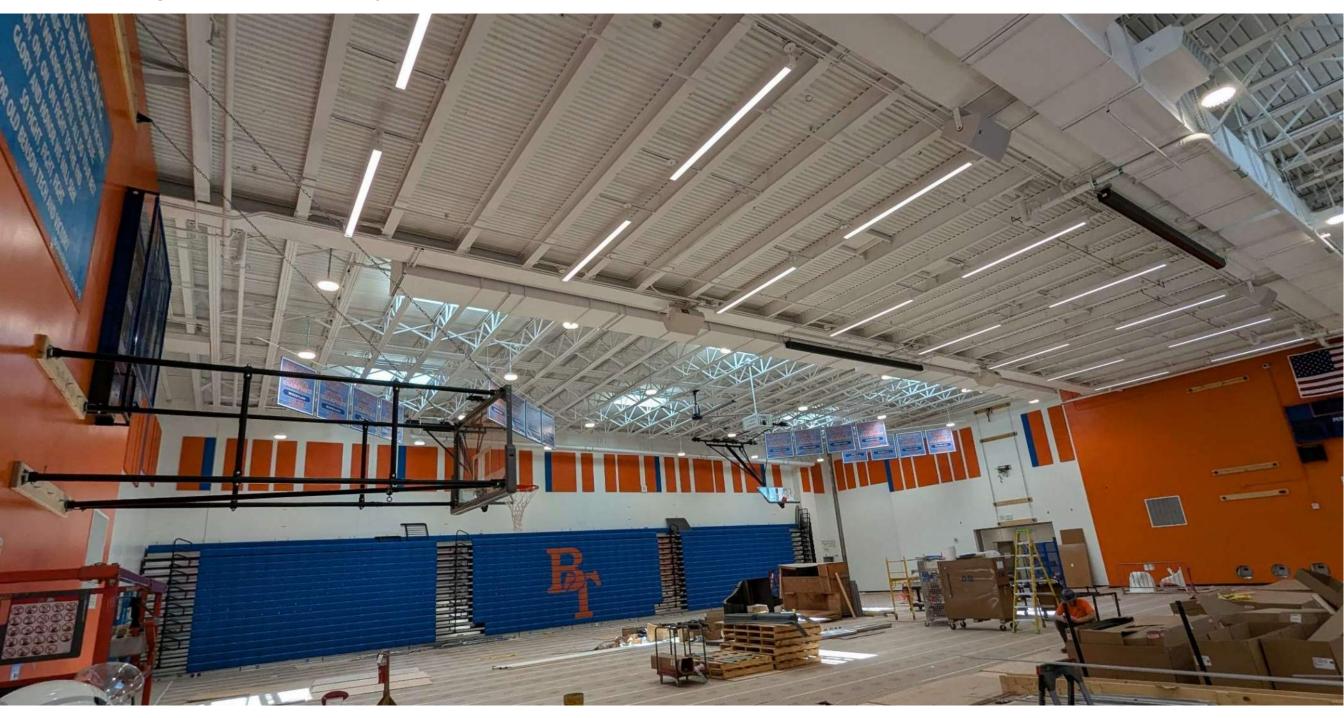
Building G2 – Main Gymnasium



Building G2 – Main Gymnasium

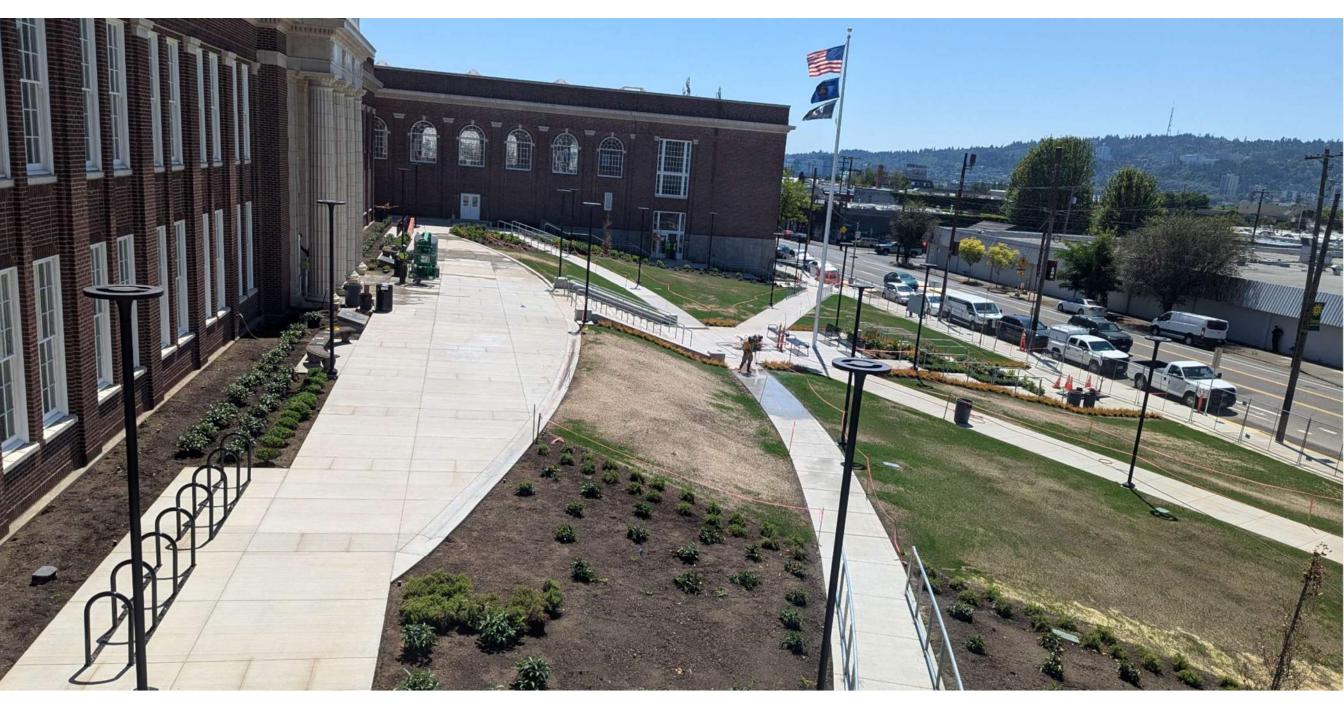


Building G2 – Main Gymnasium

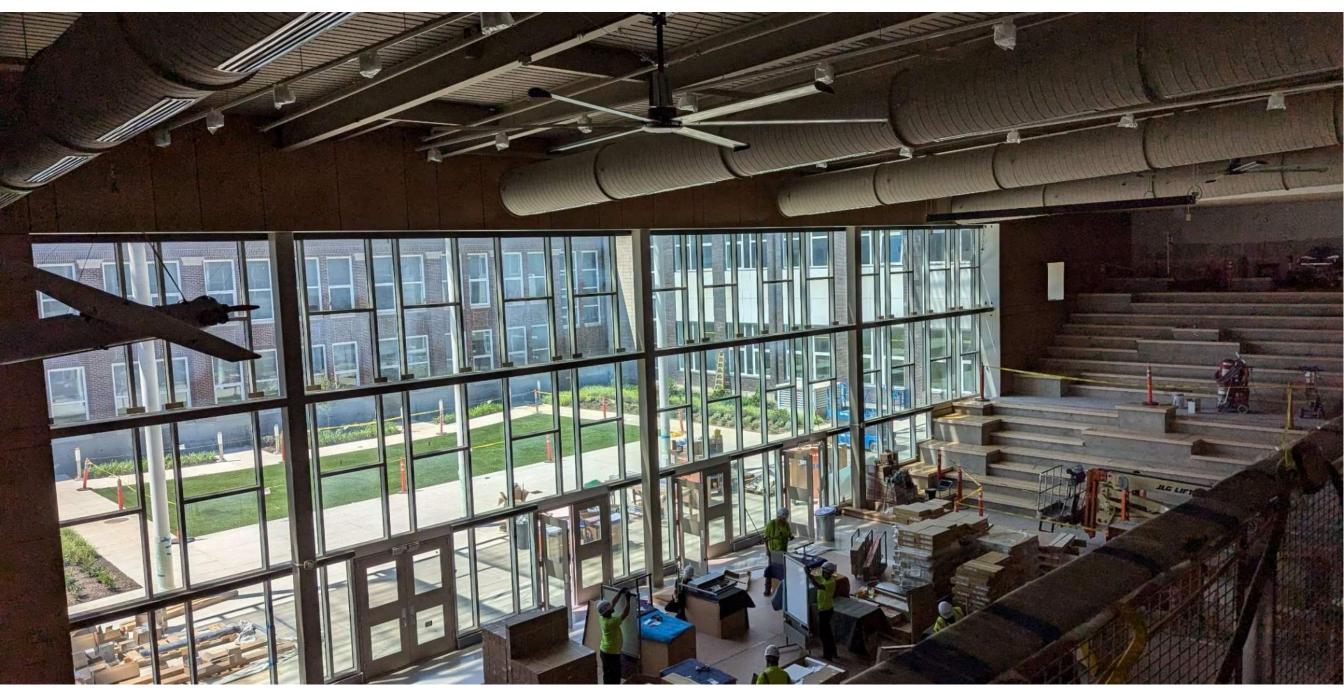












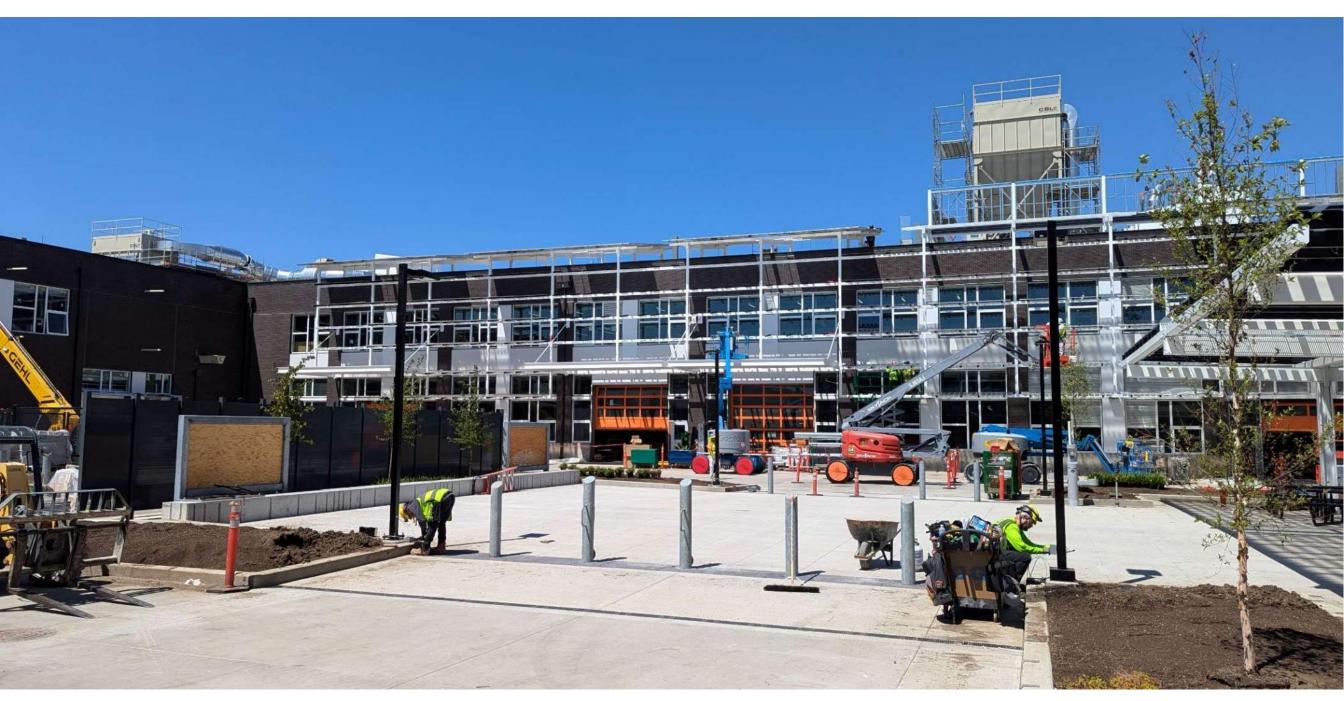




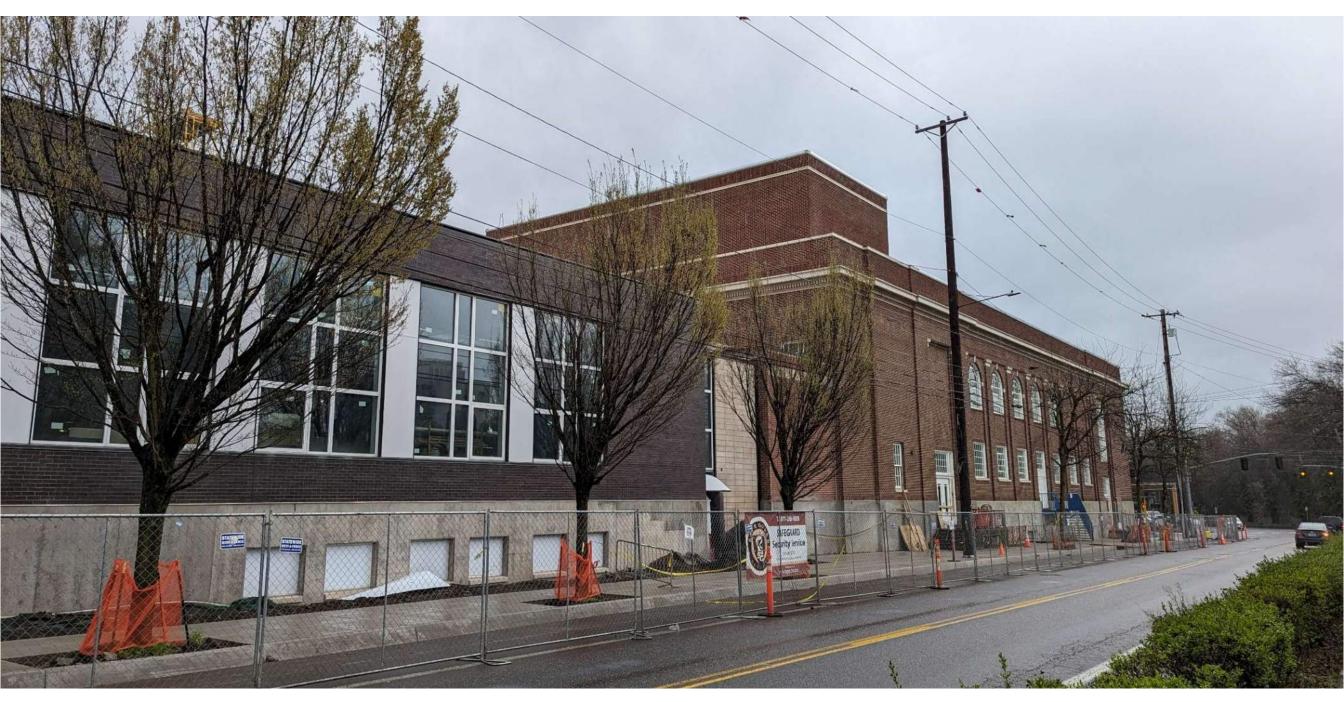
























Questions?





Thank you for Participating!

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