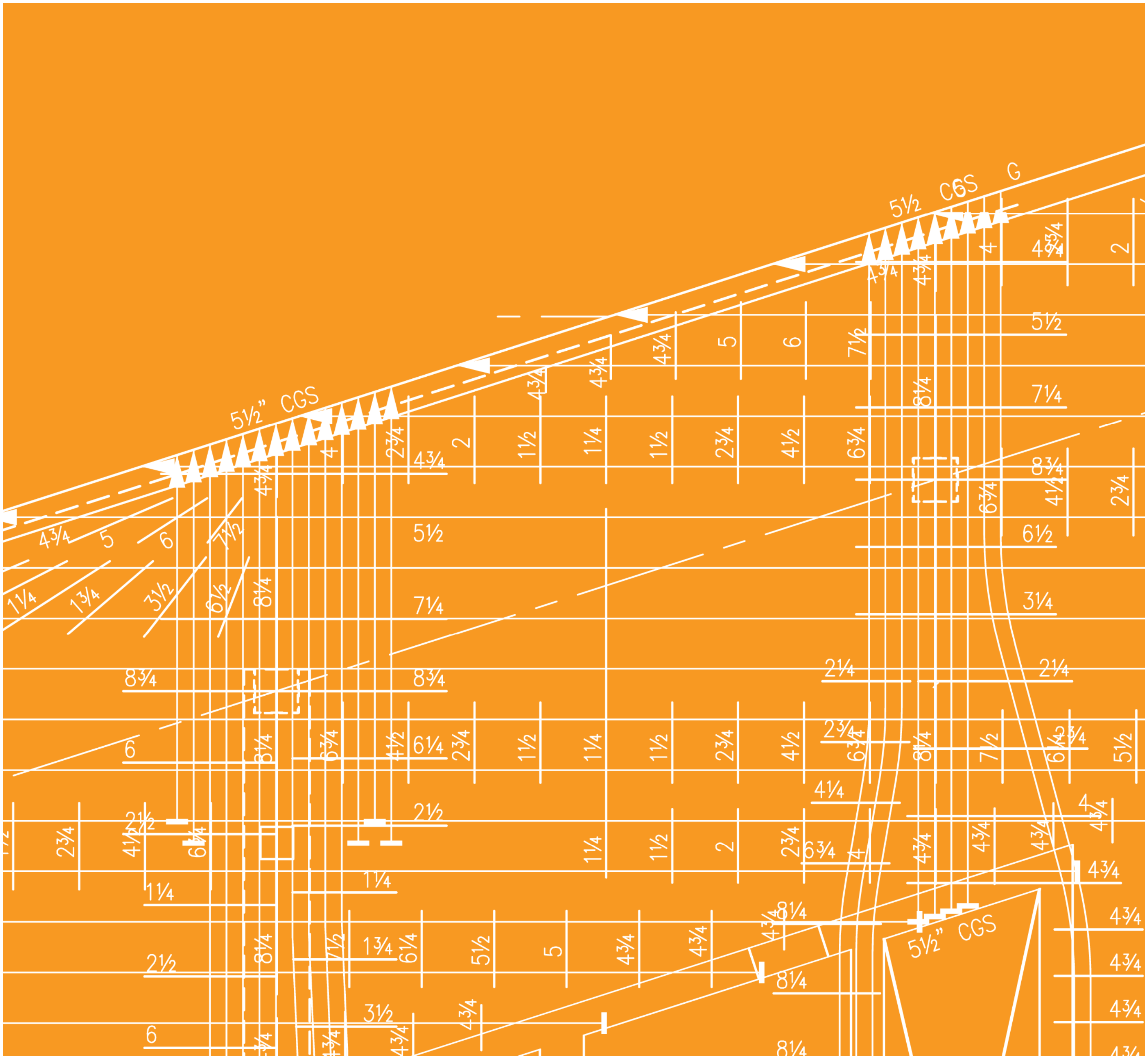

EXP. 12/31/2025

Seismic Assessment Update for the Beaverton School District

Holmes

Version 0.0.0
October 6, 2023
Project 22264.10

EXECUTIVE SUMMARY

PROJECT OVERVIEW

In 2019, the Beaverton School District (BSD) commissioned a seismic assessment report for every campus in the district. In that report each campus was categorized and scored for both structural and non-structural seismic performance. Since 2019, several of the campuses have undergone seismic retrofits to improve the seismic performance. This report serves to update the findings of the original report and incorporate the completed retrofit work. School numbering system and color coding have been carried over for district consistency from the prior full district report.

Summary of Updates

- Beaver Acres Elementary – full seismic retrofit completed in 2020.
- Bethany Elementary – full seismic retrofit completed in 2021/2022.
- Cooper Mountain Elementary - full seismic retrofit completed in 2021.
- Rock Creek Elementary – covered play seismic retrofit completed in 2023.
- West Tualatin View Elementary – roof level only seismic retrofit in 2020, gymnasium retrofit 2022.
- Five Oaks Middle School – seismic upgrade in 2023
- Aloha High School – full seismic retrofit completed in 2019.
- Sunset High School – auditorium partial seismic upgrade in 2022.

Planned Future Updates

- Raleigh Hills K-8 – slated for replacement in 2024/2025.
- Mountainview Middle School – scheduled for seismic upgrade in 2024.
- Meadow Park Middle School – scheduled for seismic upgrade in 2025.
- Cedar Park Middle School – scheduled for seismic upgrade in 2026.
- Whitford Middle School – scheduled for seismic upgrade in 2027.
- Highland Park Middle School – scheduled for seismic upgrade in 2028.

Structural Performance Objectives

The evaluation and retrofit process use structural performance objectives defined in Seismic Evaluation and Retrofit of Existing Buildings ASCE 41. Each performance objective level is detailed in the original report. The structural performance objectives targeted in the recent retrofits are outlined below.

- S-1: Immediate Occupancy (IO)
  - The post-earthquake building remains safe to occupy and retains essentially the same lateral strength and stiffness of the pre-earthquake building.
- S-2: Damage Control (DC)
  - The post-earthquake building damage between Immediate Occupancy and Life Safety.

- S-3: Life Safety (LS)
    - The post-earthquake building has sustained some damage but retains a margin of safety against collapse.
    - The damage level is such that the risk of life-threatening injury is low. All occupants are expected to be able to safely evacuate after the earthquake.
    - Damage is expected to be extensive and will require repair before the building can be re-occupied.

The State of Oregon has implemented the Seismic Rehabilitation Grant Program (SRGP) to fund the seismic upgrade of critical public buildings, including school buildings. The program requires two levels of seismic hazard be used in conjunction with appropriate performance objectives discussed above. The first hazard level is larger of the Basic Safety Earthquake 1 for use with performance objectives for existing buildings (BSE-1E) or 75% of the Basic Safety Earthquake 1 for use with performance objective for new buildings (BSE-1N). BSE-1E is an event with 20% chance of exceedance in 50 years. BSE-1N is equal to two-thirds of the BSE-2N. The second hazard level is larger of the Basic Safety Earthquake 2 for use with performance objectives for existing buildings (BSE-2E) or 75% of the Basic Safety Earthquake 2 for use with performance objective for new buildings (BSE-2N). BSE-2E is larger than the BSE-1E and is an event with 5% chance of exceedance in 50 years. BSE-2N is the event based on the risk targeted maximum considered earthquake (MCE_R) for the site.

Achieving the stated goal of the school district would correspond to a structural performance score of 80 or higher (Damage Control for a BSE-1E event). Achieving the performance objective requirements for the SRGP would correspond to a structural performance score of 90 or higher (Immediate Occupancy for a BSE-1E event).

The following tables are reproduced from the original Seismic Assessment report with the campuses that have been updated highlighted grey with updated structural and nonstructural scores. The 2019 structural and non-structural scores are included in parentheses for comparison.

The pages following the Executive Summary include school specific seismic descriptions for each school that received a seismic (partial or full) upgrade since the completion of the 2019 district-wide report. All of these schools have revised structural scores in the tables below.

Type	#	Facility Name	Structural Score[1]	Non-structural Score[1]`	Notes
Elementary Schools	1	Aloha-Huber Park (K-8)	80	75	
	2	Barnes	51	61	
	3	Beaver Acres	85 (52)	82 (61)	Seismic retrofit 2020
	4	Bethany	88 (58)	82 (60)	Seismic retrofit 2021/22
	5	Bonny Slope	80	75	
	6	Cedar Mill	55	63	
	7	Chehalem	67	66	
	8	Cooper Mountain	94 (64)	82 (67)	Seismic retrofit 2021
	9	Elmonica	62	63	
	10	Errol Hassell	65	63	
	11	Findley	68	78	
	12	Fir Grove	48	55	
	13	Greenway	63	63	
	14	Hazeldale	95	95	
	15	Hiteon	62	65	
	16	Jacob Wismer	70	70	
	17	Kinnaman	66	65	
	18	McKay	49	59	
	19	McKinley	52	62	
	20	Montclair	69	65	
	21	Nancy Ryles	67	78	
	22	Oak Hills	69	65	
	23	Raleigh Hills (K-8)	47	58	
	24	Raleigh Park	50	61	
	25	Ridgewood	56	61	
	26	Rock Creek	68(66)	66 (66)	Partial seismic retrofit 2022
	27	Sato	95	95	
	28	Scholls Heights	69	78	
	29	Sexton Mountain	67	72	
	30	Springville (K-8)	85	85	
	31	Terra Linda	69	66	
	32	Vose	95	95	
	33	West Tualatin View	50 (45)	52 (52)	Partial roof level retrofit 2020
	34	William Walker	95	95	

1: Scores in parentheses are prior 2019 scores.

Table 1: Updated Elementary School Campus Scores

Type	#	Facility Name	Structural Score[1]	Non-structural Score[1]	Notes
Middle Schools	35	Cedar Park	50	65	Scheduled for seismic upgrade in 2026
	36	Conestoga	70	78	
	37	Five Oaks	85 (55)	82 (62)	Seismic upgrade in 2023
	38	Highland Park	50	65	Scheduled for roof level seismic upgrade in 2028
	39	Meadow Park	54	65	Scheduled for seismic upgrade in 2025
	40	Mountain View	50	65	Scheduled for seismic upgrade in 2024
	41	Timberland	95	95	
	42	Stoller	70	78	
	43	Whitford	50	65	Scheduled for seismic upgrade in 2027

1: Scores in parentheses are prior 2019 scores.

Table 2: Updated Middle School Campus Scores

Type	#	Facility Name	Structural Score[1]	Non-structural Score[1]	Notes
High Schools	44	Aloha	94 (63)	76 (65)	Seismic retrofit 2019/2020
	45A	Beaverton High School (Main)	45	60	
	45B	Beaverton High School (Cafeteria)	75	75	
	45C	Merle Davies	69	69	
	46	Mountainside	95	95	
	47	Southridge	70	70	
	48	Sunset	56 (55)	55 (55)	Partial seismic upgrade 2022
	49	Westview	68	68	

1: Scores in parentheses are prior 2019 scores.

Table 3: Updated High School Campus Scores

Type	#	Facility Name	Structural Score[1]	Non-structural Score[1]	Notes
Option Schools	50A	Arts & Communication ACMA (Main Building)	95	95	
	50B	ACMA (Performing Arts Building)	85	85	
	51	Capital Center - Health & Science School	58	60	
	52	International School ISB	48	58	
	53	Merlo Station Community High	69	65	
	54	Terra Nova School of Science & Sustainability	62	55	

1: Scores in parentheses are prior 2019 scores.

Table 4: Updated Option School Campus Scores

Type	#	Facility Name	Structural Score[1]	Non-structural Score[1]	Notes
Support Facilities	55	Administration Building	68	66	
	56	Maintenance Building	67	60	
	57	Transportation Main	67	61	
	58	Transportation Allen	58	69	
	59	Transportation 5th St. North	68	69	
	60	Transportation 5th St. South	58	68	

1: Scores in parentheses are prior 2019 scores.

Table 5: Updated Support Facilities Scores

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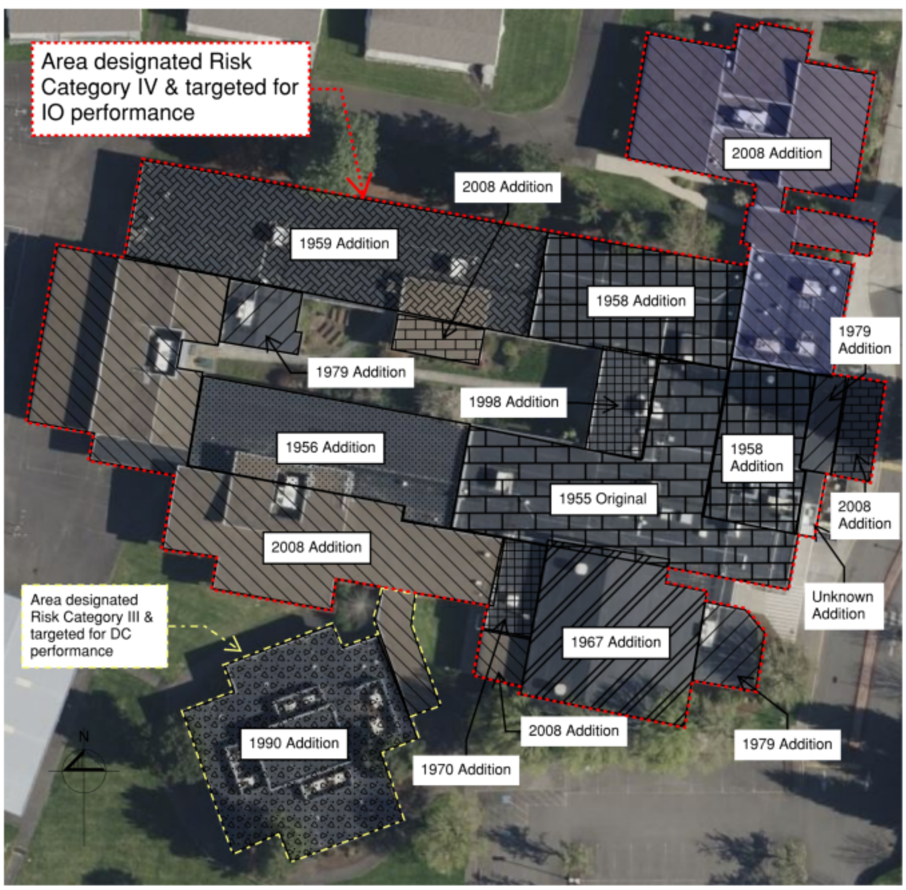
03: BEAVER ACRES ELEMENTARY SCHOOL

Following the successful application for a grant through the State of Oregon's Seismic Rehabilitation Grant Program (SRGP), a seismic retrofit of the building was completed in 2020.

BUILDING SUMMARY AND BUILDING YEAR PLAN

Originally constructed in 1955, the Beavers Acres Elementary School was expanded in 1956, 1958, 1959, 1967, 1970, 1979, 1990, and 2008 with a full seismic upgrade in 2020. The aerial image below shows the approximate extent of each addition.

The lateral force resisting system, the elements of the structure that resist forces generated by earthquake and wind, is a combination of wood, concrete, and masonry shear walls and the flexible wood framed roof diaphragm. The seismic retrofit strengthened the existing system as is described in more detail below.



Beaver Acres Elementary - Approximate Outlines of Construction Dates

BUILDING DESCRIPTION

The original building and the additions from 1956 through 1970 are of similar construction. These sections are composed of wood framed roofs with diagonal sheathing, concrete shear walls, concrete slab-on-grade, and footings. The 1970 addition enclosed an existing covered play area with reinforced masonry (CMU) walls and window storefronts.

The 1979 addition was constructed of reinforced CMU bearing walls with a wood framed roof over a concrete slab-on-grade and concrete footings.

The south building, constructed in 1990, is of conventional wood frame. The ground floor is wood framed over a crawlspace, similar to typical residential construction in the Pacific Northwest. The lateral system is composed of perimeter wood framed shear walls. The building is supported on concrete footings.

In 2008, two large additions were constructed. Both are conventional wood framed on a concrete slab-on-grade. Lateral loads are resisted by wood shear walls. The north wing is structurally separated from the main building by a seismic joint that allows the north wing and the main building to move independently in the event of an earthquake.

SEISMIC RETROFIT

The retrofit was undertaken to address specific deficiencies identified in a previous seismic assessment. The retrofit of the main building targeted Immediate Occupancy structural performance level for 75% of the BSE-1N hazard and the Life Safety structural performance level for the BSE-2E hazard. For the 1990 addition, a structural performance objective of Damage Control was selected for 75% of the BSE-1N and Limited Safety structural performance level for the BSE-2E hazard.

New wood framed shear walls were added to provide lateral strength where needed. Plywood sheathing and holdown anchors were also added to existing walls to transform them into modern shear walls. The addition and creation of shear walls also serves to reduce the spans and thus lateral demands on the roof diaphragm. Positive connections between the roof framing and the existing masonry and concrete shear walls were added to facilitate the transfer of loads. New plywood sheathing was added to significant portions of the roof to provide increased strength for distributing lateral loads to both new and existing shear walls. At the 1990 addition, diagonal tension only rod bracing was added to transfer lateral loads from the upper roof down to the low roof level. Various other seismic connections were implemented to improve the connectivity of different elements of the building to facilitate the structure working together in a seismic event.

Improvements were also made to non-structural elements of the building. Suspended ceilings were improved with modern characteristics, including lateral bracing and separation joints, that allow them to be more resilient to earthquakes. Bracing or anchorage was also added to mechanical, electrical, and plumbing equipment, such as hanging lights and mechanical units, fires suppression system, etc. The unreinforced masonry partition wall in the locker rooms was removed and replaced.

These improvements are anticipated to significantly improve the seismic performance of Beaver Acres Elementary School such that the campus now exceeds the district performance goal.

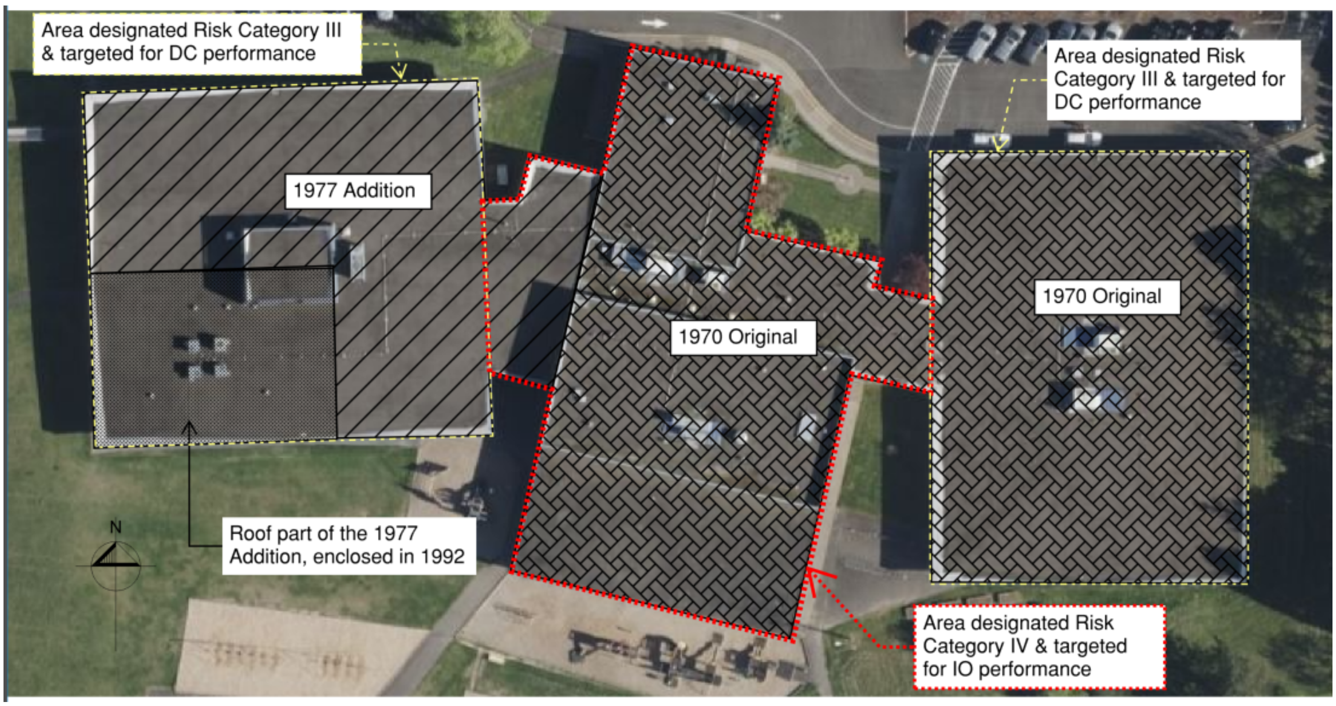
04: BETHANY ELEMENTARY SCHOOL

The Bethany Elementary School is in the final stages of a seismic upgrade. The first phase of a seismic retrofit of the building was completed in 2021 with the second, and final, phase started construction in the summer of 2022.

BUILDING SUMMARY AND BUILDING YEAR PLAN

The Bethany Elementary School was originally constructed in 1970 and expanded in 1977 and 1992 with a seismic upgrade being completed during the summer of 2022. The aerial image below shows the approximate extent of each addition.

A combination of masonry and wood shear walls with a flexible wood framed roof diaphragm are used to resist forces generated by earthquake and wind. The seismic retrofit strengthening the existing system is described in more detail below.



Bethany Elementary School - Approximate Outlines of Construction Dates

BUILDING DESCRIPTION

The building is constructed of reinforced masonry bearing walls, primarily at the perimeter, and wood framed interior walls. The roofs are primarily wood framed. At the east wing of the original structure, the roof consists of steel girders and glulam beams supporting straight wood sheathing. At the central wing, the roof consists of straight sheathing over wood framing. The 1977 addition has open web joists supported by glulam beams with plywood sheathing. The building foundations are generally concrete strip footings with concrete stem walls at the perimeter of the building and the gymnasium walls with limited number of interior spread footings. The lateral system is primarily the flexible roof diaphragms spanning to the perimeter masonry shear walls with contribution from the interior wood framed shear walls.

SEISMIC RETROFIT

The retrofit was undertaken to address specific deficiencies identified in a previous seismic assessment. The retrofit of the central wing of the building targeted Immediately Occupancy structural performance level for the BSE-1N hazard and the Life Safety structural performance level for the BSE-2E hazard. For the east and west wings, a structural performance objective of Damage Control was selected for the BSE-1E and Limited Safety structural performance level for the BSE-2E hazard.

Plywood or Sure-Board sheathing was added to existing wood framed interior walls to increase the strength, stiffness, and contribution to lateral force resistance of the existing walls. Foundation strengthening and holdowns were included at the wall strengthening as needed to support the walls. The improvement of the interior shear walls also serves to reduce the spans and thus lateral demands on the roof diaphragm. A steel moment frame was added at the south edge of the covered play area, located on the south edge of the central wing, to laterally brace the open end of the roof cover. At the roof, new 3/8-inch thick plywood was added over the existing sheathing of the original building and the nailing of the existing sheathing over the 1977 Addition was increased. Steel strap collectors were added on top of the roof sheathing to collect lateral load to the shear walls. The out-of-plane connection of the top of the masonry walls to the roof framing was improved to prevent the walls from being able to separate from the roof when shaken.

Improvements were also made to non-structural elements of the building. Suspended ceilings were improved with modern characteristics, including lateral bracing and separation joints, that allow them to be more resilient to earthquakes. Bracing or anchorage was also added to mechanical, electrical, and plumbing equipment, such as hanging lights and mechanical units, fires suppression system, natural gas piping, etc.

These improvements are anticipated to significantly improve the seismic performance of Bethany Elementary School such that the campus now exceeds the district performance goal.

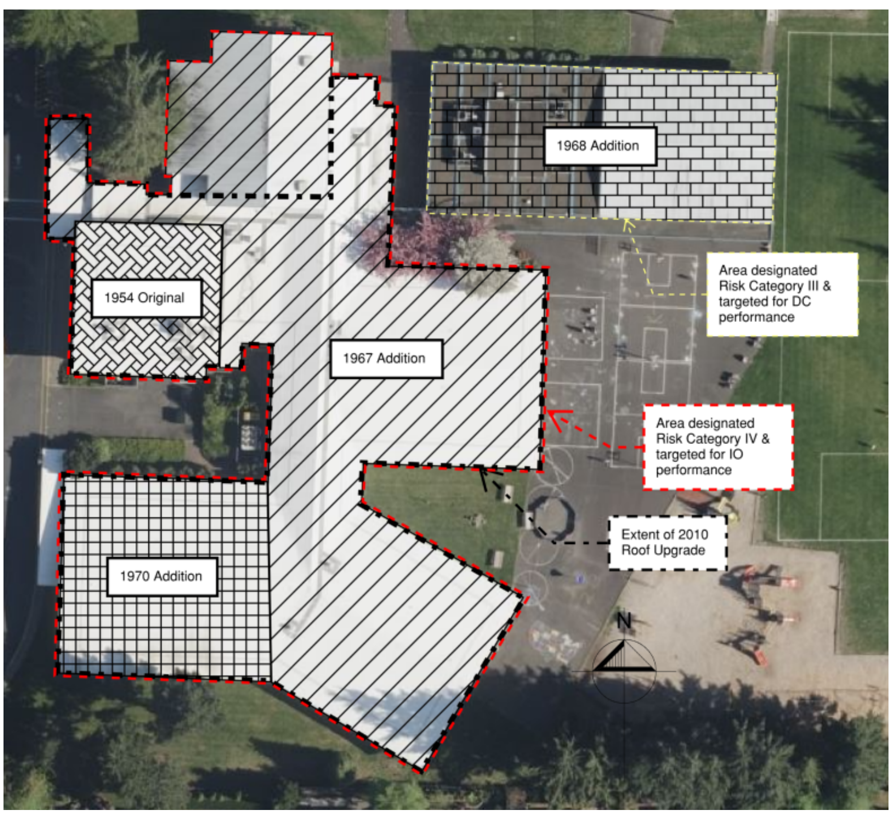
08: COOPER MOUNTAIN ELEMENTARY

Following the successful application for a grant through the State of Oregon's Seismic Rehabilitation Grant Program (SRGP), a seismic retrofit of the building was completed in 2021.

BUILDING SUMMARY AND BUILDING YEAR PLAN

Cooper Mountain Elementary was originally constructed in 1954. Additions to the building were made in 1967, 1970, and 1986. A partial, roof level seismic upgrade was completed in 2010 and a full seismic upgrade was completed in 2021.

The building has a combination of multiple structural systems including wood framing, concrete masonry block (CMU) walls, concrete walls, and steel framing. All sections of the building have wood framed roofs. In 2010, a partial seismic upgrade was completed in conjunction with a re-roof project. The scope of that project included adding plywood sheathing to the majority of the 1967 Addition and some roof to wall connections that could be done from above the roof.



Cooper Mountain Elementary School - Approximate Outlines of Construction Dates

BUILDING DESCRIPTION

The original building section from 1954 is both single and two-story and is wood framed and relies on wood shear walls for lateral force resistance. The 1967 and 1970 additions are single-story with perimeter concrete bearing/shear walls with a wood framed roof. The 1986 Addition is wood frame roof over wood framed bearing walls at the western half with steel columns at the canopy on the eastern half.

SEISMIC RETROFIT

The retrofit was undertaken to address specific deficiencies identified in a previous seismic assessment. The retrofit of the main building and classrooms targeted Immediately Occupancy structural performance level for the BSE-1N hazard and the Life Safety structural performance level for the BSE-2E hazard. For the covered play area, a structural performance objective of Damage Control was selected for the BSE-1E and Limited Safety structural performance level for the BSE-2E hazard.

Plywood or Sure-Board sheathing was added to new and existing wood framed walls to increase the strength, stiffness, and contribution to lateral force resistance of the existing walls. At the roof level, new plywood sheathing was added to the roof of the northwest corner of the 1967 Addition, where it was not improved in 2010. Steel strapping was also added to the roof in strategic locations to direct lateral loads into the shear walls. Connections between the roof diaphragm and the shear walls were improved to better deliver lateral loads to the shear walls. Connections of the roof framing to the existing concrete walls were improved to support the concrete walls in the out-of-plane direction, providing lateral support to the tops of the walls to prevent separation of the walls from the roof in the event of strong shaking.

Improvements were also made to non-structural elements of the building. Suspended ceilings were improved with modern characteristics, including lateral bracing and separation joints, that allow them to be more resilient to earthquakes. Bracing or anchorage was also added to mechanical, electrical, and plumbing equipment such as hanging lights and mechanical units, fires suppression system, etc.

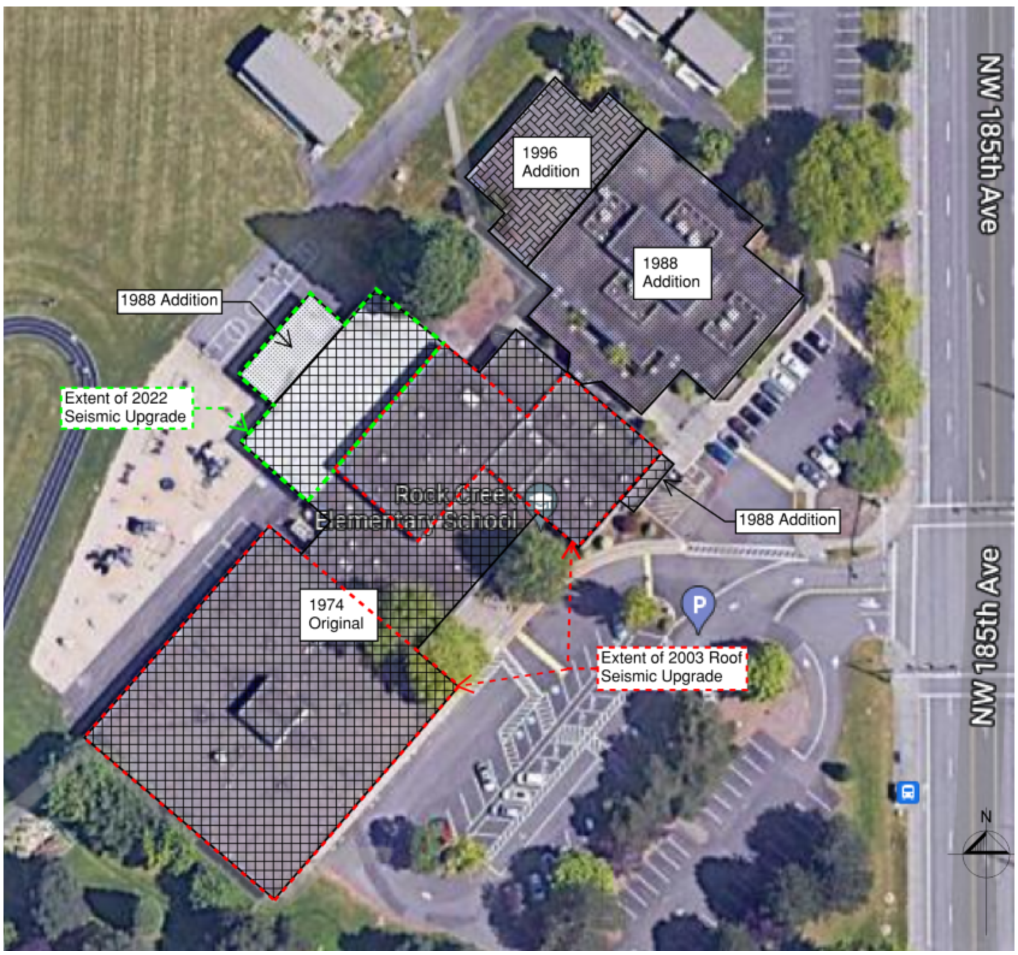
These improvements are anticipated to significantly improve the seismic performance of Cooper Mountain Elementary School such that the campus now exceeds the district performance goal.

26: ROCK CREEK ELEMENTARY SCHOOL

Rock Creek Elementary School completed a seismic improvement to the covered play structure in 2023.

BUILDING SUMMARY AND BUILDING YEAR PLAN

Rock Creek Elementary was originally constructed in 1974 of reinforced masonry walls with a wood framed roof. Additions or wood bearing/shear walls were added to the north and west sides in 1988 and 1996. In 2003 a roof level seismic upgrade was completed to portions of the original construction.



Rock Creek Elementary School - Approximate Outlines of Construction Dates

BUILDING DESCRIPTION

The original 1974 building is two sections. The north section houses classrooms and the library. The south section houses the cafeteria and gymnasium. Reinforced masonry bearing walls, steel columns, and wood bearing walls combine to support the wood framed roof. The foundations are shallow concrete footings and a concrete slab-on-grade. Lateral forces caused by wind or earthquake are resisted by perimeter and interior reinforced masonry shear walls.

The 1988 Addition is located primarily on the north end of the original structure and added more classrooms. A canopy at the main entrance and an extension of the covered play were also added at this time. The classroom wing is a wood framed bearing wall structure with a wood framed roof. The ground level is a wood framed, post-and-beam construction over a crawlspace with shallow concrete footings and perimeter concrete stem walls. Lateral loads caused by wind and earthquake are resisted by the perimeter wood framed shear walls that are sheathed with plywood. The covered play area is an extension of the original covered play area. It consists of a wood roof supported on steel tube columns.

At the northwest edge of the 1988 classroom addition, a further addition was added in 1996. Only limited drawings of the 1996 Addition were available. However, the structure appears to be of similar construction to the 1988 classroom addition.

A roof level seismic upgrade was completed to portions of the original structure in 2003. The scope of this upgrade was limited to the roof-to-wall connections and roof diaphragm chord straps.

SEISMIC RETROFIT

The 2023 seismic upgrade was focused on the covered play area. The upgrade was designed using the current building code loads from the American Society of Civil Engineers (ASCE 7-16). The project upgraded the connection of the covered play to the reinforced masonry wall between the covered play area and the original structure as well as the addition of steel ordinary moment frames to provide lateral bracing to the outer edge of the play area.

The limited nature of the recent retrofit serves to improve portions of the building and mitigate some of the seismic deficiencies previously identified. However, there are still seismic deficiencies that have not been mitigated.

SUMMARY OF REMAINING SEISMIC STRUCTURAL DEFICIENCIES

- Deficient reinforcement within the perimeter masonry bearing/shear walls. This deficiency may be disproven with further analysis.
- The roof diaphragms are not reinforced at re-entrant corners.
- Wood posts lack positive connection to foundations at the 1988 and 1996 additions.
- Discontinuous diaphragm along the long continuous windows on the sides of the 1988 pop-up roof area.
- Cross-grain bending in wood ledgers exists at some roof connections throughout the original building and additions
- Covered play area tongue and groove decking is still likely a deficiency and warrants plywood overlay strengthening.
- Foundation element ties at the covered play area are not present.
- The school is in an area identified as a moderate liquefaction hazard.

33: WEST TUALATIN VIEW ELEMENTARY

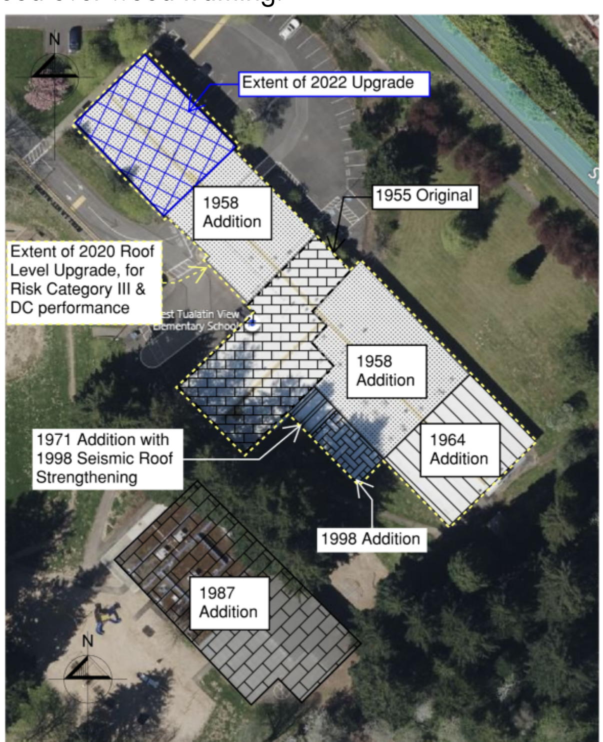
In 2020, West Tualatin View Elementary School underwent a reroofing and roof level only seismic retrofit. The seismic portion of the project was included with the reroof to take advantage of the removal of the old roof to expose the roof structure and to improve the roof level seismic detailing in anticipation of seismic strengthening of the rest of the building in the future without the need to disturb the roofing a second time.

In 2022, additional seismic upgrading was completed at the gym at the north end of the 1958 Addition.

BUILDING SUMMARY AND BUILDING YEAR PLAN

The original school was constructed in 1955. Subsequent additions were added in 1958, 1964, 1971, 1987, and 1998. Along with the 1998 addition, various seismic upgrades were also made to previous additions. In 2020 a roof level only seismic upgrade was completed. In 2022, a seismic upgrade was completed at the gym.

The lateral force resisting system, the elements of the structure that resist forces generated by earthquake and wind, are reinforced masonry shear walls at the 1955 original section and wood shear walls at the additions. The roof diaphragms are plywood over wood framing.



West Tualatin View Elementary School - Approximate Outlines of Construction Dates

BUILDING DESCRIPTION

The original 1955 school building is a two-level, wood framed structure. The lower level is a daylight basement. Seismic loads are resisted by the wood framed roof and upper floor diaphragms spanning horizontally to a small central core of masonry shear walls at the upper level and concrete shear walls in the basement. In the 1998 retrofit, wood shear walls were added to the lateral system.

In 1958, additions were made to both the northwest and southeast of the original building. The northwest wing houses the gymnasium, classrooms, and a covered drive. The southeast wing added more classrooms and restrooms. The gymnasium has a concrete frame with unreinforced brick masonry infill supported on a concrete slab-on-grade. The balance of the 1955 addition is wood framed over a crawl space and relies on wood shear walls for lateral stability.

The 1964 addition further extended the building toward the southeast. This addition created four new classrooms and is wood framed over a crawl space, similar to the earlier construction. Wood shear walls provide the lateral load resistance.

A small library area over a daylight basement storage room was added in 1971 to the southeast corner between the 1955 original building and the 1955 addition. This addition used masonry shear walls at the perimeter to laterally brace the wood framed roof and upper floor.

In 1987 an independent building containing classrooms and a covered play area was added to the southwest of the main building. The lateral system of this structure appears to be a combination of wood shear walls, a masonry shear wall that separates the classrooms from the play area, and steel moment frames in the play area.

Another classroom was added in 1998. It is located next to the 1971 Library addition. This is a wood framed structure that relies on wood framed shear walls. Along with this addition, select elements of the prior construction were seismically upgraded. These upgrades included the addition of wood shear walls (exact locations are not clearly documented), added anchorage to existing shear walls, and some minor foundation work.

SEISMIC RETROFIT

The 2020 roof level seismic retrofit did not fully upgrade the building. Strengthening was completed at the roof level only, with the anticipation of future upgrade work to be done below the roof in the future. Phasing a seismic retrofit in this way ties the roof level work and a reroofing project together to replace the roofing when necessary and avoid needing to disturb the new roofing for a future seismic project. The scope of the roof level retrofit covered the main building (the 1987 Addition was not included) including increasing the sheathing nailing at the gymnasium roof, adding anchorage of the east gymnasium wall to the low roof of the classrooms, and verification of roof sheathing nailing patterns at wall and beam locations.

The 2022 upgrade focused on the gymnasium in the north end of the 1958 construction. The upgrade targeted Immediate Occupancy (IO) performance for the greater of BSE-1E and 75% of the BSE-1N and Life Safety (LS) for BSE-2E. The scope of the upgrade provides metal stud backing wall that supports the existing unreinforced masonry infill for out of plane loading. The metal studs primarily span horizontal to the existing concrete frame.

These improvements do not bring the expected performance of the entire building up to the district goal. Additional future seismic improvement of the building below the roof level is needed to complete the building upgrade. Further, the 2020 roof level seismic upgrade does not appear to address all the roof level deficiencies identified in the 2019 Tier 1 assessment performed by KPFF. The 2020 project appears to address the in-plane connections of the roof to shear walls identified as deficient in the prior report.

SUMMARY OF REMAINING SEISMIC STRUCTURAL DEFICIENCIES

- Re-entrant corners lack sufficient tensile capacity to develop the strength of the diaphragm.
- Straight sheathed diaphragms likely need strengthened.
- Cross ties at diaphragm likely need strengthened.
- URM masonry shear walls lack sufficient reinforcement for both in- and out-of-plane loading. Out-of-plane addressed at the gymnasium.
- Additional shear walls likely required to meet the performance goals.
- Wood ledgers subject to cross-grain bending.

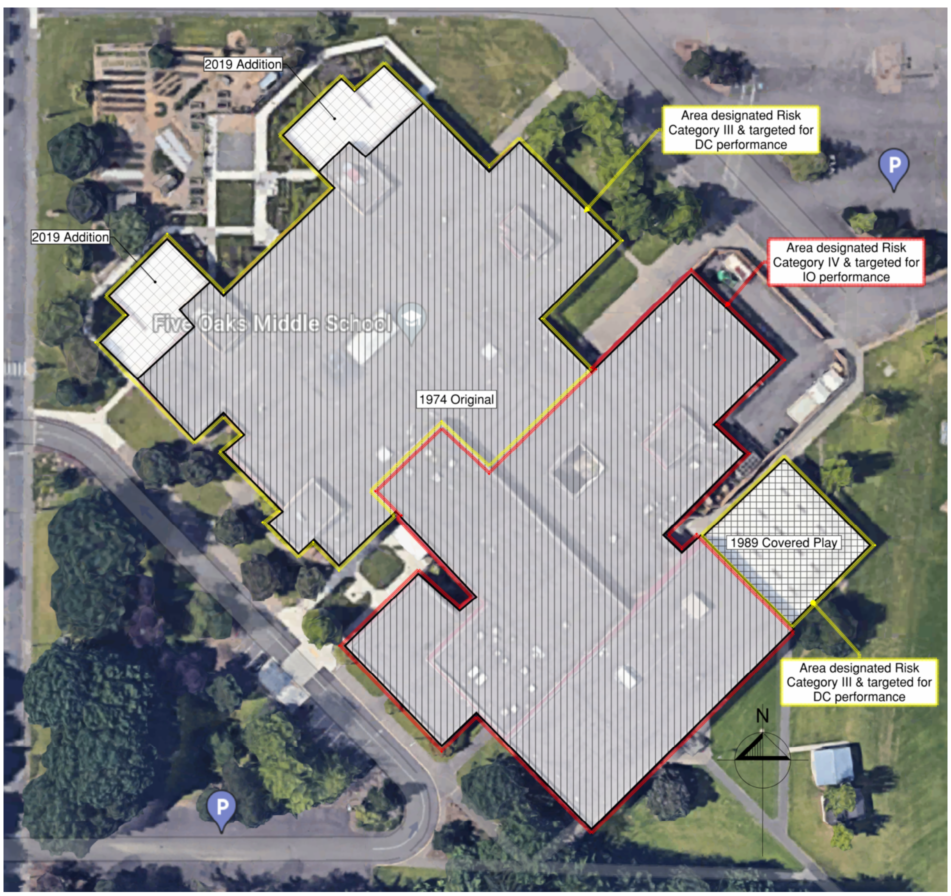
37: FIVE OAKS MIDDLE SCHOOL

The design of a seismic retrofit and re-roof for the campus began in 2022.

BUILDING SUMMARY AND BUILDING YEAR PLAN

The Five Oaks Middle School was constructed in 1974. A covered play structure was added in 1989 and two classroom additions were added in 2019.

The lateral force resisting system, the elements of the structure that resist forces generated by earthquake and wind, is comprised of both reinforced masonry shear walls and tilt-up concrete shear walls. The roof diaphragms are bare metal deck.



Five Oaks Middle School - Approximate Outlines of Construction Dates

BUILDING DESCRIPTION

The original 1974 building has a combination of reinforced brick masonry shear walls, precast concrete shear walls, reinforced concrete masonry shear walls, and wood bearing walls. The ground floor is a concrete slab-on-grade. Bearing walls along the perimeter of the structure and steel HSS posts on the interior provide gravity support for the roof. The roof is constructed with a combination of open web steel joists and wide flange beams that support the bare metal deck diaphragm.

The gymnasium, which was built during the original construction in 1974, is seismically separated from the rest of the building with a 1-inch joint. The gymnasium walls are precast concrete panels at the exterior walls with cast-in-place concrete pilasters where these walls meet. Below the metal deck roof diaphragm, the roof is framed with open web steel joists with diagonal channel bridging at the top flange to brace the joists.

The 1989 covered play structure is a pre-engineered steel “Butler Building” frame and appeared to have moment frames in both directions. The 2019 classroom additions were constructed with a 4” seismic joint from the original structure.

SEISMIC RETROFIT

The retrofit was undertaken to address specific deficiencies identified in a previous seismic assessment. The retrofit of the gymnasiums, cafeteria, and common areas targeted Immediate Occupancy structural performance level for the BSE-1E hazard and the Life Safety structural performance level for the BSE-2E hazard. For the classrooms of the main building, the covered play and the 2019 classroom additions, a structural performance objective of Damage Control was selected for the BSE-1E and Limited Safety structural performance for the BSE-2E hazard.

For shear walls, new CMU walls were added, in addition to new sheathing provided at existing metal stud walls. The work also focused on the bracing of masonry partition walls, masonry pilasters, and brick veneer to existing concrete walls. Walls were also braced to the mezzanine floors and/or roof diaphragm to improve the seismic load path. Similarly, to improve the seismic load path, new steel drags and collectors were added. The roof deck connections were also strengthened. At the foundation, work was done to ensure the existing tilt up walls are tied to the foundation. Various other connections throughout the building were improved to ensure a full lateral load path.

Improvements were also made to non-structural elements of the building. This upgrade included an entire roof replacement of the main building. Suspended ceilings were improved with modern characteristics, including lateral bracing and separation joints, that allow them to be more resilient to earthquakes. Bracing or anchorage was added to architectural, mechanical, electrical, and plumbing equipment such as boiler, hanging lights, fire suppression system, cabinets, lockers, etc.

These improvements are anticipated to significantly improve the seismic performance of Five Oaks Middle School such that the campus now exceeds the district performance goal.

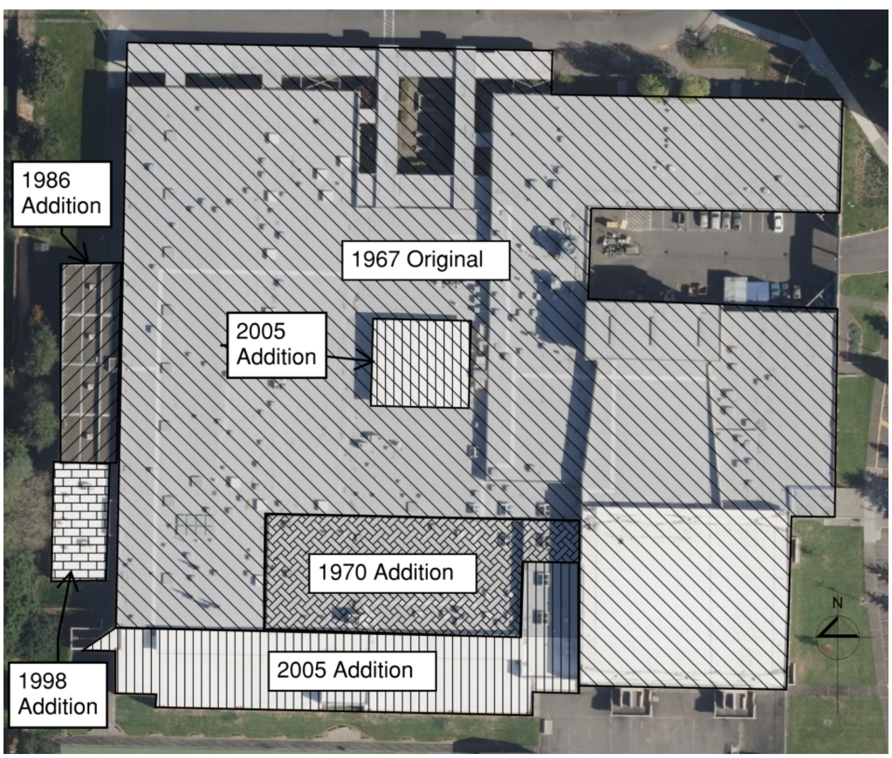
44: ALOHA HIGH SCHOOL

Following the successful application for a grant through the State of Oregon's Seismic Rehabilitation Grant Program (SRGP), a seismic retrofit of the building was completed in 2019-20.

BUILDING SUMMARY AND BUILDING YEAR PLAN

Originally constructed in 1967, the Aloha High School was expanded in 1970, 1986, 1998, and 2005. A seismic upgrade of the building was completed in 2020. The aerial image below shows the approximate extent of each addition.

The lateral force resisting system, the elements of the structure that resist forces generated by earthquake and wind, are primarily tilt-up concrete shear walls and the flexible wood framed roof diaphragm. Some wood framed and reinforced masonry shear walls are also present. The roof diaphragm is plywood over wood framing except for the gymnasium where the roof is Tectum panels and 2005 Addition where the roof is metal deck.



Aloha High School - Approximate Outlines of Construction Dates

BUILDING DESCRIPTION

The original building was constructed in in 1967. Precast concrete bearing walls at the perimeter with interior wood and masonry bearing walls support the roof. The roof is primarily wood framed with plywood sheathing. The exception is the gymnasium roof which is steel framed with Tectum sheathing. The foundation is reinforced shallow concrete footings and the ground floor is a concrete slab-on-grade.

The 1970 Addition is of similar construction to the original building. The 1986 Addition is an independent wood framed structure. Built on sloping ground resulted in a crawl space beneath a wood framed ground floor at the 1986 Addition. The 1998 Addition is similar in construction and connected to the 1986 Addition. The 2005 Addition is two-story framed with wood and masonry bearing walls supporting steel framed second floor and roof.

SEISMIC RETROFIT

The retrofit was undertaken to address specific deficiencies identified in a previous seismic assessment. The retrofit targeted Immediately Occupancy structural performance level for 75% of the BSE-1E hazard and the Life Safety structural performance level for the BSE-2E hazard for the entire structure. The non-structural performance level target was Position Retention for the Gym, Auditorium, Commons and associated egress hallways from these areas. All other areas targeted the non-structural performance level of Life Safety. The structural and non-structural performance objectives aligned with the SRGP requirements at the time of the seismic retrofit.

New concrete shear walls were added, new wood shear walls were created, and new CMU shear walls were added. The work also included strengthening of foundations, where needed, for the new shear walls. New steel bracing elements were added to the gymnasium roof framing at the southeast corner of the building, to improve the diaphragm capacity. Areas of the roof were improved with increased nailing or new plywood overlay. Roof to wall connections were strengthened. Various other connections throughout the building were improved to ensure a full lateral load path.

Improvements were also made to non-structural elements of the building. Suspended ceilings were improved with modern characteristics, including lateral bracing and separation joints, that allow them to be more resilient to earthquakes. Bracing or anchorage was also added to mechanical, electrical, and plumbing equipment such as hanging lights and mechanical units, fires suppression system, etc.

These improvements are anticipated to significantly improve the seismic performance of Aloha High School such that the campus now exceeds the district performance goal.

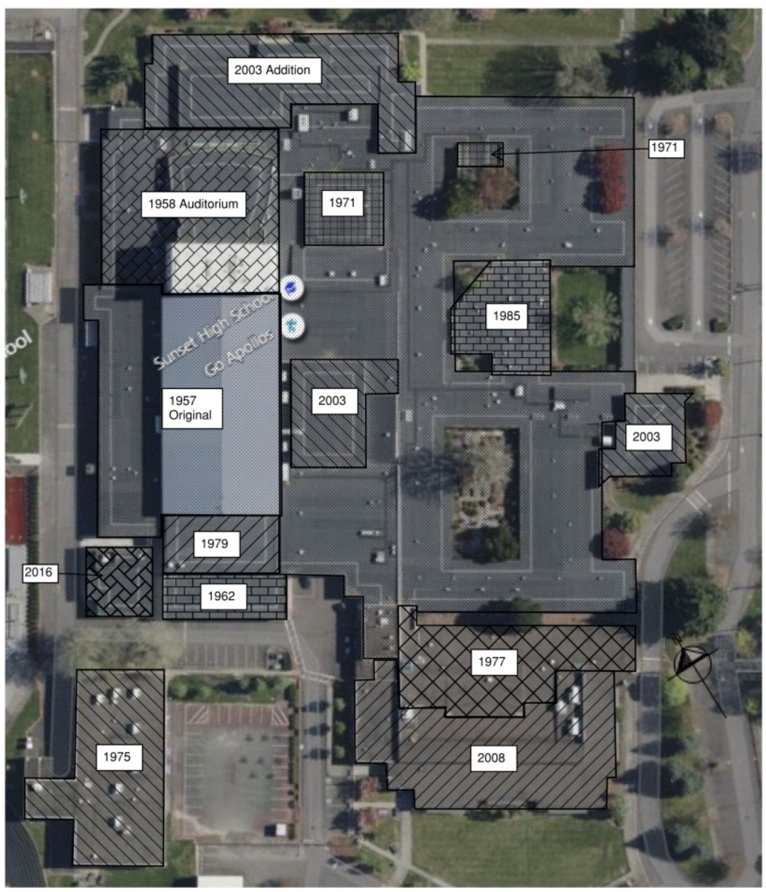
48: SUNSET HIGH SCHOOL

Sunset High School completed a seismic improvement to address attachments of the auditorium walls to the foundations in 2022.

BUILDING SUMMARY AND BUILDING YEAR PLAN

Sunset High School was originally constructed in 1957 with expansions in 1958, 1962, 1971, 1975, 1985, 2003, and 2008. In 2014, a roofing upgrade was completed at the gymnasium and auditorium. The aerial image below shows the approximate extent of each addition.

The 1958 auditorium building, which underwent seismic improvements at the foundation in 2022, is constructed of cast-in-place concrete walls with a combination of concrete and plywood diaphragms to resist earthquake and wind forces.



Sunset High School - Approximate Outlines of Construction Dates

BUILDING DESCRIPTION

The original 1957 building at Sunset High School is single-story with wood framing. Wood framed walls with plywood sheathing and a wood sheathed diaphragm resist forces from both earthquake and wind loads. The 1958 auditorium was built with cast-in-place concrete walls and both concrete and plywood diaphragms. To further expand the campus, in 1962, a section of building was added to house the shop space, and two more building sections were erected in 1971. During the years between 1977 and 1979, two more building sections were built, along with a 1985 science addition, and a 2003 structure. All these additions are wood structures with plywood sheathed walls and wood sheathed roof diaphragms. A similar building was then added around 2016.

SEISMIC RETROFIT

The seismic improvement was undertaken to address a specific deficiency identified in a previous seismic assessment. As mentioned above, the auditorium at Sunset High School uses a plywood sheathed diaphragm to transfer earthquake and wind loads to the concrete shear walls. The 2022 upgrade added a connection of the concrete shear walls to the slab on grade to ensure the lateral load will be transferred to the foundation. This provides a load path for the lateral forces to improve the overall seismic performance of the auditorium.

The limited nature of the recent retrofit serves to improve portions of the building and mitigate a specific seismic deficiency previously identified. However, there are still seismic deficiencies that have not been mitigated.

SUMMARY OF REMAINING SEISMIC STRUCTURAL DEFICIENCIES

The following is a list of seismic deficiencies previously identified in a prior assessment that were not addressed as part of the 2022 project:

- CMU wall anchorage at science room and concrete wall anchorage at gymnasium may be inadequate for out-of-plane lateral loads as they do not provide continuous support between diaphragm chords.
- Seismic separation of the gym and auditorium.
- Weak points of lateral support from windows at exterior elevations.
- Existing shear walls may be inadequate to resist lateral forces.
- Narrow shear wall present at east wall of shop addition.
- Roof chord continuity is lacking at study hall and student center roof pop-ups.
- Likely that wood diaphragm spans are inadequate to resist lateral loads.
- Large span diaphragms likely need increased panel edge blocking.
- Concrete shear walls in the auditorium may be inadequate to resist lateral loads.
- Lateral drifts likely to cause deflection compatibility for pilasters in the auditorium.
- Coupling beam reinforcement at auditorium inadequate.

- South walls at auditorium may be inadequate to resist lateral loads due to large openings.
- Tectum roof at gymnasium. Unknown sheathing and sheathing attachments from 2014 roof project.
- Concrete tilt-up walls at gymnasium may be inadequate to resist lateral loads.
- Concrete tilt-up walls at gymnasium may be too thin and lacks out of plan capacity to span.
- Concrete tilt-up walls at gymnasium unlikely to have positive attachments to footings.
- Girder connections at gymnasium concrete tilt-up walls may inadequate.
- Re-entrant corners throughout building may lack sufficient tensile capacity to develop strength of diaphragm.
- Structural “hinging” to occur at F Hall entry masonry walls from varying wall heights.
- Half-height masonry bearing wall at south side of trash enclosure may be inadequate to support main building.
- The school is in an area identified as a moderate liquefaction hazard.