**Dale F. Jones, Structural Engineer, Inc.**
**3250 Sedgwick Circle**
**Loveland, CO 80538**
**(970) 568-2919**
**djones@dfjse.com**

October 11, 2022

**Don Taranto, P.E.**
**Public Works Director**
**Town of Timnath**
4750 Signal Tree Drive
Timnath, CO 80547

**Re: Structural Evaluation of 4104 Main Street, Timnath, CO**

**Don,**

The Town of Timnath entered into an agreement with Dale F Jones, Structural Engineer, Inc. to provide a structural evaluation of 4104 Main Street in Timnath. The building is currently used by the Town for storage and has previously served as the fire station. This is a report of the findings and conclusions of that evaluation.

**INTRODUCTION**

The age of the structure is unknown. It is approximately fifty feet square with a bearing wall in the east-west direction dividing the interior of the building into two rectangles. The roof slopes from the west to the east, with a continuous gutter on the east side to capture drainage. The roof covering is a built up asphalt roof with a gravel covering. The roof and ceiling are framed with sawn lumber. The ceiling on the north half of the building is plaster applied to wood lath which is attached to the underside of the ceiling joists. The ceiling on the south side appears to have been built similar to the north side with the addition of an additional ceiling below the original. The exterior perimeter walls are brick masonry and the interior bearing wall is brick masonry.

Front (West) View of Building

**ROOF FRAMING**

The surface of the roof was walked to check for soft areas or other obvious defects. None were found. From the surface of the roof it was determined the structural framing spans in the north-south direction, each way from the center interior bearing wall to the north and south exterior walls.

North-West Corner of Roof

North-East Corner of Roof

Looking East

South-East Corner of Roof

The framing on the north side of the building was partially observed through a hole in the ceiling created during placement of the wall header over the vehicle door on the west side of the building. The 1 5/8" x 9 ¼" rough sawn ceiling joists, which are spaced at 16" on center, are the primary supporting members for the roof/ceiling structure and are built into pockets in the masonry walls. The 1 5/8" x 5 ½" rough sawn roof joists are spaced at 16" on center and are located directly over the ceiling joists. In addition to directly supporting the roof sheathing, they serve to provide additional overall roof support. At the exterior wall the roof joists are supported on a ledge created by a narrowing the masonry wall from thirteen inches to eight and one half inches wide. There are rough sawn 1x4's placed vertically at the center of the span. These 1x4's are nailed to the side of the ceiling joists and rafters (side-nailed). In addition to the vertical 1x4's, there are side-nailed rough sawn 1x6 members extending from each end of the ceiling joists to within several feet of the vertical 1x4's. There are 1x wood roof

sheathing boards on top of the roof joists. Below the ceiling joists there are wood lath strips with a plaster finish.

North-West Corner of North Attic

North Wall of North Attic

North Attic looking East

South-West Corner of North Attic

The roof and ceiling framing on the south side of the building are only partially observable from the heavily weathered section of plywood siding on the east side of the building's exterior. It was observed that the framing in this location is similar to the framing on the north side of the building, with the exception that the framing for the additional ceiling on the south side can be observed. This additional ceiling framing spans in the east-west direction and is presumably supported by the two intermediate beams which were added at a later date and the full height walls near the front of the building.

Structural calculations were performed to determine the capacity of the roof framing. The Town of Timnath has adopted a ground snow load of 30 pounds per square foot. This is a common ground snow load requirement for the area. For analysis purposes, the ground snow load is converted to a roof snow load by taking into account such factors as the wind exposure of the building, the thermal characteristics of the roof/ceiling assembly, and the tendency for snow drifts to form on the roof. For this

building the additional loading due to drifting is minimal since the parapets extend only 1'-6" above the roof surface. In the building's current condition, the snow loading is reduced by melting (except for the spring storm condition noted below) since the roof/ceiling assembly is not insulated and significant heat escapes from the building through the roof. Some jurisdictions limit these loading reductions to account for the condition that occurs during and after heavy spring snow events. In these storms the snow builds up rapidly, often accompanied by minimal wind to blow snow from the roof and minimal time for melting of the snow.

The structural calculations for the north side of the building show the 1 5/8" x 5 ½" roof joists and the 1 5/8" x 9 ¼" ceiling joists to be within their allowable capacity based on a design roof snow load of 21 pounds per square foot and considering the plaster ceiling, which has a weight of approximately 10 pounds per square foot. The calculated deflection is only slightly over that allowed by the current building code. This deflection is not a detriment to safety. These calculations do not account for any increase in strength provided by the diagonal 1x6's side-nailed to the roof and ceiling joists. These members tend to increase the capacity of the roof framing, but their effect is much less where they flatten at the east side of the building due to the slope of the roof.

The structural calculations for the south side of the building, which is 1'-4" wider than the north side, show the 1 5/8" x 5 ½" roof joists to be within their allowable capacity and the 1 5/8" x 9 ¼" ceiling joists to be only slightly (3%) above their allowable capacity based on a roof snow load of 21 pounds per square foot and the plaster ceiling, which occurs in the front (west) room. The 3% calculated overstress is within tolerable limits and is not a safety concern. The calculated deflection is over that allowed by the current building code but is not a detriment to safety. As with the north side, these calculations do not account for any increase in strength provided by the diagonal 1x6's side-nailed to the roof and ceiling joists.

Please note that except for the small area on the east side of the building, the roof framing on the south side cannot be observed without removal of interior ceiling finishes or the roofing membrane. The calculations are based on the assumption that the south side framing is the same as at the north.

If the building is to be re-roofed, the condition of the wood roof sheathing can be verified when the existing sheathing is removed. Often damage to the roof sheathing does not penetrate to the bottom of the sheathing and is not apparent until removal of the roofing membrane. Any damaged roof sheathing can be removed and replaced at the time of re-roofing.

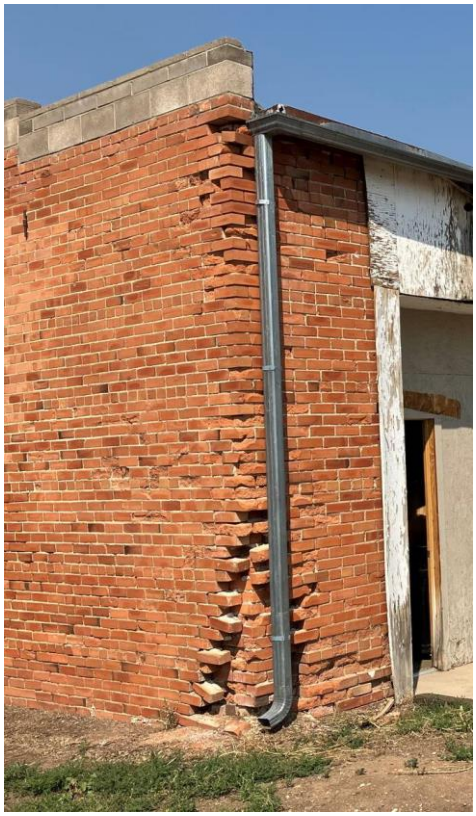
## EXTERIOR MASONRY WALLS

The exterior walls of the building are brick masonry. The north and south exterior walls are three wythes of brick (three rows of brick) with an approximate thickness of thirteen inches. Above the ceiling the thickness of the wall is reduced to two wythes to provide a 4" wide ledge for the 1 5/8" x 5 ½" roof joists to rest on. The remaining two wythes extend above the roof to form the parapet.

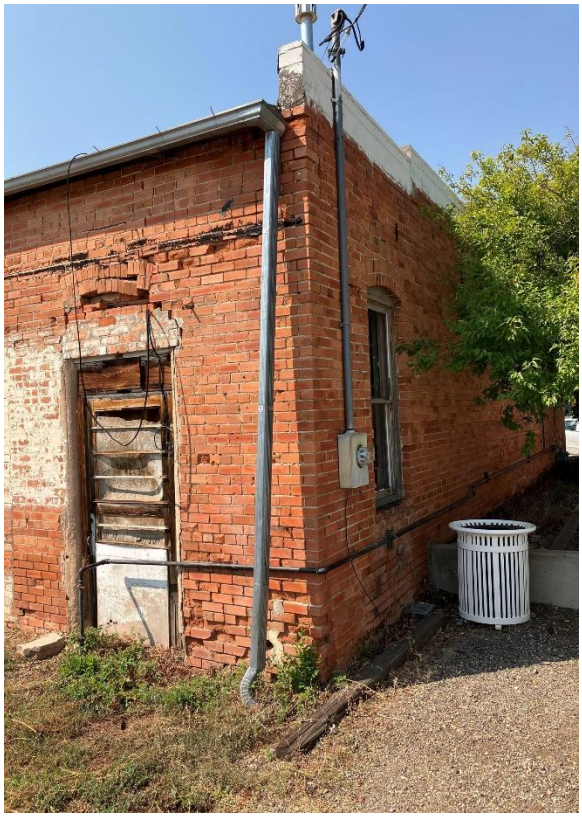
The east and west walls are two wythe brick masonry. The west wall extends above the roof to form the west parapet. The east wall terminates at the underside of the roof framing to allow the roof to drain to the continuous gutter on the east side.

There is significant damage to the outer (exterior) wythe of the masonry walls from moisture and freeze-thaw action. It was observed that this damage extends beyond the outer wythe in some locations. Most of the brick units are in acceptable condition, but there are many locations where the bricks are heavily weathered and friable (easily crumbled). The mortar in the bed (horizontal) and head (vertical) joints are in acceptable condition in some locations, but for significant portions of the wall the mortar is heavily weathered, resulting in very friable mortar. Many of the locations where the mortar is heavily weathered correspond with locations where the wall remained wet and was subjected to freeze-thaw action.

There are locations where the weathering has resulted in significant degradation of the masonry wall, leading to a potential for eventual partial wall collapse in these areas. The most advanced deterioration is the south-east corner of the building where the mortar has completely, or nearly completely, degraded leaving the bricks at the outer wythe, and some at the inner wythes, loose and unattached. With close observation it can be seen that the masonry wall has bulged outward. This degradation is most likely due to freeze-thaw action caused by saturation of the masonry from water flowing from the roof and running down the exterior face of the wall. A similar situation exists on the north-east corner of the building.



South-East Corner of Building



North-East Corner of Building

Weathering of the masonry at the top of the exterior walls is significant. It is apparent that the upper portion of the wall was partially removed and replaced with concrete masonry units. It is likely the brick parapets, because of their exposure to the elements, became highly weathered and may have presented a safety hazard prior to their replacement with concrete masonry. The parapets were replaced on the north, west and south sides of the building. There are many areas where significant weathering of the bricks and mortar can be seen below the newer concrete masonry.

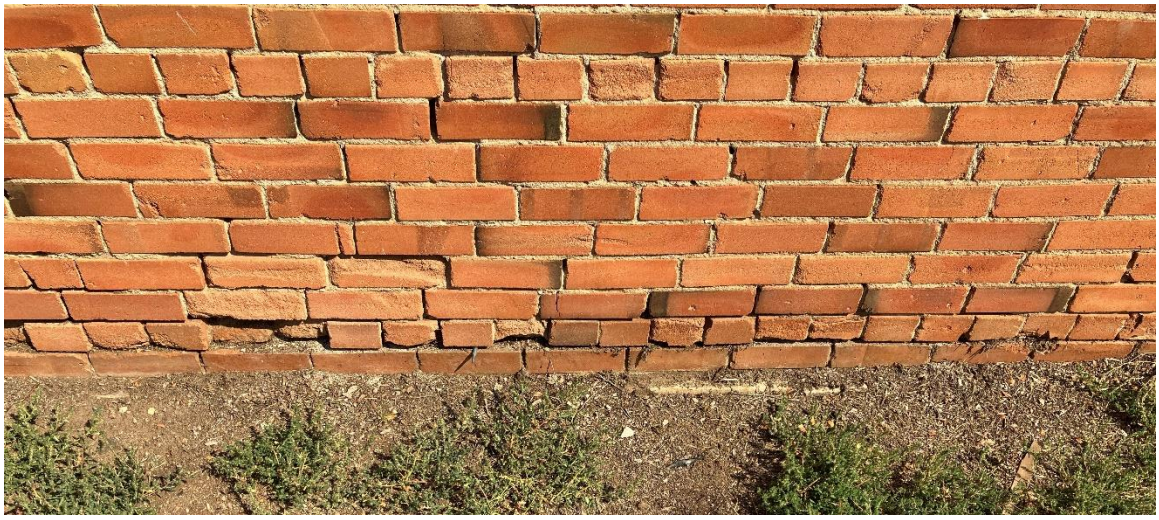
Weathering of Top of Brick Masonry on South Wall

The photo below shows a condition at the north wall. The area of weathering extends down the face of the wall, perhaps due to a previous condition of water saturation due to improper drainage.

Weathering of Brick Masonry on North Wall

Weathering of the masonry at the bottom of the exterior walls is quite significant. The first photo below shows an overall view of the bottom of wall at the south side of the building. The mortar has degraded to a very friable condition leaving at least the outer wythe of bricks unsupported. Some of the brick units have significantly degraded also. This is likely due absorption of moisture into the masonry wall from the adjacent saturated soils followed by freeze-thaw cycles. It is likely this condition occurs in other areas of the building as well. The next photograph shows a closer view of a portion of the wall and the third photograph shows a six inch long pen inserted into the bed joint showing the mortar is missing in the outer brick wythe.

Overall View of Disintegrated Mortar Joints at Bottom of South Wall



Disintegrated Mortar Joints and Bricks at Bottom of South Wall
(pen at center of photograph, several inches above grade)

Six Inch Long Pen Inserted into Disintegrated Bed Joint at Bottom of South Wall

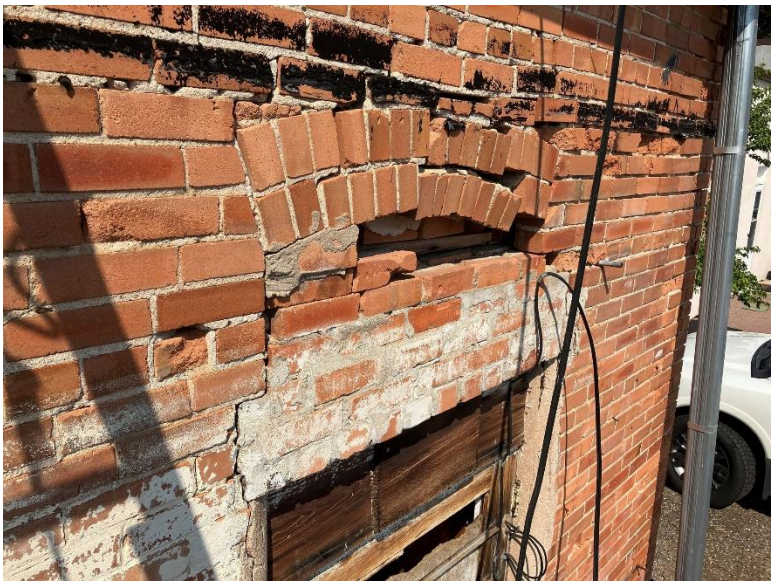
Water Barrier at Bottom of North Exterior Wall
(note mortar degradation)

Northwest Corner of Building with Significant Brick and Mortar Degradation

There are other areas on the exterior walls where there is significant degradation of the bricks and mortar. The rear (east) wall of the building exhibits degradation near the bottom of the wall, at each end of the wall as previously noted, above the infilled window openings, and other locations.

East Exterior Wall

Rear Wall with Degraded Brick and Mortar



Above Opening near Northeast Corner of Building

The interior surface of the north exterior wall shows signs of moisture migrating through the wall. The infiltration near the bottom of the wall is likely due to a moist soil condition in the planter adjacent to the wall. Based on the height of the water barrier applied to the exterior surface of the wall, the level of the soil in the planter may have been higher at one time.

Interior Surface of North Wall Near Bottom – Planter on Opposite Side

Interior Surface of North Wall Showing Signs of Moisture Migration

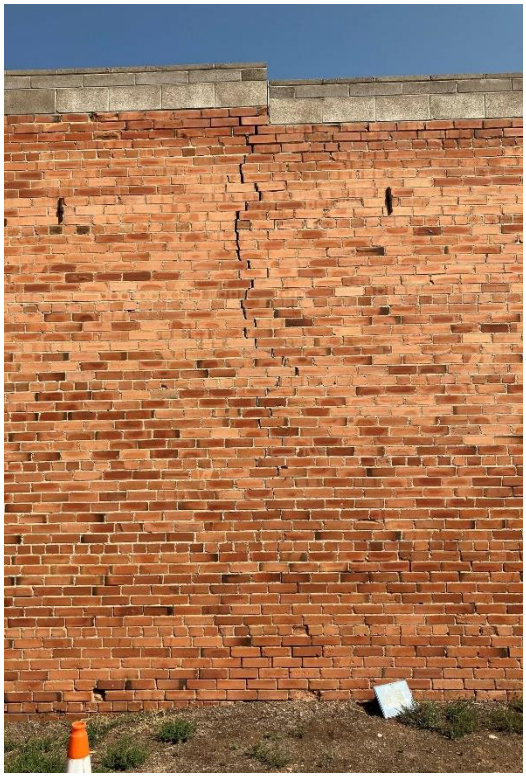
**INTERIOR MASONRY WALLS**

The interior wall running east-west near the center of the building is three wythe brick masonry and is covered with plaster on each side, except in the attic. This wall extends to the underside of the roof sheathing and supports the 1 5/8" x 9 ¼" ceiling joists. The 1 5/8" x 5 ½" roof joists are supported on a wood ledger at the masonry wall. There is a vertical crack in the wall from foundation movement, similar to the crack visible on the south exterior wall, but the wall appears to be performing adequately.

**FOUNDATION**

The exterior masonry walls extend below grade. The foundation is not visible except for one area, near the center of the south wall, a mortared stone wall can be seen.

Stone Foundation on South Wall



Crack on South Wall

The building exhibits a vertical crack in the south exterior wall and the center masonry wall, approximately eighteen feet west of the east wall. The width of the crack on the south wall varies from near zero at the foundation to approximately ¾" in the brick masonry at the top of the wall. It should be noted that the crack in the concrete masonry units at the top of the wall is only one quarter inch wide. This indicates the crack in the brick wall was approximately one-half inch wide when the concrete masonry units were installed, and has increased one-quarter inch since then. It is my opinion that except for the movement which caused the above noted wall cracks, the foundation appears to be performing adequately.

## RESISTANCE TO LATERAL LOADS

In the east-west direction, the building obtains significant resistance to wind loading due to the exterior masonry walls on the north and south sides and the center interior wall oriented in the east-west direction.

In the north-south direction, the building obtains resistance to lateral wind loading from the exterior masonry wall on the east side, the interior masonry wall approximately ten feet east of the west exterior wall, and the west exterior wall which has significant openings.

A lateral analysis to determine resistance to wind loading was not performed since the building layout is typical of downtown buildings built at this time. Resistance to seismic loading would not have been a consideration when this building was built and is not a part of this evaluation. It was noted that the building has metal ties which connect the north, west and south walls to the roof/ceiling framing. It has not been determined if the east wall has such ties, but it is noted that on the north half of the building, the east exterior wall has pulled away from the ceiling approximately one-half inch.

## CONCLUSIONS

Unless there is significant wood decay in the roof framing (which was not observed with this limited observation), the roof framing is currently adequate to resist the anticipated snow loading. When the roofing membrane is scheduled to be replaced the opportunity should be taken to check for damage to the roof sheathing. Any damaged sections should be replaced as necessary. If the building is to be remodeled and portions of the roof and ceiling framing are exposed, the opportunity should be taken to check the exposed framing for decay.

The details of the building foundation are unknown, but the foundation appears to be performing adequately considering the age of the building.

If it is anticipated to remodel the building, consideration should be given to verify that adequate resistance to lateral loading in the north-south direction is maintained.

The interior east-west center masonry wall is performing adequately.

The biggest challenge with the building is the significant degradation of the exterior of the brick masonry walls. As noted above there are significant areas of the exterior walls (approximately 50%) which require some amount of rehabilitation, and areas such as the rear two corners which will need to be removed and replaced.

If rehabilitation of the building is considered, please note it is common for structural conditions to be discovered during the rehabilitation project that were not discovered prior to demolition. The Town should provide contingency funds for these events.

**LIMITATIONS**

This evaluation was limited to the structural condition of the building only, and did not include evaluation of other aspects of the building, such as but not limited to; roofing condition, fire safety, egress, mechanical equipment condition, electrical condition, and asbestos or other hazardous materials potential.

The field investigation was limited to observation of the existing structural conditions without removal of any interior or exterior finishes. If the building is to be remodeled, it is recommended that portions of the interior finishes be removed to verify the condition of the structure. This report is exclusively intended for use by the Town of Timnath and is not authorized for use by any other party. Any modifications to the building should not be performed without the involvement of qualified licensed professionals.

It has been a pleasure to have been of assistance to the Town of Timnath. If you have any questions or I can be of further assistance, please contact me.

Sincerely,

Dale F. Jones, P.E.
President

Dale Jones
Digitally signed by Dale Jones
Date: 2022.10.11 14:37:49 -06'00'