CRESTON ELEMENTARY SCHOOL
4701 SE BUSH STREET

SEISMIC IMPROVEMENTS MADE TO FACILITY IN CONJUNCTION WITH THE 2009 REROOFING PROJECTS

LATERAL UPGRADE AND REROOFING SCOPE IN 2009

The 2009 Reroofing Project for Creston Elementary reroofed approximately the east third of the school. The attached Roofing Summary Plan by Professional Roof Consultants shows visually with shading the areas reroofed under this contract and identifies each separate roof sector by letter. Those letter identifications were used on our project documents, and will be used in this narrative to identify the areas being discussed.

Creston Elementary was originally built in 1946 and the sectors reroofed are all part of the original building. The typical construction includes concrete walls which have a moderate amount of reinforcing plus some wood frame exterior walls. Concrete walls surround large volume spaces at the building interior, including the auditorium. Many interior walls, including most corridor walls are glazed face unreinforced brick tile masonry. Roofs are generally wood frame with sawn rafters supporting 1" nominal wood sheathing which is always oriented perpendicular to the rafters. The roofs of the Stage and Boiler Rooms are concrete slab and joist construction.

AREA A - AUDITORIUM AND FAN ROOM

The Auditorium roof is framed with heavy trusses spanning across the space in the east/west direction. These trusses are now constructed of steel which replaced the original wooden ones. Sawn 2x6 rafters at 24" spacing are supported by the trusses and in turn support 1" nominal sawn straight sheathing. The Fan Room roof is framed with beams supporting sawn rafters and 1" nominal straight sheathing These roof zones received the following lateral upgrades:

- Added ½" plywood sheathing overall to strengthen the diaphragm.
- Connected diaphragm to concrete walls at perimeter for in-plane and out of place forces.
- Connected to top of the curved concrete wall which terminates about 14" below roof level along the north side of corridor. Wood blocking and steel angle attachments were provided to transfer both in-plane and out of plane forces.

AREA B - LOWER ROOF LEVEL ALONG WEST SIDE OF AUDITORIUM

This zone is framed with sawn rafters at 24" spacing supporting 1" nominal straight sheathing. It received the following lateral upgrades:

- Added ½" plywood over existing roof sheathing
- Provided diaphragm to wall connection at all perimeter walls.

AREA C - PLAY AREA AT NORTH

This roof is framed with 3x14 rafters at 24" spacing running north/south and supporting 1" nominal straight sawn sheathing. It received a supplemental plywood diaphragm. The problem of fasteners projecting through the deck and being exposed to the play below was solved by restricting the nailing of the plywood into the rafters only. This produced what we considered to be an unblocked diaphragm which was still strong enough for the lateral requirements of the ASCE 41-06 design. We also determined that it would be possible to laterally brace the tall chimney which projects in this zone using diagonal cable braces connected only to the walls, thru making it unnecessary to provide cable connections points for the future in the areas being reroofed. It should be noted that we consider the option of reducing the chimney height to be a better solution to its lateral issues than diagonal bracing, but the bracing solution appears to be feasible also.

- Added ½" plywood over existing roof sheathing using nailing into rafters only and so producing an unblocked plywood diaphragm.
- Provided diaphragm to wall connections at south and east sides of the zone.

AREA D & E - STAGE AND BOILER ROOM ROOFS

These zones of the building are both concrete roof structures with concrete perimeter walls, and no lateral upgrading was required.

AREA F - BUILDING SECONDARY ENTRY AREA AT EAST SIDE

Existing roof framing is 1" nominal sawn sheathing supported by sawn rafters, and it received the following upgrades:

- Added ½" plywood over existing sawn sheathing.
- Improved connection of roof diaphragm to perimeter wood frame walls at west, south and north sides.

AREA G - CAFETERIA

This zone is framed with wood trusses which span in the north/south direction across the space and support sawn rafters and 1" nominal straight sheathing. Supplemental shearwalls will be needed in a future upgrade to provided additional lateral resistance at the north and east sides of this zone. Our

work also strengthened the wood frame wall along the south side of Area G down to the top of the lower roof of Area H, but did not complete the load path from the Area H roof level down into the top of the URM corridor wall below Area H roof. We believe the URM wall below has sufficient capacity to act as a shearwalls for the diaphragm forces at the south edge of Area G and north edge of Area H if fully connected. The following lateral upgrades were completed under this contract at Area G:

- Added ½" plywood over existing sawn sheathing.
- Added steel diaphragm chord straps along north and south edges of zone.
- Strengthened wood wall along south side of Area G stopping at lower roof level of Area H. We recommend further strengthening of this zone in the future to transmit the forces down further to the tops of the URM wall running along the north side of the corridor below.
- Connected roof diaphragm to concrete shearwall at east side of the north/south running corridor located at the west side of Area G roof zone.

AREA H - INCLUDES KITCHEN AT EAST PLUS CORRIDOR & CLASSROOMS AT SOUTH

Existing roof framing, like most other areas of the building is 1" nominal straight sheathing supported by sawn rafters. We believe this zone will need additional lateral capacity at the exterior walls at the south and east sides of the Classroom section, and at the east wall of the Kitchen. It received the following under this reroofing project:

- Added ½" plywood over existing sawn sheathing of entire sector.
- Improved connection into perimeter wall lines, including those sections which need additional lateral capacity in the future as noted above.

AREA I - AREA ON THE EAST SIDE OF THE MAIN [SOUTH] ENTRY

As with all other wood roof zones, this area is framed originally with 1"nominal straight sheathing on sawn rafters. It has concrete perimeter walls and received the following upgrades:

- Added ½" plywood over existing sawn sheathing of entire sector.
- Improved diaphragm to perimeter wall connections.

CONCLUSION

Since this was a reroofing project, the lateral improvements we made stopped at or near the roof level. Additional lateral resistance is needed for Area G and Area H zones of the building, in our opinion. We have attempted to construct the supplemented diaphragms installed in this project to have sufficient strength to span to various alternative locations in order to give maximum flexibility in selecting the locations for strengthening shearwalls, or installing new lateral elements. Our calculations and project files will provide additional insight into the various options for upgrade of the zones mentioned.

SCHOOL NUMBER

243

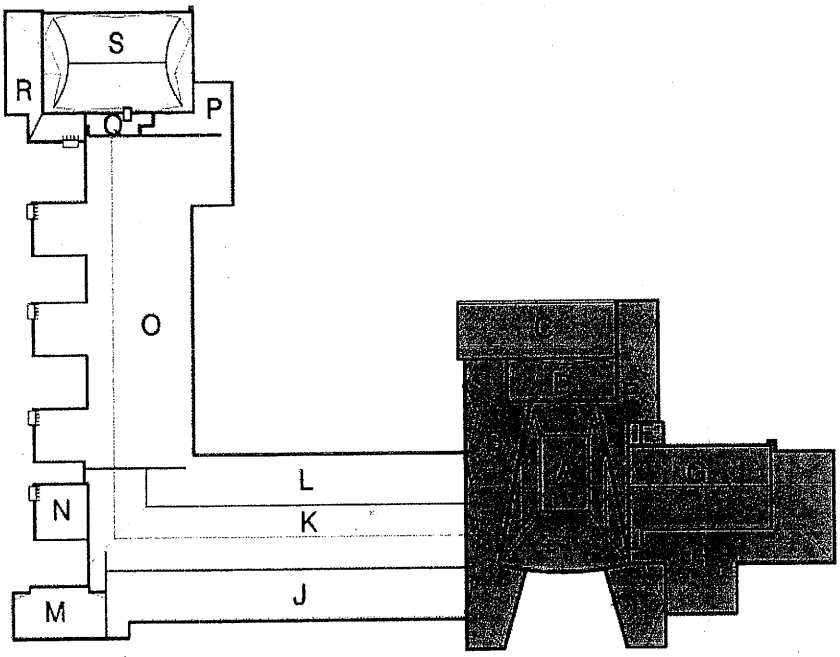
BUILDING SUMMARY

PROJECT GROUP

Replace - C

SCHOOL NAME

CRESTON ELEMENTARY SCHOOL



ROOF PLAN - CRESTON MIDDLE SCHOOL

SCALE: NO SCALE

N

Priority 1

Existing roof system has generally expired. Repair scopes should not be considered an option. ***Replace in 2009.***

Priority 2

Roof systems are approaching the end of their service life. Roof system replacement could be deferred. ***Repair in 2009.***

P.V. Option

As denoted with a hatch pattern, these areas could be considered for installation of a rooftop P.V. system.

Priority 3

Roof system replacement or major repair is not immediately required.

2009 COST SUMMARY – CRESTON ELEMENTARY SCHOOL		
2009 Replacement	*Areas A, B, C, D, E, F, G, H, I*	***$377,700.00***
2009 Repair	*Areas J, K, L, M, N, O, P, Q, R, S*	***$44,300.00***
Structural Scope	*Gymnasium / Auditorium Sections*	***$77,000.00***
TOTAL		**$499,000.00**

UPGRADE PHILOSOPHY

THIS IS A REROOFING PROJECT WHICH ADDRESSES THE AUDITORIUM AND CAFETERIA WING AT THE EAST SIDE OF CRESTON SCHOOL. SEISMIC UPGRADES ARE INCLUDED ONLY IN THIS EAST WING OF THE BUILDING WHERE ROOF MEMBRANES ARE BEING REMOVED AND REPLACED. OTHER ZONES OF THIS FACILITY ARE NOT BEING UPGRADED AT THIS TIME.

PORTLAND PUBLIC SCHOOLS HAS INITIATED A VOLUNTARY SEISMIC HAZARD REDUCTION PROGRAM FOR EXISTING SCHOOL FACILITIES WITHIN THE DISTRICT. AS PART OF THAT OVERALL PROGRAM, JAMES G. PIERSON INC. HAS BEEN INSTRUCTED TO INCORPORATE SEISMIC STRENGTHENING INTO THE REROOFING WORK WHICH EXPOSES THE STRUCTURAL ROOF SHEATHING FOR IMPROVEMENT AS PART OF THE NATURAL PROGRESS OF THE REROOFING WORK. THE CURRENT PORTLAND PUBLIC SCHOOLS LATERAL UPGRADE GOAL IS COMPLIANCE WITH THE "BASIC SAFETY OBJECTIVE" OUTLINED IN ASCE-31 AND ASCE-41 STANDARDS, USING LIFE SAFETY LEVEL FOR THE BSE-1 EARTHQUAKE, AND COLLAPSE PREVENTION FOR BSE-2 EARTHQUAKE.

STRENGTHENING OF DIAPHRAGMS, CONNECTIONS TO WALLS, AND OTHER SIMILAR SEISMIC IMPROVEMENTS LOGICALLY UNDERTAKEN IN CONJUNCTION WITH THE REROOFING PROJECT ARE INCLUDED. THE DESIGN OF THESE ROOF LEVEL ELEMENTS IS IN ACCORDANCE WITH THE ASCE-31 AND 41 DOCUMENTS IN VIEW TO AN OVERALL BUILDING UPGRADE SCHEME. THE SEISMIC IMPROVEMENTS OF THIS CONTRACT MAY TERMINATE AT OR IMMEDIATELY BELOW ROOF SURFACE LEAVING FURTHER STRENGTHENING OF THE ENTIRE LOAD PATH UNTIL SUBSEQUENT SEISMIC UPGRADE PROJECTS.

REVIEWERS ARE DIRECTED TO THE SUPPORTING STRUCTURAL CALCULATIONS FOR MORE DETAIL AS TO THE OVERALL BUILDING UPGRADE SCHEME PLANNED, AND THE ELEMENTS OF THE BUILDING WHICH PARTICIPATE IN THAT MECHANISM. ELEMENTS OF THAT SCHEME NOT STRENGTHENED AT THIS TIME (BUT IMPORTANT TO THE LATERAL RESISTANCE OF THE BUILDING) ARE IDENTIFIED SPECIFICALLY AND FULLY BY THAT PACKAGE FOR FUTURE ATTENTION, AND MAY NOT BE AS CLEARLY DEFINED IN THE SHORT SUMMARY SENTENCES WHICH FOLLOW BELOW.

FEMA 178 REPORTS FOR ALL PORTLAND PUBLIC SCHOOLS HAVE BEEN COMPLETED PREVIOUSLY IN 1997 THROUGH 1999. A FEMA REPORT BY OTHERS IS PROVIDED IN CONJUNCTION WITH THE STRUCTURAL SUBMITTAL FOR THIS BUILDING PERMIT.

<u>AREAS OF THE EAST WING OF THE BUILDING RECEIVING SEISMIC UPGRADE AT THIS TIME</u>

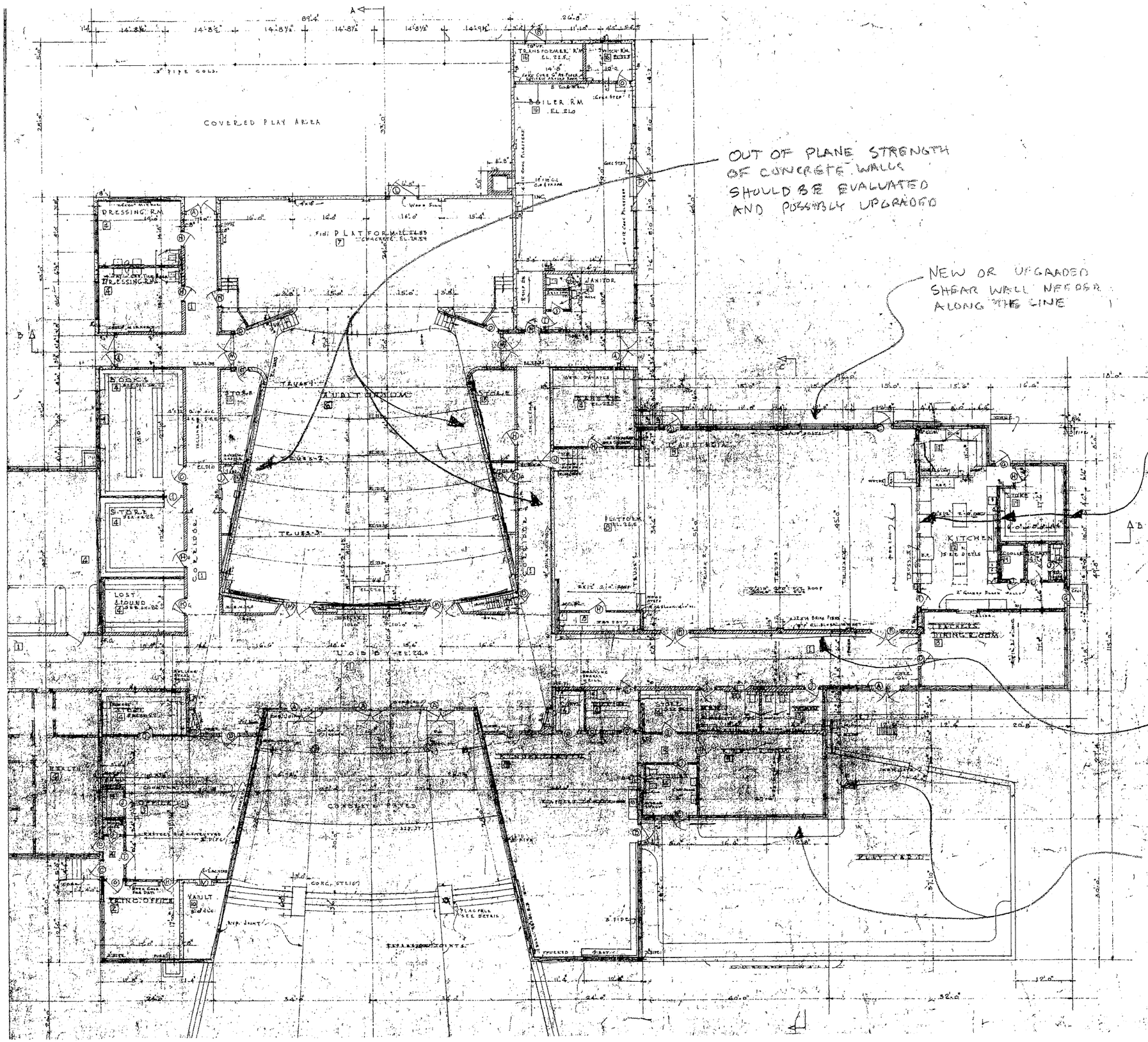
1. STRENGTHEN (E) ROOF DIAPHRAGM BY ADDING PLYWOOD ON TOP OF (E) STRAIGHT SAWN SHEATHING.
2. STRENGTHEN IN-PLANE SHEAR TRANSFER BETWEEN ROOF DIAPHRAGM AND (E) CONCRETE WALLS.
3. STRENGTHEN OUT-OF-PLANE CONNECTIONS BETWEEN ROOF DIAPHRAGM AND CONCRETE WALLS.
4. STRENGTHEN IN-PLANE SHEAR TRANSFER BETWEEN UPPER AND LOWER ROOFS, ADDING PLYWOOD TO EXTERIOR FACE OF WOOD STUDWALLS. REFER TO DETAILS 4 & 5/S3.1
5. STRENGTHEN IN-PLANE SHEAR TRANSFER BETWEEN ROOF DIAPHRAGM AND WOOD STUDWALLS. REFER TO DETAILS 2 & 3/S3.2

<u>AREAS OF THE BUILDING PREVIOUSLY UPGRADED UNDER PRIOR PERMITS</u>

1. STEEL TUBE BEAM AND COLUMN FRAMES ADDED AT INTERIOR URM CLAY TILE CORRIDOR WALLS FOR VERTICAL SUPPORT OF ROOF FRAMING IF URM BEARING WALLS FAIL.

<u>AREAS OF THE BUILDING IDENTIFIED FOR FUTURE UPGRADES</u>

1. LATERALLY BRACE OR REDUCE HEIGHT OF (E) URM CHIMNEY
2. ADD SUPPLEMENTAL SHEARWALLS AT NORTH WALL OF CAFETERIA, AND AT EAST AND SOUTH SIDES OF WING. REFER TO STRUCTURAL CALCULATIONS.
3. STRENGTHEN INTERIOR WOOD FRAMED AND URM CLAY TILE SHEARWALL AT INTERIOR OF EAST WING. REFER TO STRUCTURAL CALCULATIONS.



OUT OF PLANE STRENGTH OF CONCRETE WALLS SHOULD BE EVALUATED AND POSSIBLY UPGRADED

NEW OR UPGRADED SHEAR WALL NEEDED ALONG THE LINE

NEW SHEAR WALLS REQUIRED ALONG ONE OR MORE OF THESE LINES

LOAD PATH FROM DIAPHRAGM TO EXISTING CLAY TILE WALL SHOULD BE FURTHER EVALUATED AND POSSIBLY STRENGTHENED

NEW OR UPGRADED SHEAR WALL NEED ALONG THESE LINES