

EMANUEL ENGINEERING, INC.

ENGINEERING CONSULTANTS



118 PORTSMOUTH AVENUE, SUITE A202
STRATHAM, NEW HAMPSHIRE 03885
603-772-4400 Fax: 603-772-4487
www.emanuelengineering.com

March 13, 2015

Mr. Jim Rozycki
Director of Facilities
Oyster River Cooperative School District
36 Coe Drive
Durham, NH 03824

RE: Roof Snow Loads
Moharimet Elementary School
Oyster River Cooperative School District
Madbury, NH

Dear Mr. Rozycki,

At your request, Emanuel Engineering, Inc. visited the Moharimet Elementary School located at 11 Lee Road, Madbury, NH on February 18, 2015, to investigate possible roof problems due to snow loads on the roof. Dave Emanuel and I met with you, Business Manger Sue Caswell, Fire Chief Tom Pearly, Assistant Fire Chief Jim Davis and Superintendent Dr. Jim Morse.

This report summarizes our observations and recommendations.

Dave Emanuel, P.E. and I performed a visual site inspection of the facility, in particular where reported noises were heard, sprinkler heads were observed (lower than normal) below the ceiling grid, and reported new drywall or masonry cracking had occurred. A list of the visited areas is below. Each area was visually inspected at the potential reported problem, at the wall / occupied area, and above the ceiling to check for obvious deformation, displacement, distress, or signs of structural failure.

Room:	Observations – Comments:
155	Observed vertical crack at juncture of masonry wall and interior drywall face of the exterior metal framed wall. Both walls are non-load bearing and independent of each other. Believed to be unrelated to current snow load conditions and crack is not of structural significance. Concerned with snow loading resulting from snow piling against window units.

130	Drywall cracking in corners of soffit opening, non-load bearing wall. Drywall track was fastened directly to the roof bar joists without using proper deflection track. Soffit cracks indicate snow loading and normal deflection of bar joists, not damage to structural elements. Snow was removed from roof area above prior to arrival. No visible signs of structural distress.
137	Drywall cracking in corners of soffit opening, non-load bearing wall. Drywall track was fastened directly to the roof bar joists without using proper deflection track. Cracks indicate snow loading and normal deflection of bar joists, not damage to structural elements. Snow was removed from roof area above prior to arrival. No visible signs of structural distress.
138	Drywall cracking in corners of soffit openings and corners of non-load bearing wall. Fire protection sprinkler heads escutcheons protruding below ceiling tiles more than normal. Drywall track was fastened directly to the roof bar joists without using proper deflection track. Sprinkler head movement and stress cracks in drywall indicate snow loading and deflection of bar joists, not damage to structural elements. No visible signs of structural distress.
114	Stress cracks in drywall were observed around HVAC ductwork. Drywall track was fastened directly to the roof bar joists without using proper deflection track. No signs of structural distress.
118	Stress cracks in drywall were observed in wall at a drywall opening and around HVAC ductwork. Fire protection sprinkler head escutcheons protruding below ceiling tiles more than normal. Sprinkler heads and stress cracks in drywall indicate snow loading and normal deflection of bar joists, not damage to structural elements. No visible signs of structural distress.
East Commons	Snow observed above skylight windows indicating heavy load in recessed roof area. Measurements were taken from the building interior floor elevation to the bottom of exposed steel bar joists. No notable deflections were observed. No signs of structural distress.
119	Stress cracks in drywall were observed in wall at a drywall opening and around HVAC ductwork. Ceiling track was observed to be slightly deformed at the wall. Fire protection sprinkler head escutcheons protruding below

119	ceiling tiles more than normal. Sprinkler heads and stress cracks in drywall indicate snow loading and normal deflection, not damage to structural elements. No visible signs of structural distress.
Exterior Windows	Snow removed from the roof was piled close to the building and was observed against the building and exterior windows. Removing the snow from against the building and windows is highly recommended to prevent damage, breakage, and water leaking into the building.

Building plans of the school prepared in 1988 were provided by the School District and reviewed for design loads. Drawings indicated a roof design snow load of 45 pounds per square foot (PSF). The current ground snow load for the Town of Madbury, NH per the ASCE 7-05, "Minimum Design Loads for Buildings and Other Structures", is 60 PSF. It is our understanding that Madbury also currently prescribes a ground snow load of 60 PSF.

The ground snow load is converted to a flat roof design snow load using several adjustment factors. Using the present day 60 PSF ground snow load, translates to a 46 PSF for flat roofs, which compares favorably with that shown on the drawing as 45 PSF.

Depending on elevations between adjacent roofs, the snow load increases due to snow drifts and sliding snow onto low roofs. No notes or provisions have been stated on drawing S8 entitled "Details and General Notes" regarding drifting, sliding, and unbalanced snow loads. These provisions were in effect based on the 1987 BOCA Building code and it is suspected that they were implemented. However, further analysis would be necessary to determine if drifting, sliding, or unbalanced snow were considered.

Based on engineering calculations for the unit weight of snow, it is estimated that approximately 24 inches of snow represents the roof design load of 45 PSF.

Recommendations & Conclusions

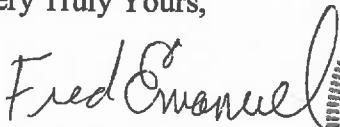
- Without further additional review and calculations, we recommend that snow depths on the elementary school roof not exceed 24 inches.
- The flat roof snow design load shown on the drawing as 45 PSF conforms favorably with minimum requirements of present day flat roof snow loads of 46 PSF.
- The drawings are silent on snow drift or sliding snow loads and the writer would recommend further analysis be done to confirm that the original design included this

aspect of snow loads. Based on the fact that no structural issues were observed, the writer suspects that proper snow loads were integrated in the original design but cannot confirm without further analysis.

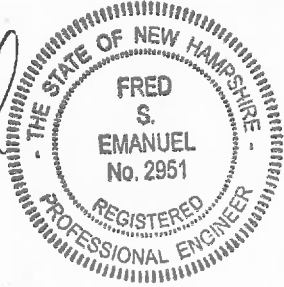
- Drywall cracks may be repaired but will reoccur when excessive snow loads occur on the roof unless the light gage metal framing is modified by using proper deflection tracks at the top of the wall above the observed cracks.
- All roof drains shall be kept free of snow to allow for snow melt.

Please see attached photographs of the inspection areas. Should you desire further evaluation of the roof or have further questions, we are available to assist you.

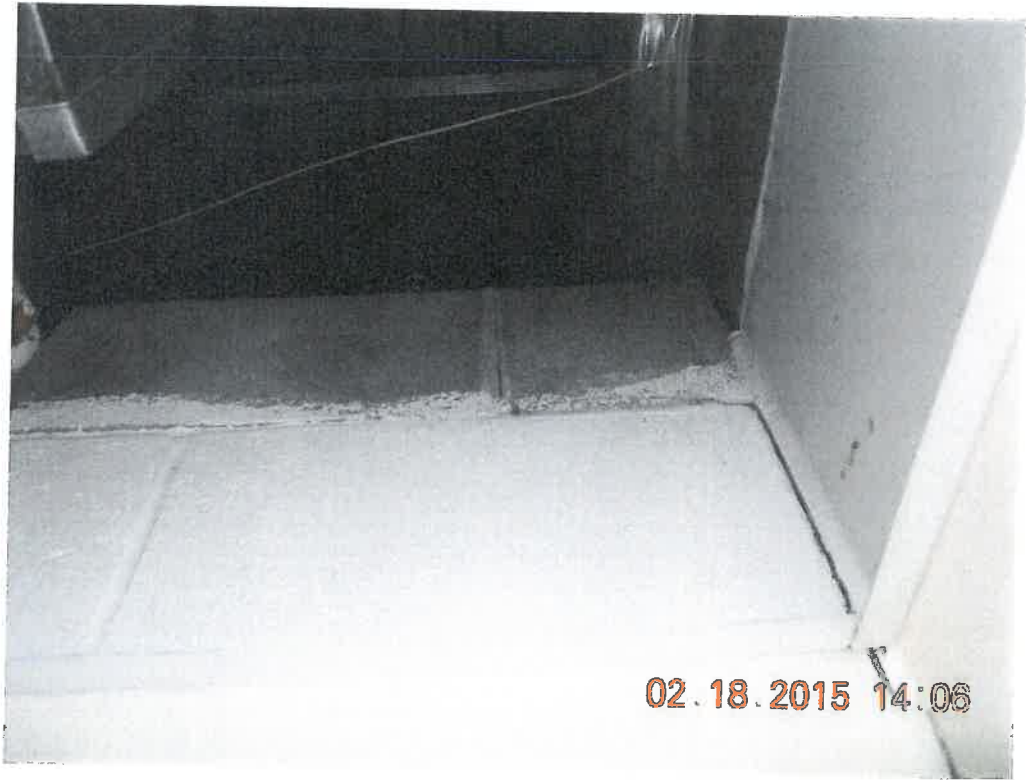
Very Truly Yours,



Fred Emanuel, P.E.



Attachments: Photographs (37 pages)

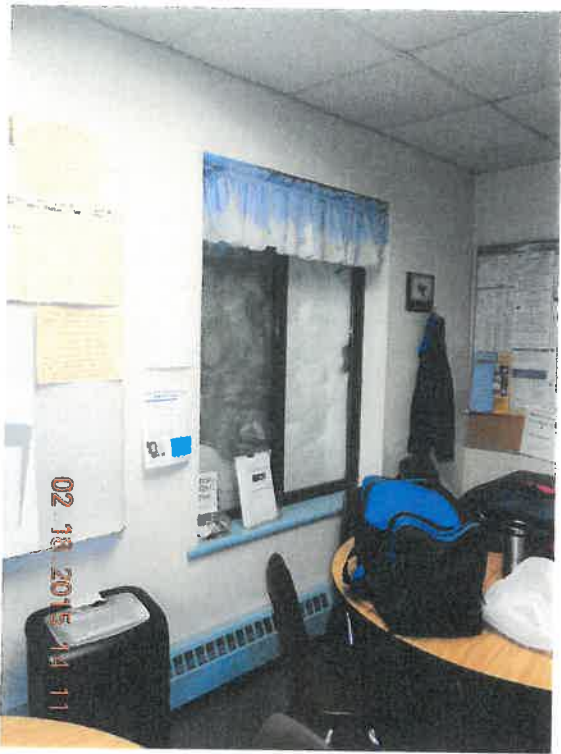


Non-load bearing masonry and stud wall.



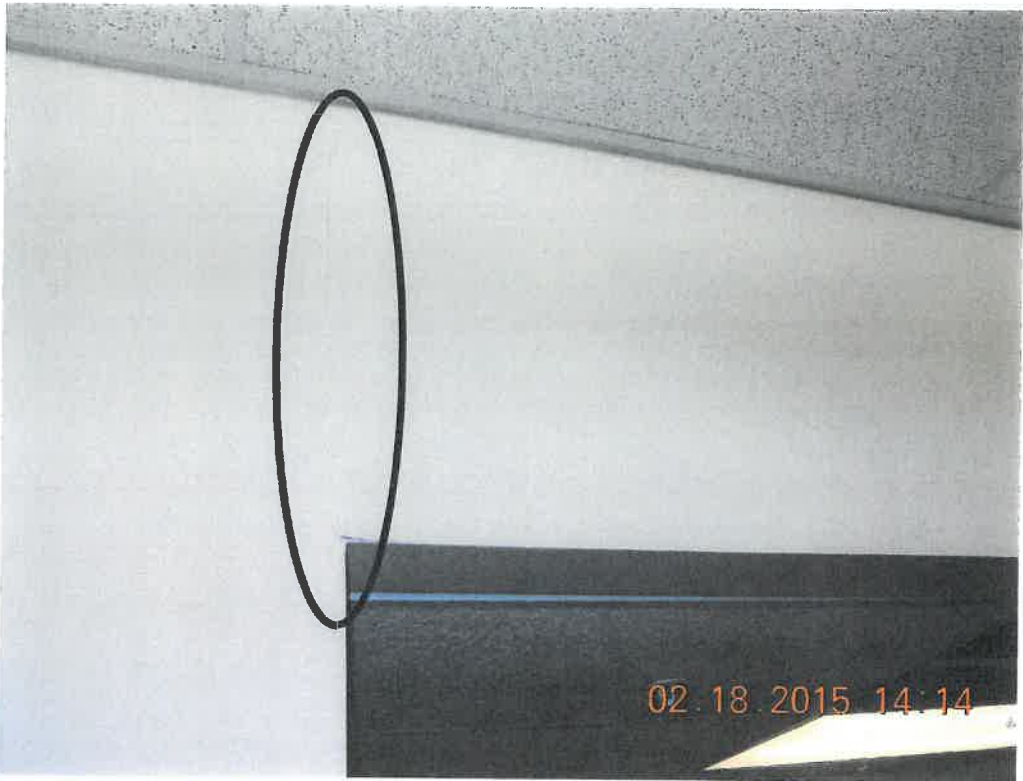
Room 155 - vertical crack at joint of 2 dissimilar walls



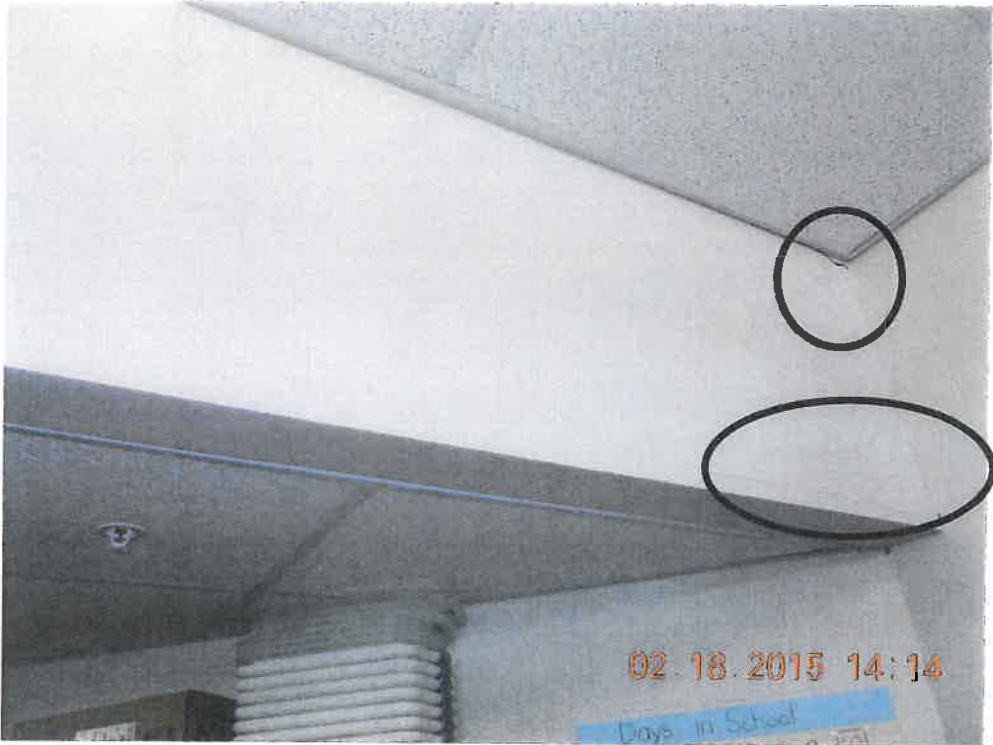


Room 155 - snow stacked against window



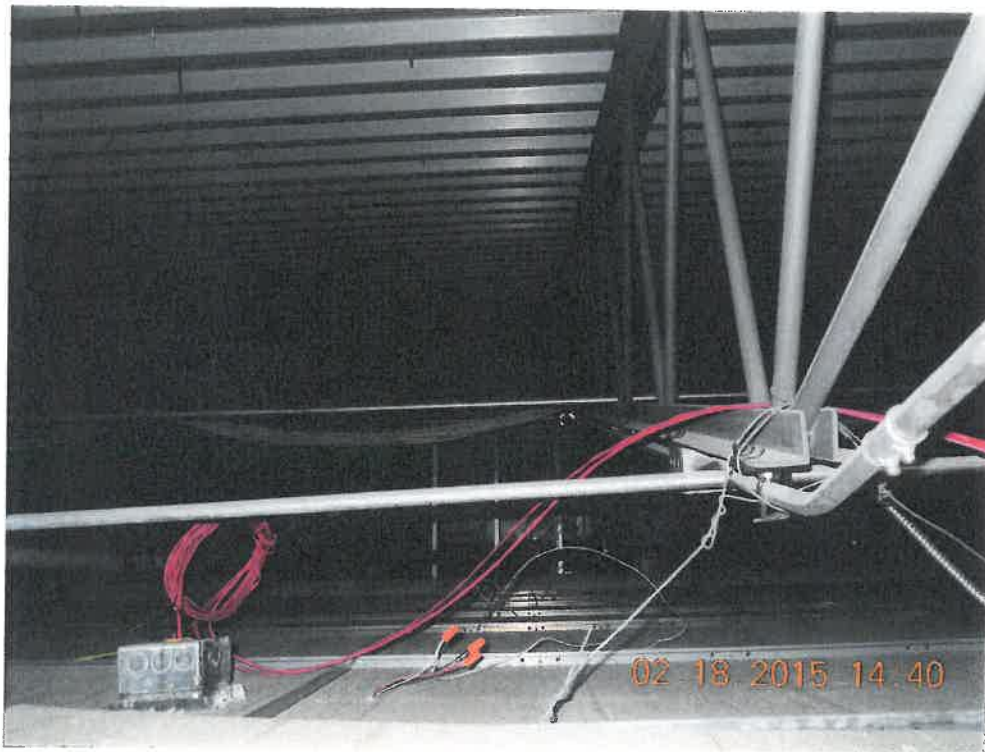


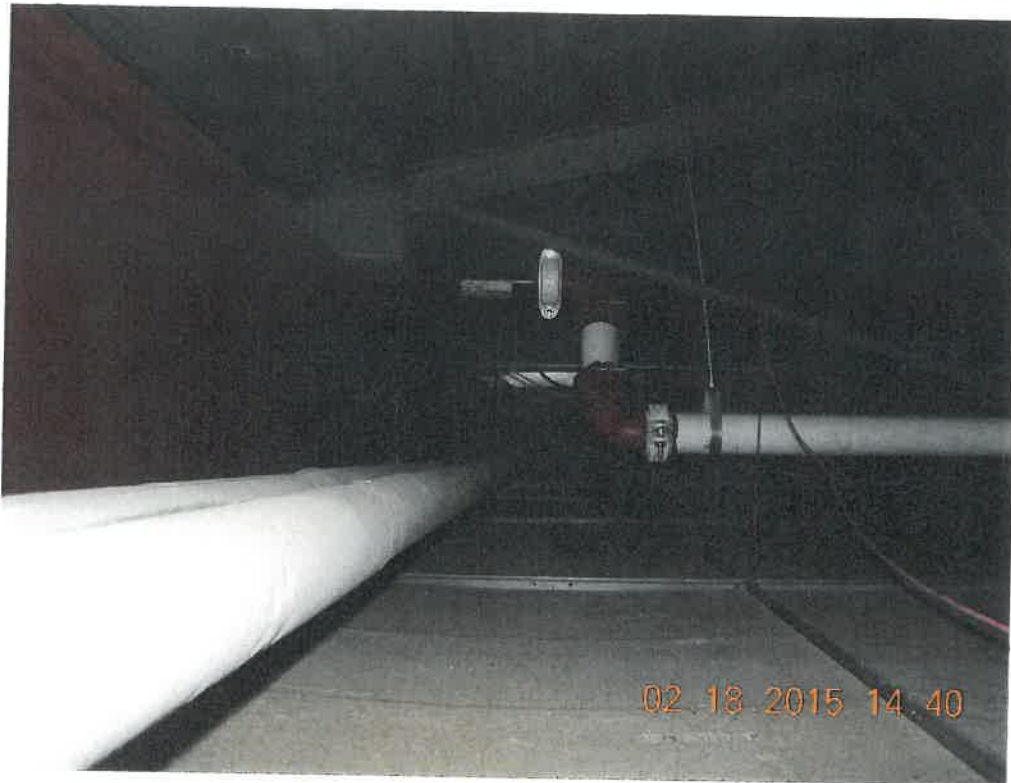
Typical drywall soffit crack



Room 130 - drywall crack





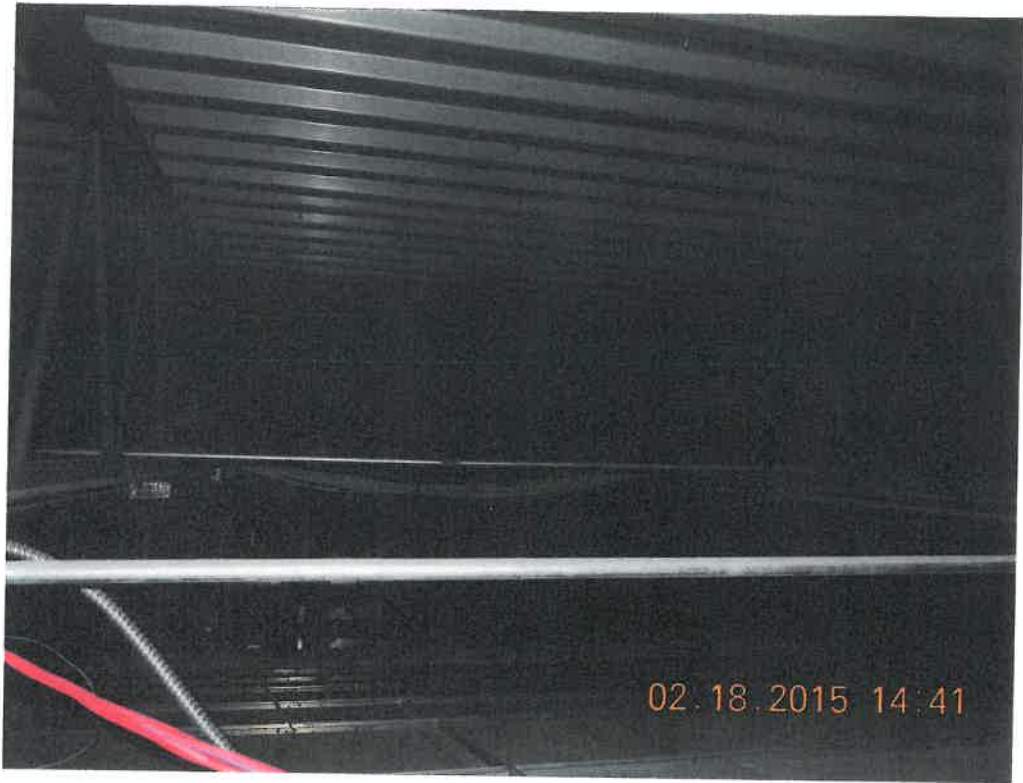


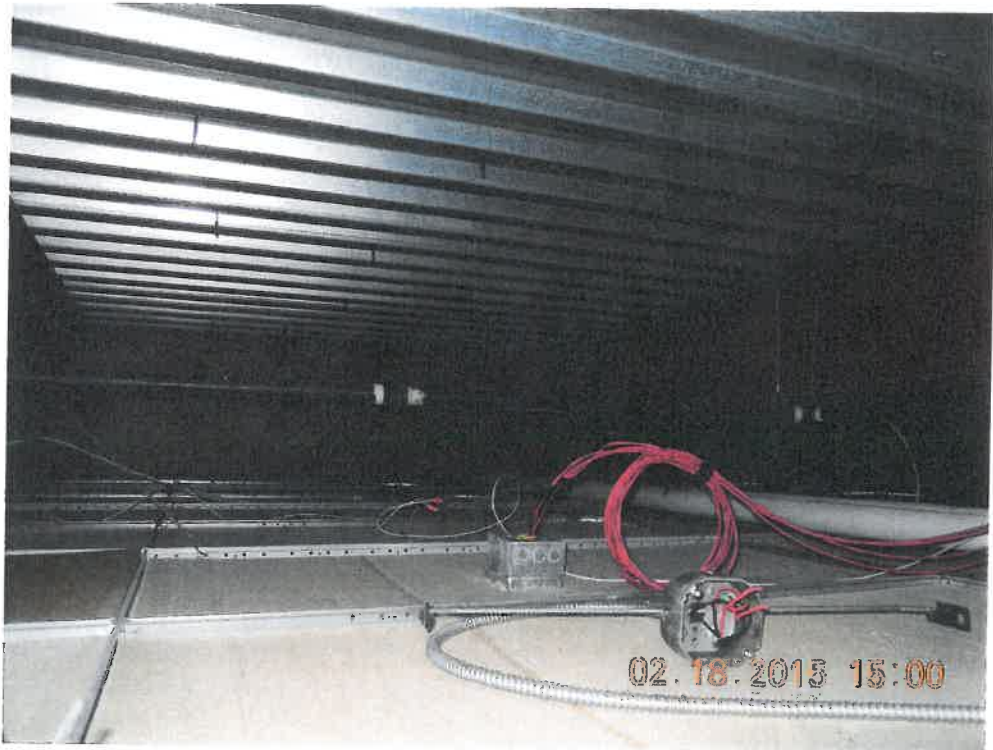


02.18.2015 14:41

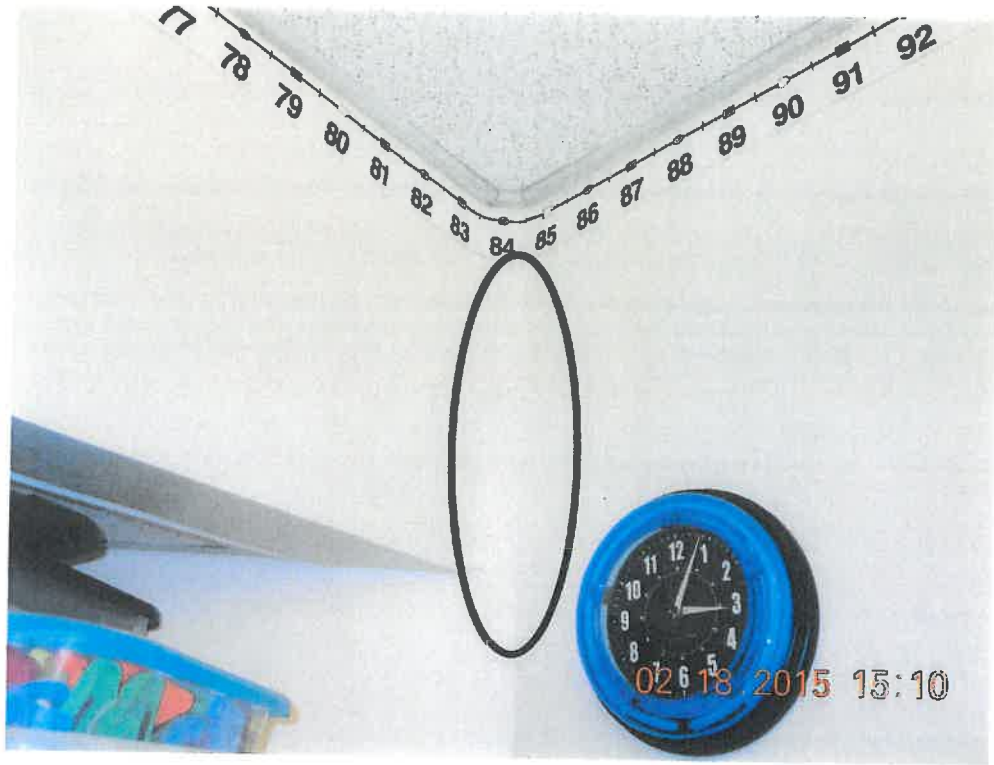


02.18.2015 14:41





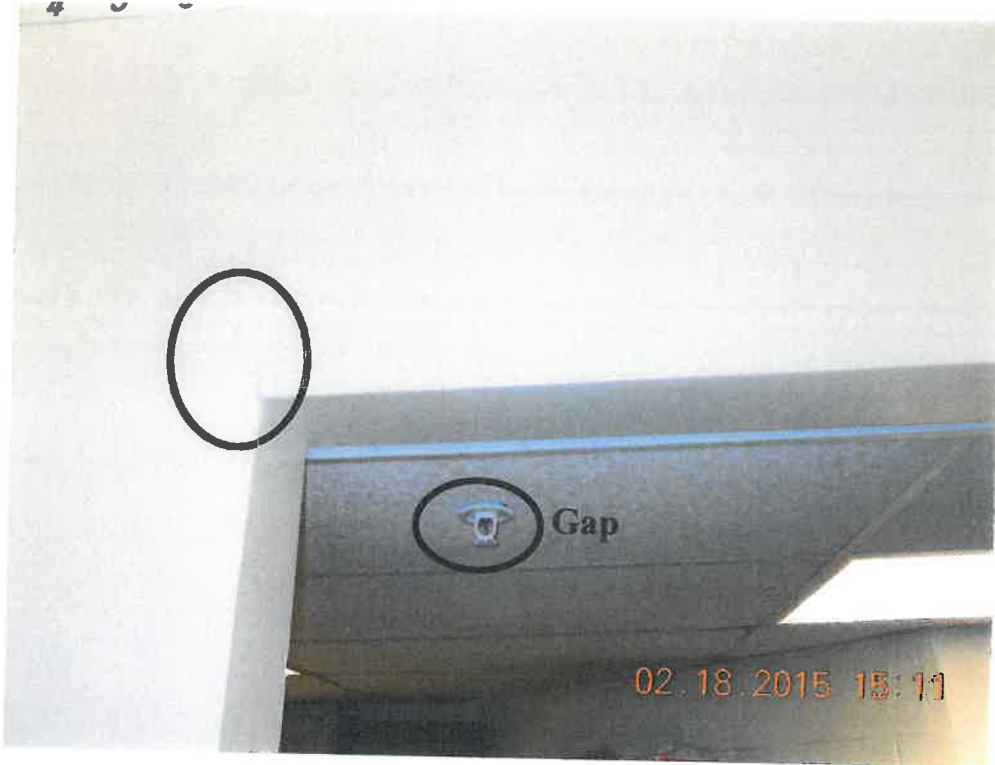




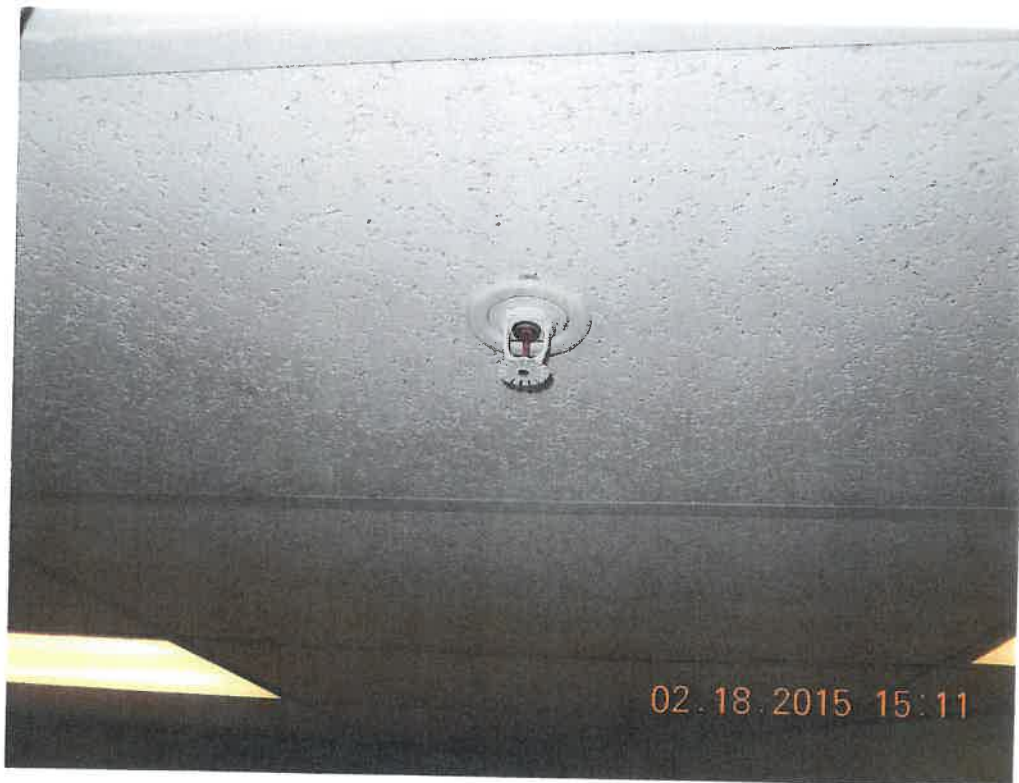
Crack



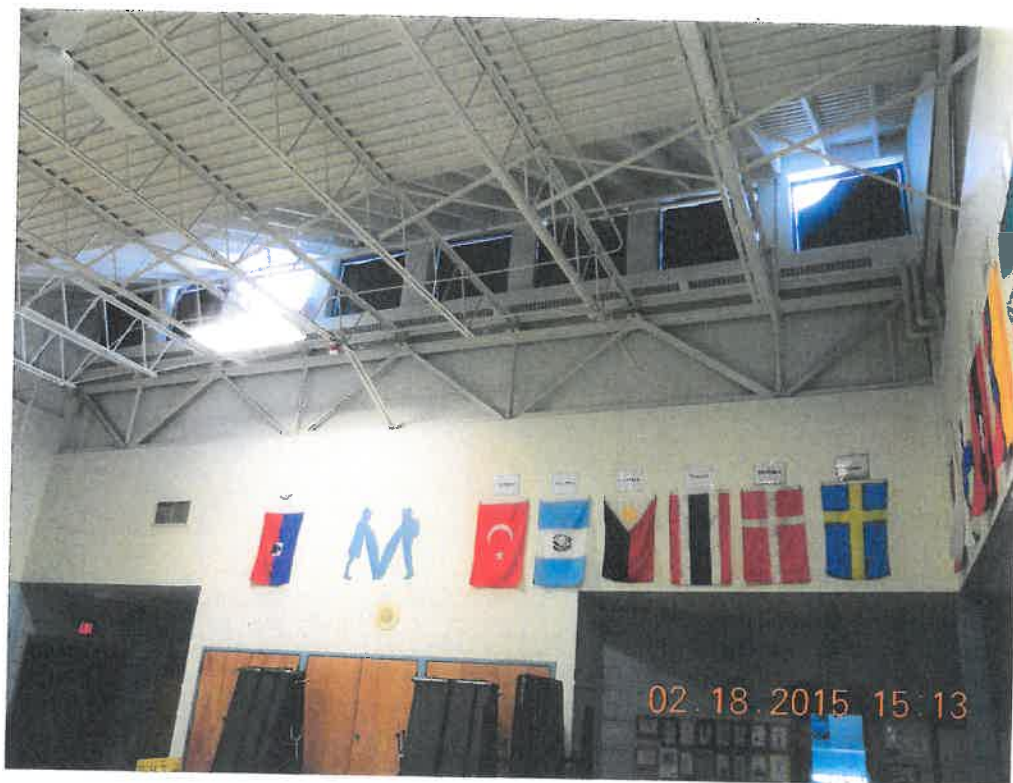
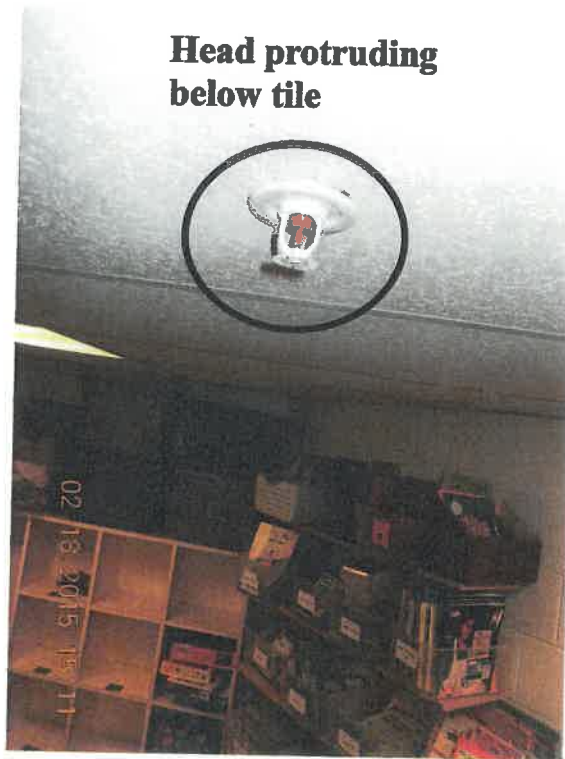
Drywall stress crack



Drywall stress crack

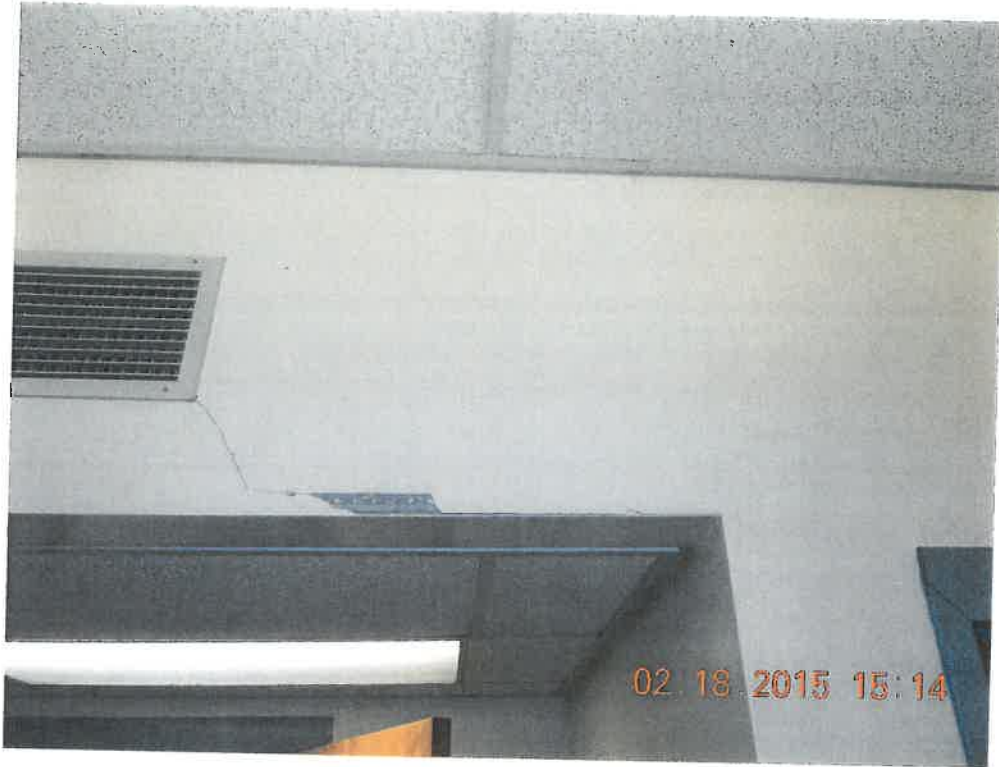


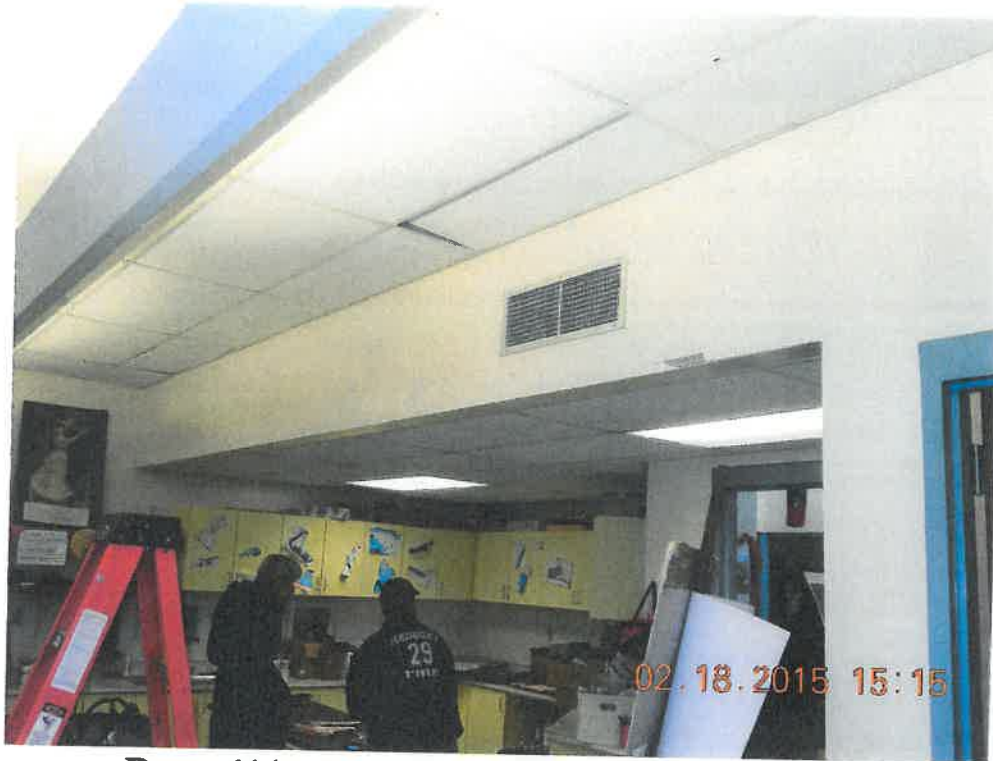
**Head protruding
below tile**



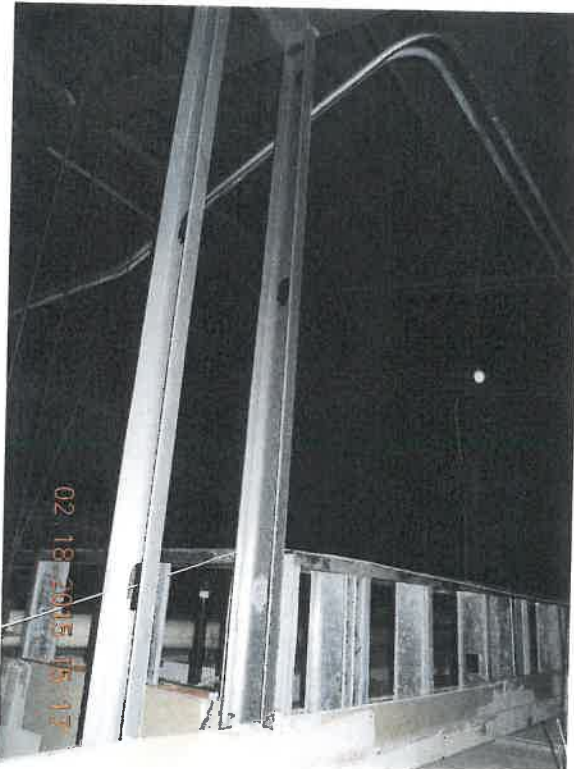




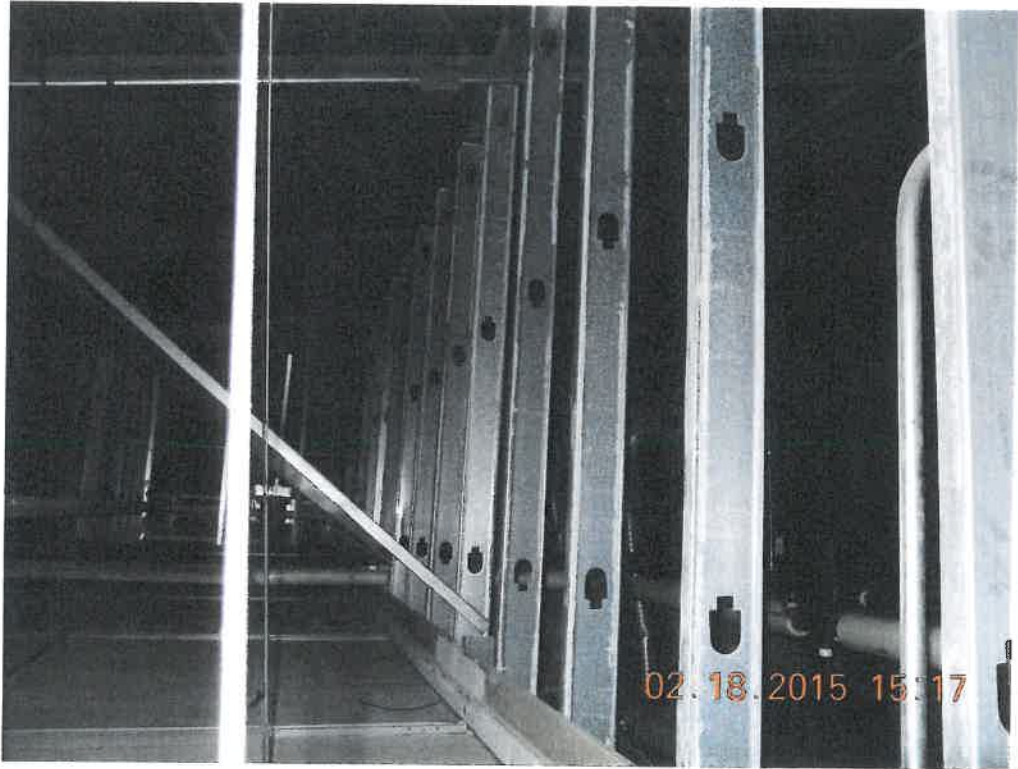
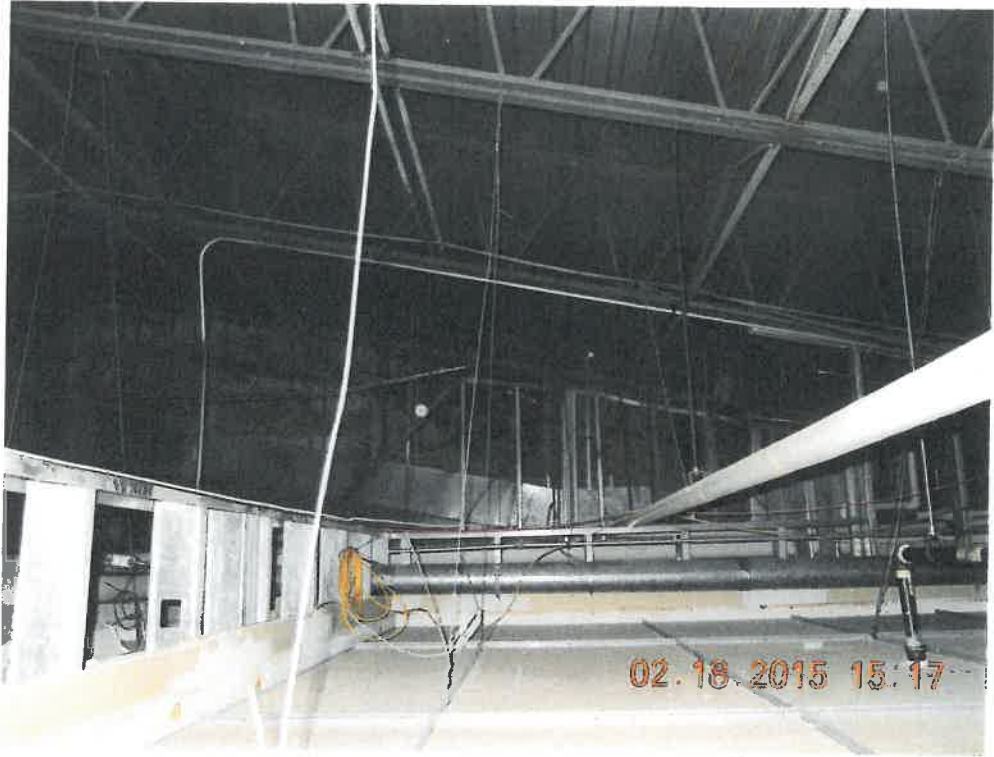




**Room 114 - drywall cracked at HVAC opening
caused by roof joists movement.**









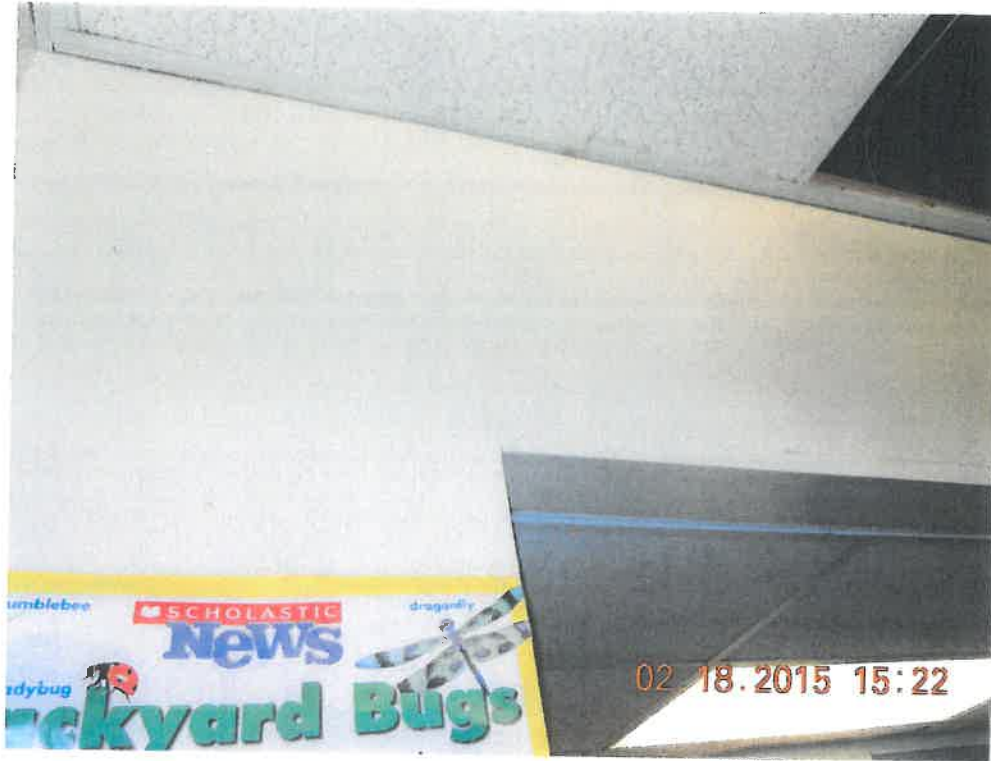
Wall studs and tack connect to roof joist.



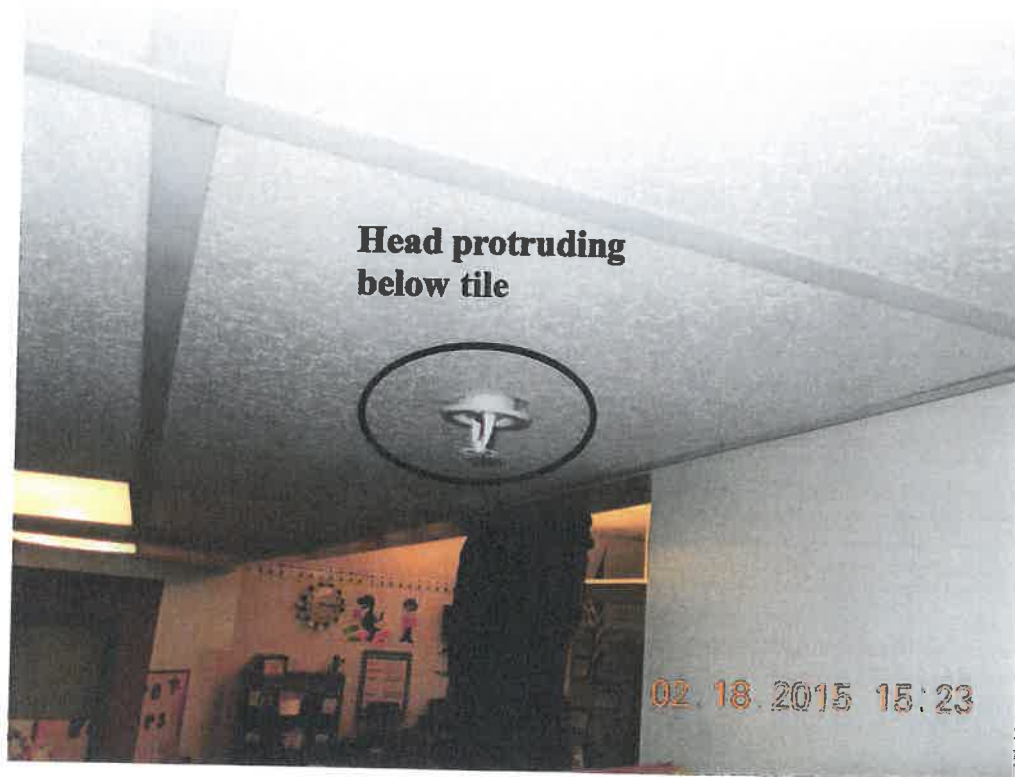
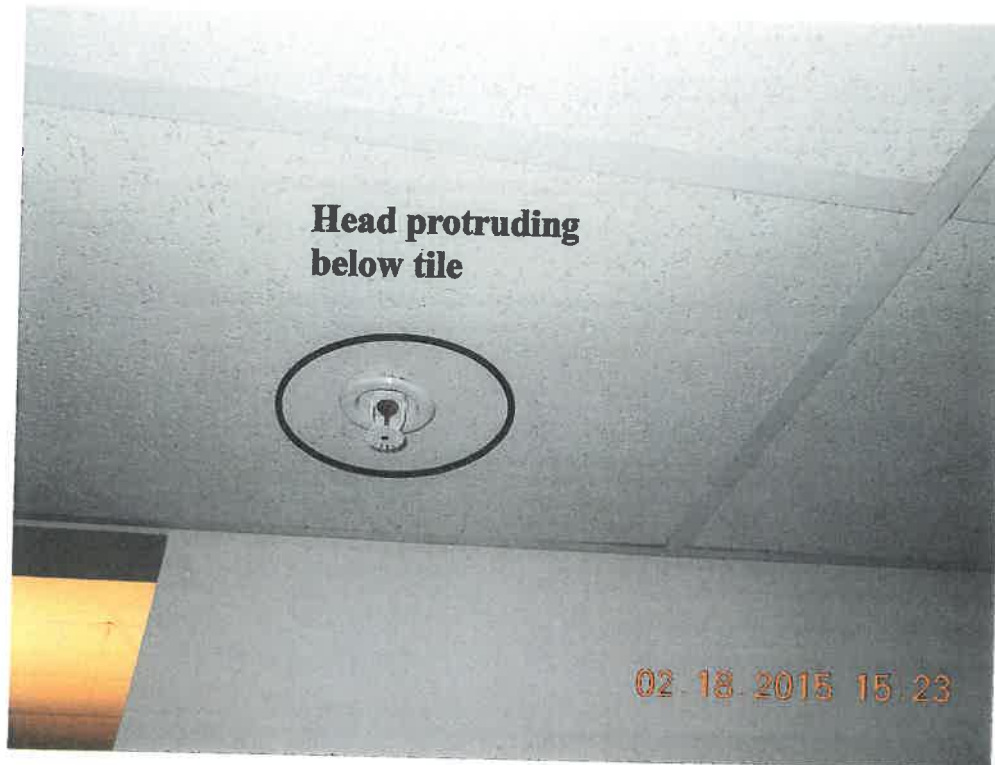


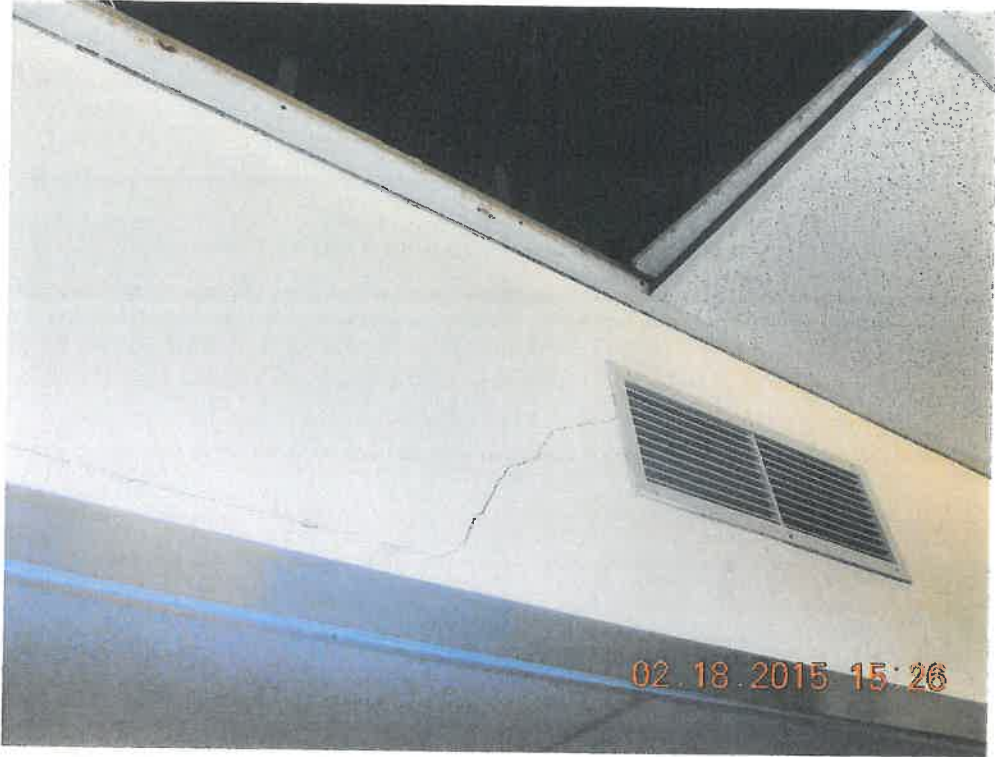
**East Commons - roof joists exhibited
and measured no significant sag.**





Sprinkler head moves downward as roof joists deflect downward.





Cracked drywall caused by improper deflection track.



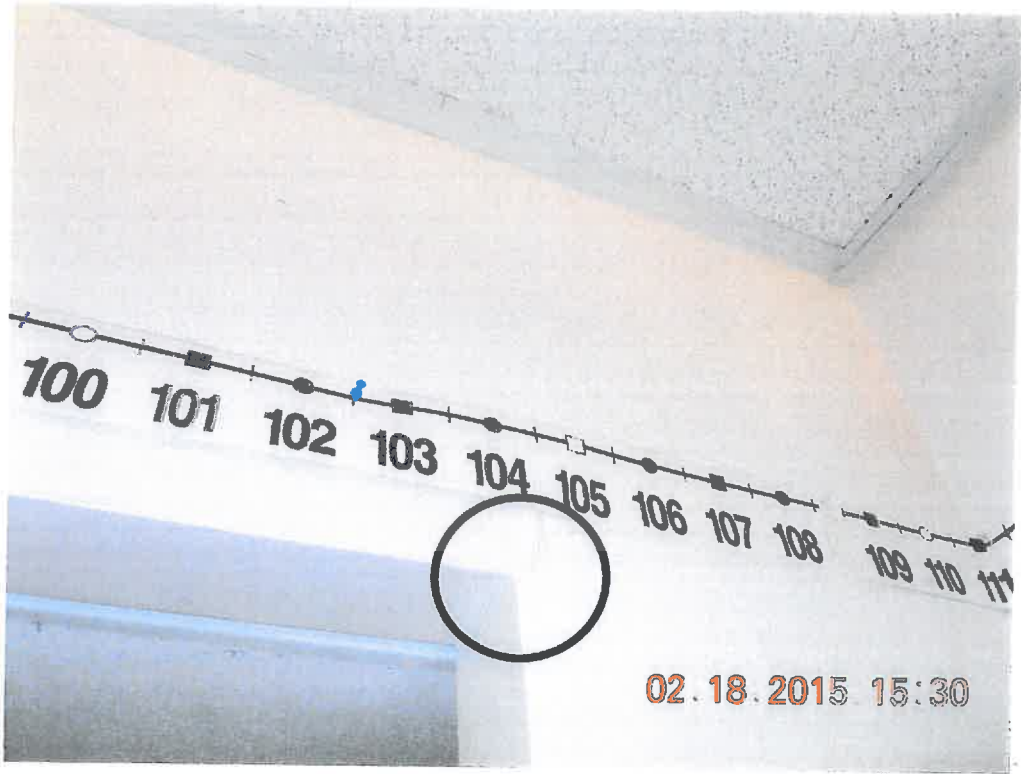


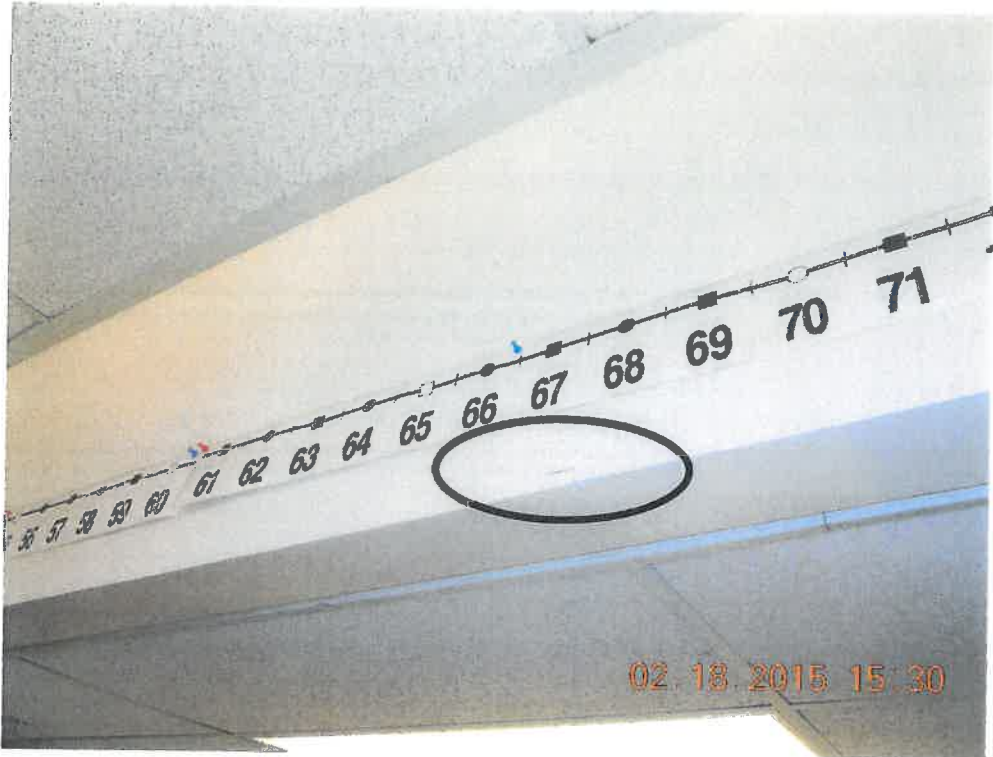
Wall track fastened directly to steel bar joist.



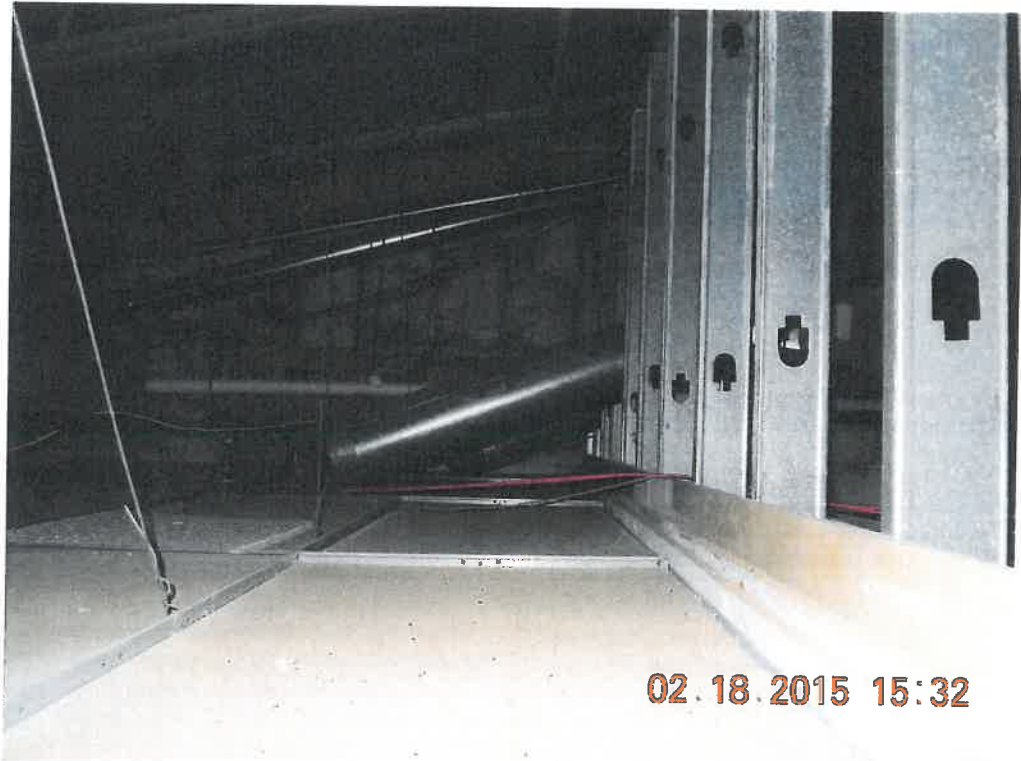
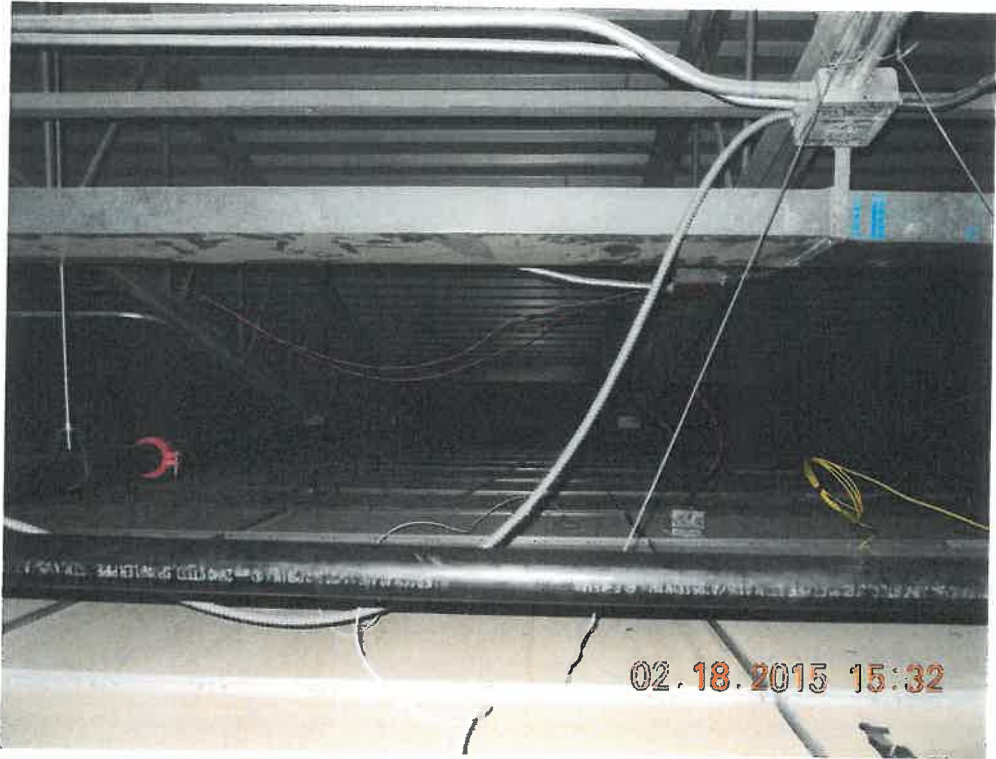


Metal stud wall allows for no movement of roof joists.

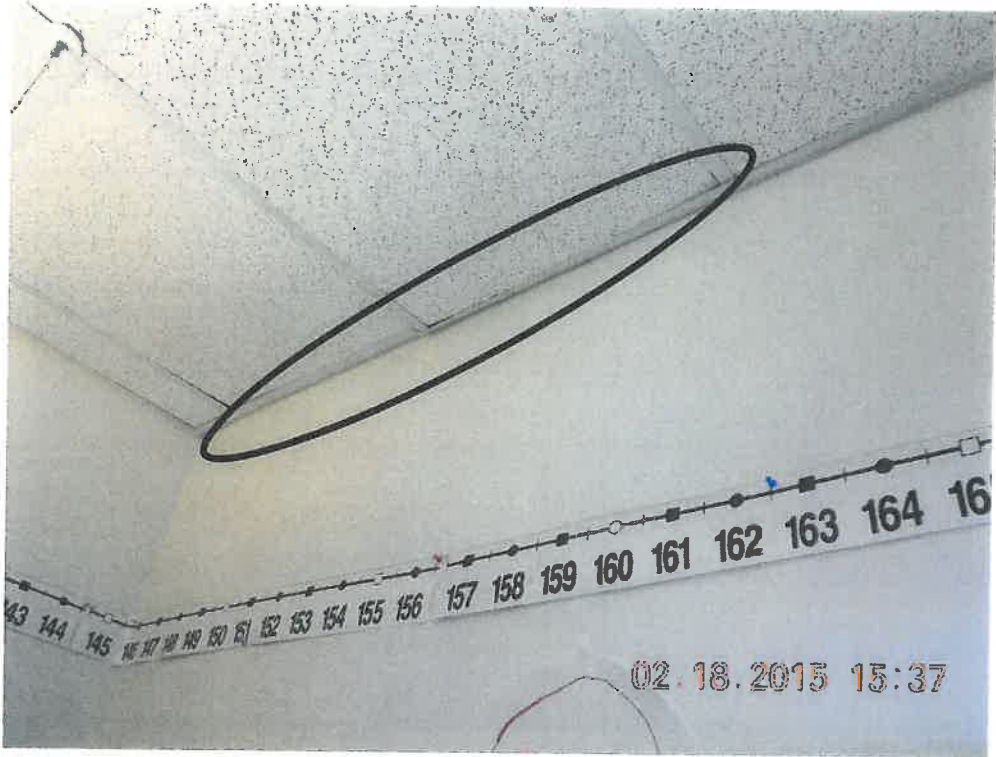












Exterior view of front entrance





