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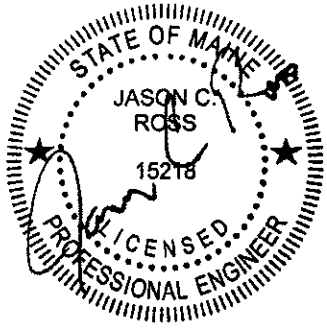
STRUCTURAL ASSESSMENT REPORT

LEBANON FIRE STATIONS
1524 CARL BROGGI HIGHWAY & 113 DEPOT ROAD
LEBANON, MAINE

Prepared for:
John Turner Consulting

March 31, 2020



Prepared by:
HEB Engineers, Inc.

Project #2020-027

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March 31, 2020

Asher Anderson, Resident Engineer
John Turner Consulting
44 Lafayette Road, Suite 6
North Hampton, NH 03862

Re: Lebanon Fire Stations, Lebanon ME
Structural Assessment Report
HEB Project #2020-027

Dear Asher,

This Structural Assessment Letter Report has been prepared by HEB Engineers, Inc. (HEB) to address the concerns about the structural integrity of the two fire stations located in Lebanon, Maine. One building is located at 1524 Carl Broggi Highway and the other is located at 113 Depot Road. On March 9, 2020, I visited the buildings with you and Roger Hooper, Chief Fire Administrator, to observe the existing structures and assess their condition. Presented in this Letter Report are my field observations and recommendations. This work was performed per our Letter Agreement, dated March 25, 2020.

Background and Field Observations:

1524 Carl Broggi Highway

The existing two-story, concrete masonry unit (CMU), wood-framed building is approximately 60 feet wide and 55 feet deep. There are four (4) overhead garage doors and one (1) standard entry door along the front (eastern side) of the building (see Photo 1 in Appendix A). The ground floor of the building houses several fire trucks and emergency vehicles along with offices and storage rooms. The second floor has a large classroom/meeting room, restrooms, kitchen, day-room, and storage areas.

The foundation of the building is constructed of CMU blocks. The depth of the foundation, size of footings, and presence of reinforcement is unknown. The foundation appears to be in fair to good condition and a few minor cracks in the grout were found along the exterior base of the building. The CMU blocks have some minor surface spalling in several areas along the north and south sides of the building (see Photo 2). The first floor of the building has a concrete slab-on-grade that is in good condition. There is a trench drain and construction joint in the rear portion of the garage bays where it appears that the floor slab and building were extended (see Photo 3).

Based on the framing of the building, it appears that the original structure only had a single story with a flat roof. The second story was added sometime later. This was confirmed by Roger Hooper and from some old photos of the building that were found on the wall of the building.

The second floor is framed with a series of 2x8 floor joists that are spaced 16 inches on center (o.c.) and that span from 9 feet 6 inches to 12 feet 0 inches in the north-south direction. The joists are supported at the north and south sides of the building by 12-foot tall CMU walls. The joists are supported in the middle portion of the building by a series of wooden beams and steel pipe columns. The beams in the front half of the building consist of six (6) 2x12s that span from 13 feet 6 inches to 15 feet 0 inches (see Photo 4). The beams in this area are supported on 3½-inch diameter steel pipe columns. The beams in the back half of the building consist of three (3) 2x12s that span approximately 12 feet 0 inches. The beams in this area of the building are supported on 5-inch diameter steel pipe columns. There is some water staining on several of the beams and floor joists, and some rot was found on the floor at the southern side of the building. In general, the floor framing appears to be in fair to good condition although it is very bouncy.

The roof has a 6:12 pitch with a single ridgeline running down the middle of the structure in the east-west direction with three different framing conditions. The center portion of the roof is framed with 36-foot long pre-engineered roof trusses, spaced 24 inches o.c. The north and south ends of the building are stick-framed with 2x6 rafters spaced 24 inches o.c. The lower ends of the rafters are supported on short, wood-framed, load-bearing, knee-walls that were constructed on top of the original exterior CMU walls (see Photo 5). The trusses and upper ends of the rafters are supported on interior, wood-framed, load-bearing walls (see Photo 6). The northern wall was constructed on top of an interior CMU wall on the first story of the building. The southern wall was constructed on top of a wooden floor beam. The entire roof structure is covered with asphalt shingles that appear to be in poor condition and near the end of their useful life. Many of the shingles are deteriorating and there is an area near the ridgeline where the shingles are missing all-together. Water staining was observed on several areas of the roof framing.

113 Depot Road

The existing single-story, concrete masonry unit (CMU), and wood-framed building is approximately 65 feet wide and 60 feet deep. There are three (3) overhead garage doors and one (1) standard entry door along the front (southern side) of the building (see Photo 7). The building houses several fire trucks and emergency vehicles along with storage rooms, a kitchen, and offices all of which are no longer being used. Roger Hooper reported that the rear portion of the building has been condemned due to some significant settling of the floor slab.

The foundation of the building is constructed of CMU blocks. The depth of the foundation, size of footings, and presence of reinforcement is unknown. The foundation appears to be in fair to good condition with only minor cracks in the grout were found along the exterior base of the building. The floor of the building has a concrete slab-on-grade with a trench drain in the rear portion of the garage bays (see Photo 8). The floor slab in the southern portion of the building is in good condition with only minor cracks. The floor slab in the room at the northwest corner of the building has settled approximately 6 inches near the middle of the room (see Photo 9). A wide section of the floor slab, approximately 6 feet long by 14 feet wide, in the middle of the room has been broken up to reveal a void between the concrete and the soil below (see Photo 10). The void is approximately 14 inches deep at the worst location. The soil in the area of the void is loose, gravely sand. The floor slab in this area is 4 inches thick with one layer of welded wire fabric located at the very bottom of the slab. The settlement appears to be limited to just under the floor slab and no movement was observed in the northern wall.

The roof has a 6:12 pitch with a single ridgeline running down the middle of the structure in the north-south direction. The roof is framed with 65-foot long, pre-engineered wood roof trusses, spaced 24 inches o.c. Most of the roof trusses are in good condition, however, the bottom chord and one of the web members have been cut out of the northern-most truss in order to install a stairway to the attic area (see Photo 11). Plywood has been installed on the bottom chords of the roof trusses and the area is being used for storage (see Photo 12). There is no structural sheathing to create a diaphragm on the top of the trusses, just strapping and metal roofing. The metal roofing is in poor to fair condition with several pinholes that can be seen from the inside of the attic area. The trusses are being supported by exterior CMU walls that are in good condition. Some efflorescence and moisture was observed on the inside face of the walls.

Structural Analysis:

The limited analysis of the existing buildings was based on the Maine State Building Code, which includes the ICC International Building Code (IBC 2015). Taking into account the site location and elevation, a ground snow load of **70 pounds per square foot (psf)** and a roof snow load of **60 psf** is required.

The following floor live loads are required based on ASCE 7-10 - Minimum Design Loads for Buildings and Other Structures:

Classrooms	40 psf
Offices	50 psf
Light Storage	125 psf

Wood framing analysis was based on the ANSI/AF&PA National Design Specification for Wood Construction (NDS-2015). Please note that pre-engineered trusses are typically designed by the fabricator and were not analyzed as part of this investigation. Frequently we have seen trusses of this age constructed with an allowable roof snow load of 50 psf. Based on limited calculations, the following are the allowable load capacities of different portions of the existing buildings:

1524 Carl Broggi Highway

Floor Joists	40 psf
Floor Beams	25-30 psf
Rafters	30 psf
Roof Trusses	50 psf *(assumed)*

113 Depot Road

Roof Trusses	50 psf *(assumed)*

Conclusions and Recommendations:

1524 Carl Broggi Highway
This existing building appears to be in fair to good condition. However, based on my observations and limited calculations, it needs some significant renovations if it is going to continue to be used. The second-floor framing is not sufficient to support the current State of Maine Building Code requirements for classroom or storage loads. Based on the age of the structure and observations, the existing roof structure does not meet the code requirements for roof-snow loading.

I recommend that the following items should be addressed on this structure:

- Reinforce the existing floor beams to support the existing floor loads.
- Reinforce the southern-most floor beam to also support the roof loads.
- Reinforce the existing roof framing to meet current snow-load requirements.
- Repair any rotten members in-kind.
- Replace the existing roofing to prevent additional water damage. Consider installing metal roofing to reduce the roof snow loads on the structure.
- Consult with code officials on the sufficiency of egress, electrical, and mechanical systems.
- Monitor the building for additional movement.

113 Depot Road
This existing building appears to be in fair condition. However, based on my observations and limited calculations, it needs some significant renovations if it is going to be used again. The primary concern with this building is the settlement of the floor slab. After looking at the land around the building, it appears that the north end of the structure was built on fill. There is also a wetland area located just north of the building site. The settlement of the slab could have been the result of poorly compacted soil in the fill area or from settling organic soil located under the fill. Alternately, the settlement could have been the result of a leaking pipe under the slab that could have washed away some of the soil. In order to determine the exact cause of the settlement, the rest of the settled floor slab should be removed and the soil should be excavated from the area. Once this is done, compaction tests can be performed on the subsoil and any water or drainage pipes under the slab can be inspected for breakage.

Another concern with the building is the roof structure. Based on the age of the structure and observations, the existing roof structure does not meet the current State of Maine Building Code requirements for roof-snow loading or storage loads.

I recommend that the following items should be addressed on this structure:

- Remove the existing settled slab and loose soil to determine the reason for settlement.
- Replace the soil with compacted fill and install a new slab.
- Reinforce the existing roof framing to meet current snow-load requirements by adding supports or reinforcing certain members of the trusses.
- Repair any truss members that have been cut.
- Repair any rotten members in-kind.
- Replace the existing roofing to prevent additional water damage.
- Install structural sheathing on the top chords of the trusses.
- Stop using the attic area for storage since the bottom chords of trusses are typically only designed for a live load of 5 psf.
- Consult with code officials on the sufficiency of egress, electrical, and mechanical systems.
- Monitor the building for additional movement.

With the amount of work required to bring the two structures up to current building code requirements and the lifespan of the existing structures, it may be wise to consider constructing a new building that would meet all of the office, training, and storage needs of the two buildings combined.

Disclaimer:
The opinions and recommendations contained in this report are based on a "walk-through" field investigation performed as part of this work. Only limited calculations were performed to determine if certain structural members are in compliance with adopted building codes and no physical testing was performed. This report does not address any other part of the structure other than those mentioned, nor does it provide any warranty, either express or implied.

Please do not hesitate to contact us if you have any questions or need any additional information.

Sincerely,
HEB Engineers, Inc.

Jason C. Ross, PE
Senior Structural Engineer

Enclosures: Appendix A – Photo Pages

Copy: File

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APPENDIX A

Photo Pages

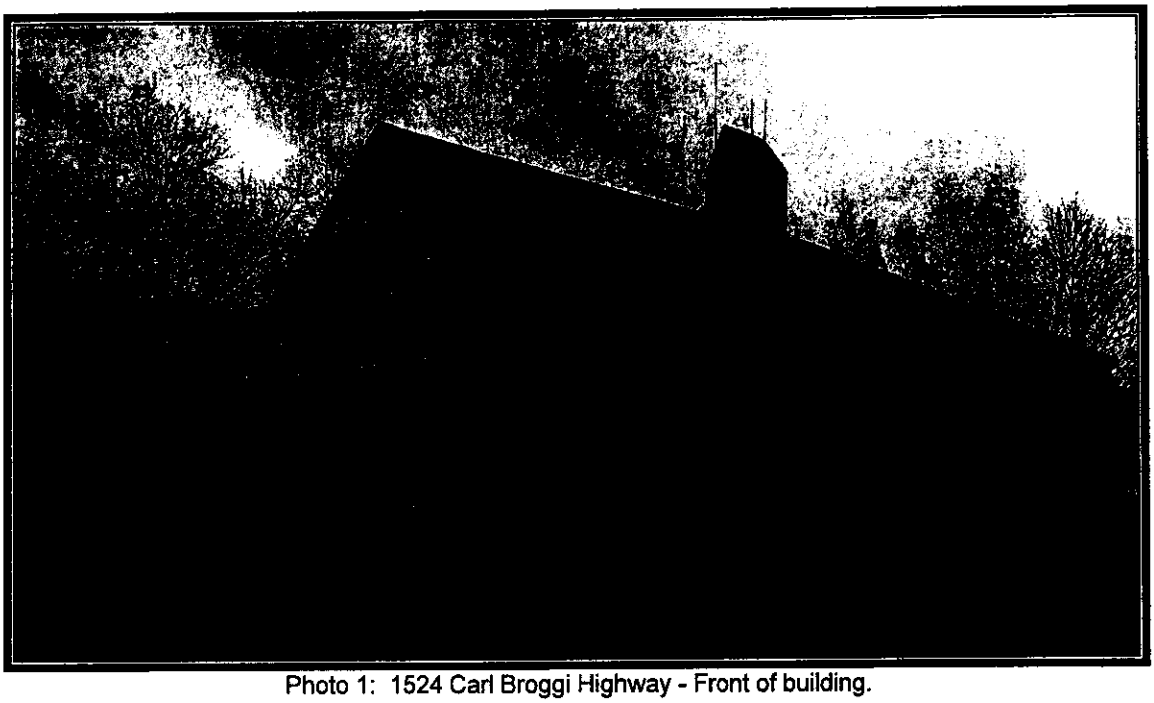

Photo 1: 1524 Carl Broggi Highway - Front of building.

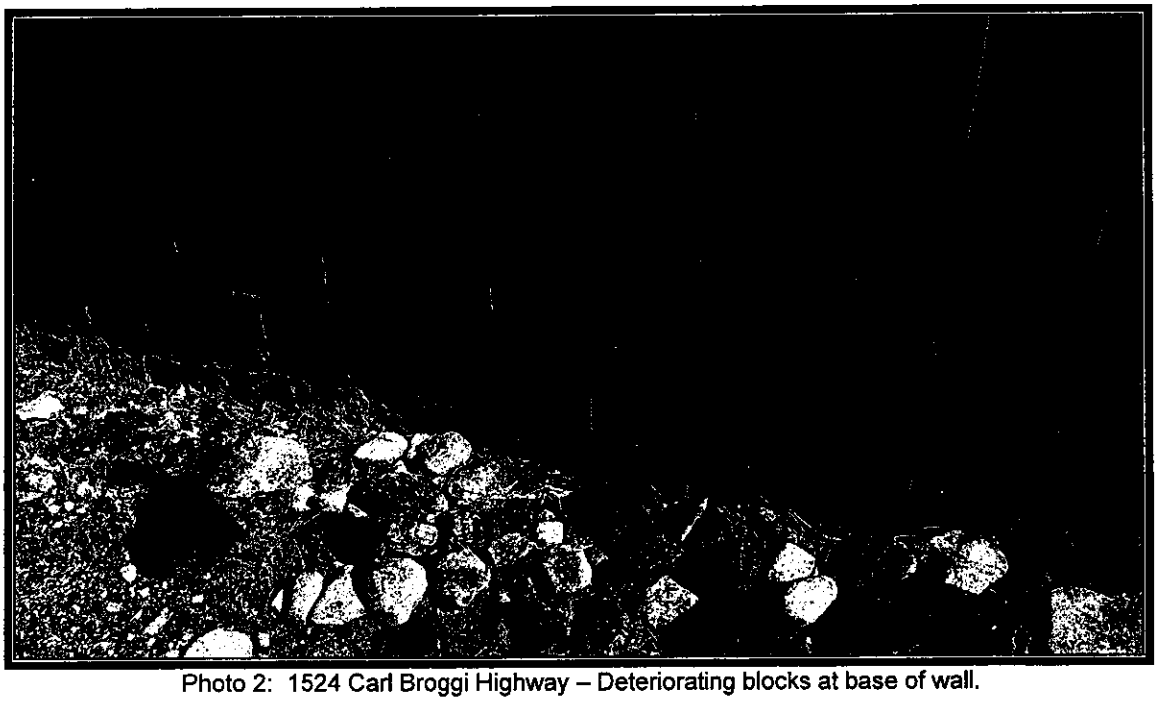

Photo 2: 1524 Carl Broggi Highway – Deteriorating blocks at base of wall.

Photo 3: 1524 Carl Broggi Highway – Trench drain in floor.

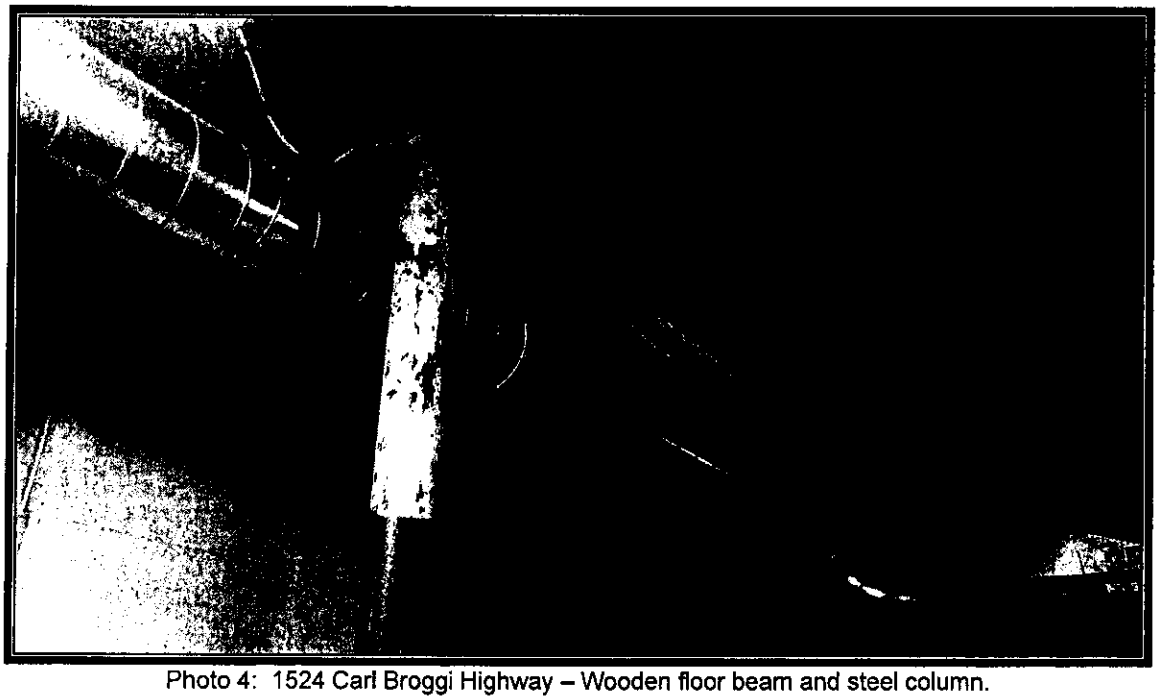

Photo 4: 1524 Carl Broggi Highway – Wooden floor beam and steel column.

Photo 5: 1524 Carl Broggi Highway – Short wall and roof framing at western end of building.

Photo 6: 1524 Carl Broggi Highway – Load bearing wall supporting trusses and rafters.

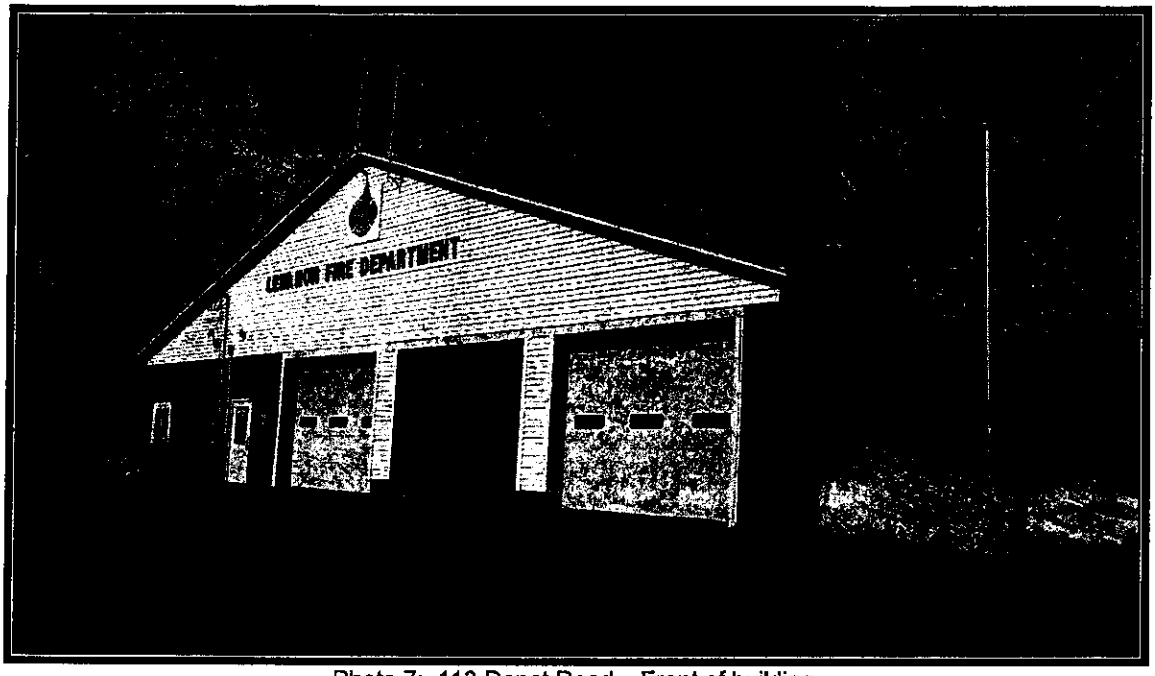

Photo 7: 113 Depot Road – Front of building.

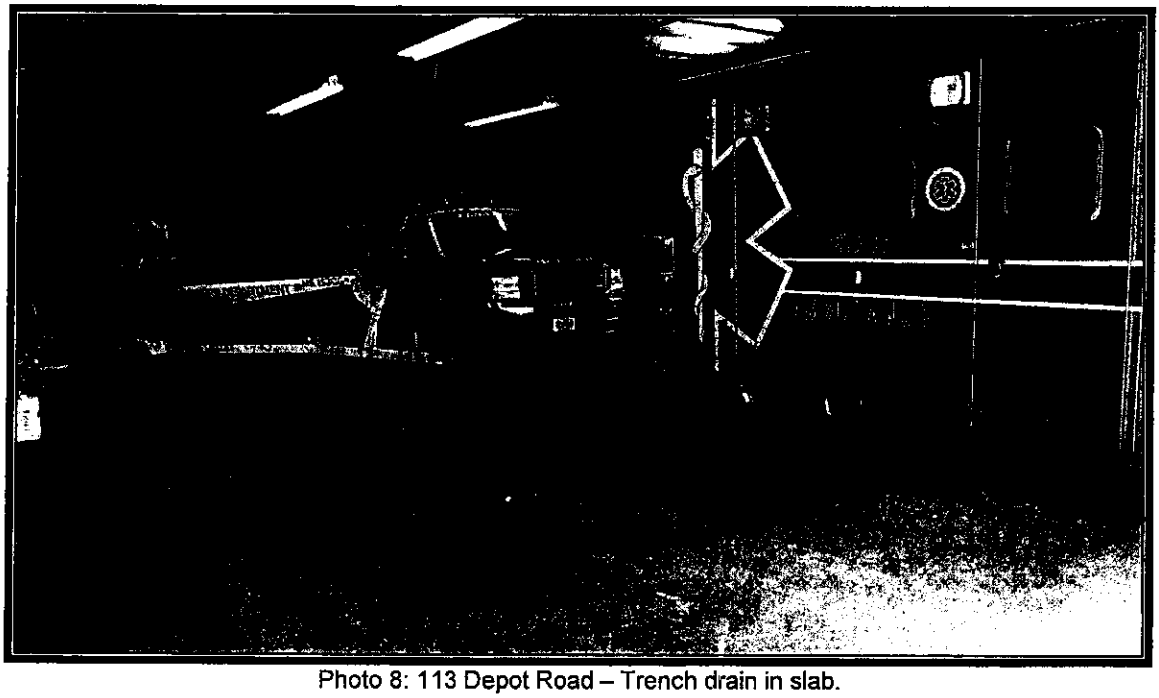

Photo 8: 113 Depot Road – Trench drain in slab.

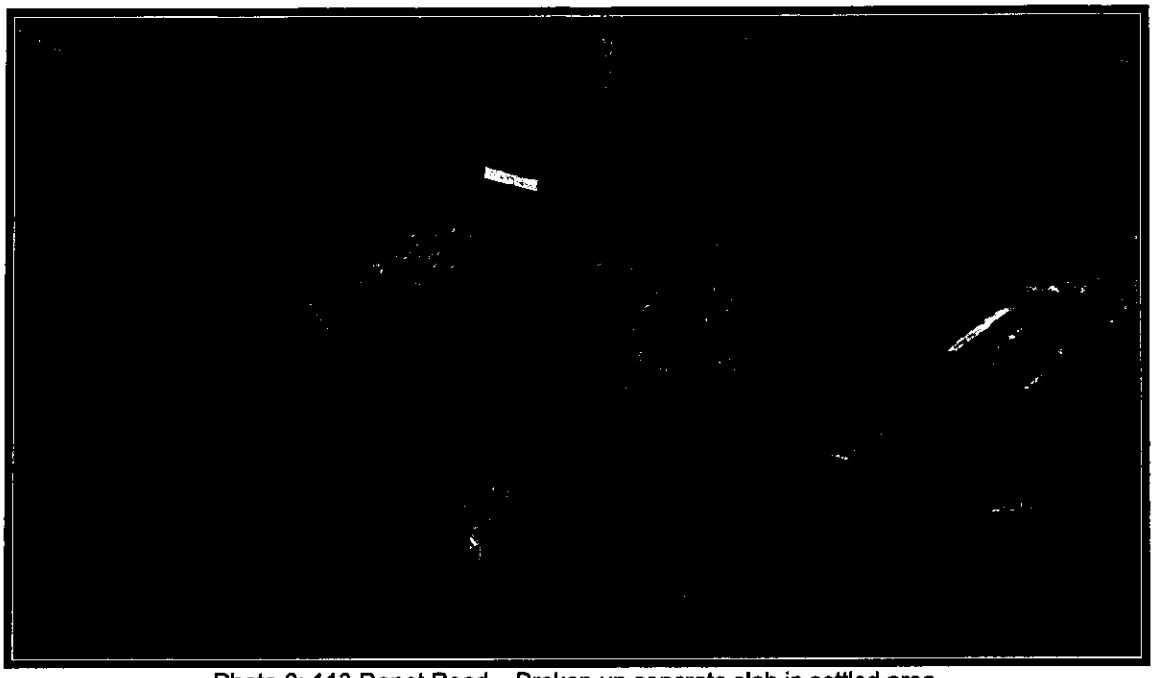

Photo 9: 113 Depot Road – Broken up concrete slab in settled area.

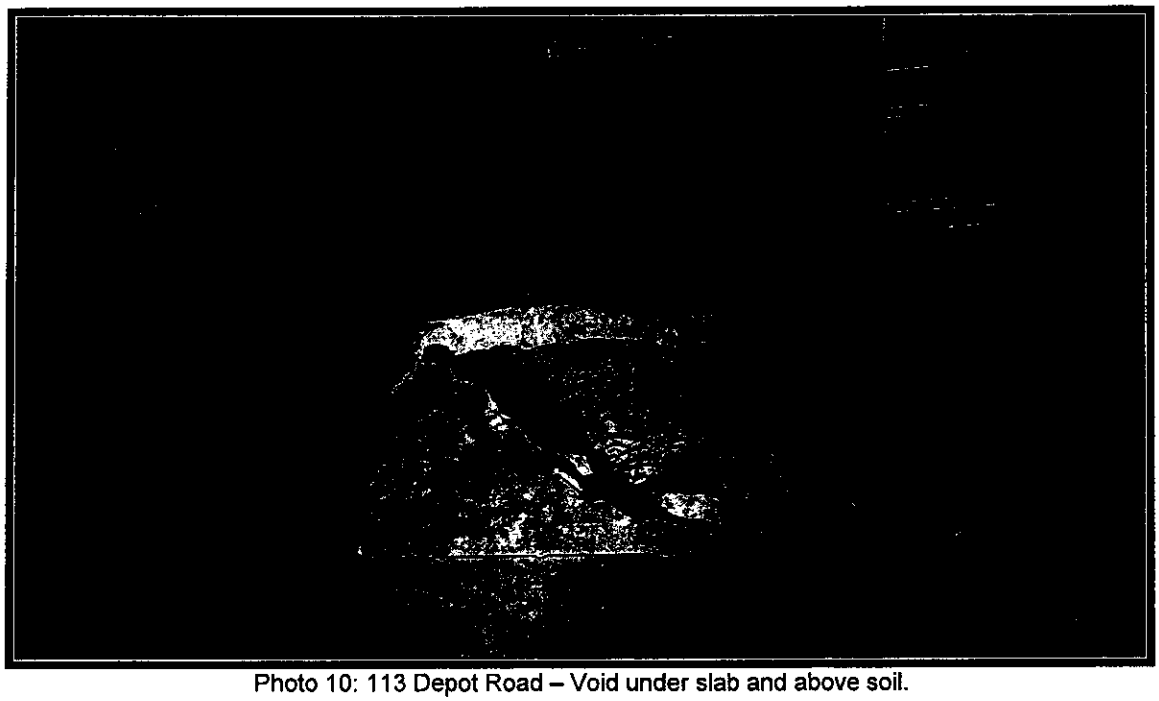

Photo 10: 113 Depot Road – Void under slab and above soil.

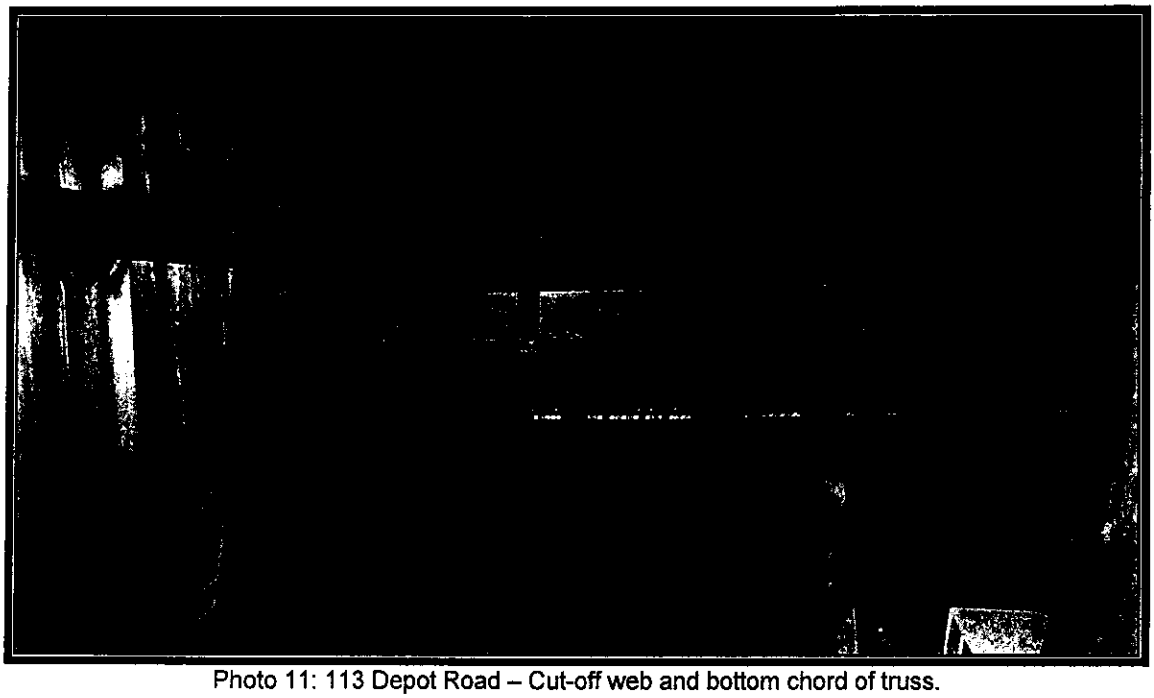

Photo 11: 113 Depot Road – Cut-off web and bottom chord of truss.

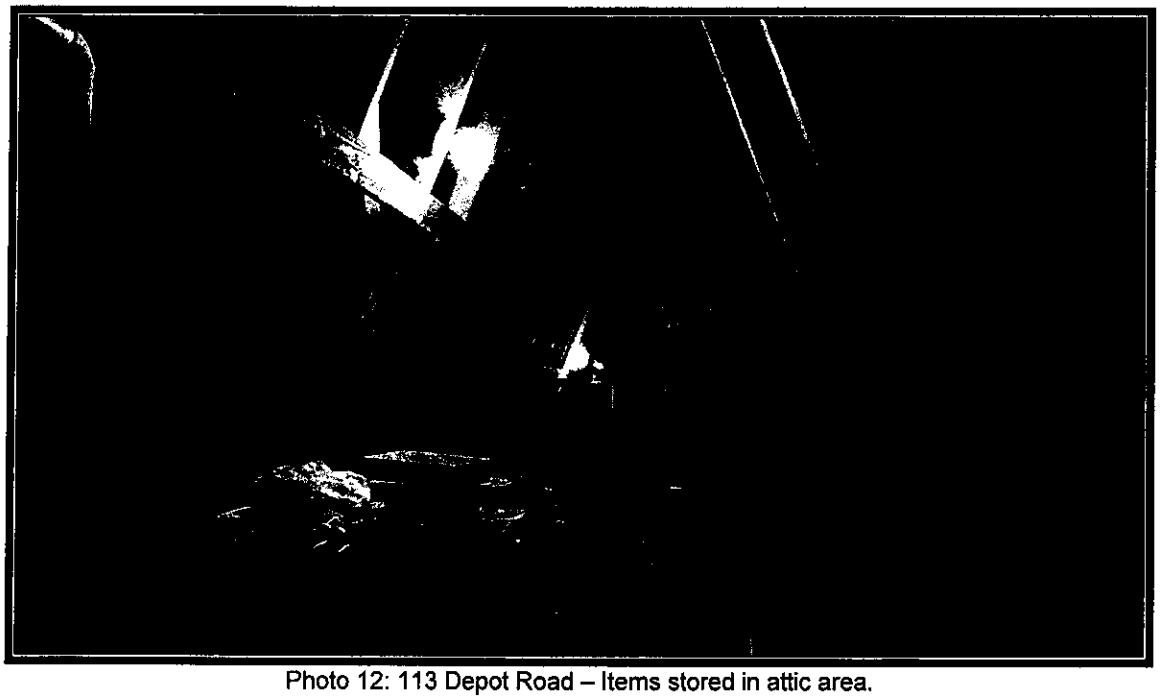

Photo 12: 113 Depot Road – Items stored in attic area.