January 12, 1995

Mr. Michael Howell
North Valley Library
Stevensville, MT. 59870

Re: Structural Evaluation
North Valley Library
Stevensville, MT.

Michael:

As requested, we have completed a structural investigation of the building presently housing the North Valley Library on Main Street Stevensville. I inspected the building on the afternoon of Thursday, October 27, 1994 along with Mark Blotkamp from our office.

STRUCTURAL DESCRIPTION

The Library building in Stevensville is a two story structure with a partial basement. The building perimeter walls are full height concrete. While the interior main floor, second floor and roof structure are wood framed. The exterior dimensions are approximately 102'(east/west) x 28'(north/south), with the partial basement on the back end of the building being roughly 30' x 28'. A crawl space exists on the front 2/3's of the building. The upper floor level consists of a full width (28') section in the front quarter of the building, with the remaining east portion of the upper floor being occupiable in the center section only. Please reference the attached plan and building sections concerning the following:

The basement floor is concrete slab on grade. A concrete wall runs north/south down the center of the 30' basement. The floor slab to ceiling height of the basement is around 6'-5".

The main floor structure consists of 1x planking on 2x12 floor joist at 16" o.c. spanning north/south from the side concrete walls to a center support girder. The support girder consists of stacked double 4x8's. The 4x8's are further supported on concrete piers at approximately 14' to 16' intervals. The girders extend through the crawl space and also the basement area.

The upper level structure has 1x floor planking on 2x8 floor joist at 16" o.c. also spanning north/south from the side concrete walls to a center support girder. The center girder is multiple 2x12's as shown on the sketched building sections. The multiple 2x12 girder has no support from below, but rather is supported from suspended 1/2" dia. steel rods at 13' o.c. to well greater than 16' o.c.. The rods are connected to the roof rafters at an upper collar tie.

The roof structure involves 1x planking on 2x8 rafters at approximately 12/12 pitch forming a ridge. The ridge line runs full length of the building (east/west). The rafter heels are supported by the 2x8 floor joist. In the front portion of the building, the pitched 2x6 rafters are interrupted as shown on section A, page 2. On each side of the 12/12 pitched roof section, there is a sloping, flat roof area. The side sections also have 2x6 rafters at 16" o.c.. These rafters span from the side concrete walls and bear on the pitched 2x6 rafters. The side sections slope from the front, high end down to the back. The back portion also has four shed dormers extending off to the south side. The roof on the front section is supported on interior bearing walls, which are in turn supported by the upper level floor structure. The roof of the center section and the back portion is "self-supported" by the concrete side walls. The interior walls of the center and back sections are formed by a 2x6 ceiling, collar tie, while the side kneewalls are 1x6's connected from the pitched rafters to the floor joist.

INSPECTION OBSERVATIONS

Our trip to the site consisted of a general walk-through, visual inspection. The basement area is deemed to be in fair condition. The concrete floor slab and concrete walls are in adequate condition.

The main floor structure was also typically in fair condition. The floor area in the front and center section seemed level and sound. The back section of the main floor has a severe low spot deemed to have been caused by a localized settled area. Sections of rotted floor planks were also noted in the far back section.

The upper floor structure has experienced significant distress and is considered in very poor condition. The floor has sagged severely for the entire length of the building (along the center girder line). This deflection is noticeable from the main floor below and is very obvious on the upper floor level. As described above, the roof structure is integral with the upper floor. So with the severe centerline deflection of the upper floor level, the roof line has also settled.

ANALYSIS RESULTS

We have completed a preliminary analysis of the structural integrity of the Library building. The foundation and main floor structure is rather straight forward, so our structural analysis results followed as such. The designated library loading required by the Uniform Building Code for stack rooms is 125 psf. The main level 2x12 floor joist are adequate for this loading requirement. The stacked, double 4x8 centerline girder potentially falls short of being able to fully support the large library book stack loads. Additional support could easily be installed to bring the girders into Code compliance.

The upper floor/roof structure, however, will require significantly more work. With no centerline interior support of the second floor level, the upper structure is obviously not adequate. The Uniform Building Code specifies a live load of 50 psf (with an additional 20 psf load for partition walls) for office-type loading. The UBC allows for a 40 psf loading if the upper floor is to be used for residential occupancy. But if the area is designated to be storage, then a 125 psf load is required. Further, if the upper level is to be considered for retail use, then a 75 psf load is dictated. So upper structure can be analyzed with several loading conditions. In conjunction with any of the above loads, a roof snow of 32 psf, as stipulated by the State of Montana, must also be considered.

We have setup and completed a computer analysis of the upper floor/roof structure. The upper floor will clearly not work without the assistance of the roof members. And conversely, the roof structure can not function without the upper floor. Plus, both the upper floor and the roof rely heavily on the stability of the concrete side walls. The system further relies very much on the double 1/2" dia. steel suspension rods at regular intervals. So, in order to appreciate the total system, our analysis shows the floor, roof and walls as a unit. We further combined the different upper floor live load conditions with a Stevensville snow load. As expected, our analysis find the system to be not adequate. With the actual weight of the floor and roof structure (dead load), combined with minimal floor load and snow loads, the members are severely overstressed. Our analysis also shows significant center deflection, which bears-out the actual condition. Considering the existing configuration and the potential for up-grading, we have analyzed the member stresses and the required member to member connections. Our findings show up-grading the existing configuration to be not feasible (i.e. continuing to rely of the side walls and no interior vertical support beams and columns). The 2x8 floor joist system would have to be totally replaced and virtually every connection would need to be up-graded. The total re-construction thus renders the up-grade economically unfeasible.

We then figured the upper floor/roof structure with centerline vertical support. A new centerline beam and column system could be incorporated with minimal disruption to the main level library area. The centerline support obviously assists the upper floor/roof structure greatly. With this support, the 2x8 floor joist remain to be somewhat touchy. Depending on the designated live load requirements, the floor joist are slightly overstressed. This is not deemed to be a major problem, however. Even with the centerline support, several connection situations will still require up-grading. Plywood gussets will need to be added to some connections and some nailed sheet metal strapping will also need to be incorporated. These connections are deemed to be easily achievable.

SUMMARY/RECOMMENDATIONS

The upper floor/roof structure is obviously distressed. The sag in the floor system is a serious concern and thus instigated this structural report. The initial construction of the building undoubtedly incorporated center support columns or a centerline wall. At some point in the life of the building, the support was removed and the 1/2" diameter suspension rods were installed. This greatly affected the structural integrity of the building. While the upper floor/roof structure has somewhat "withstood the test of time", it is not structurally capable of carrying any applied floor loads and is very touchy considering the basic dead load and roof snow loads. The structure seriously falls short of meeting the minimum design load requirements for any use of the upper floor.

While the building is deemed safe for occupancy of the main floor level (wholly based on the stability of the concrete side walls), the upper floor level should totally abandon and not be used. Plus a program should be developed to further stabilize the upper structure and bring the building into Code compliance. As just noted, the upper structure could be greatly stabilized by introducing center supports. These supports would require crawl space footings. The existing multiple 2x12 girder might be adequate (depending on the on center column spacing) or an additional beam could be added if the designated spacing of the center columns were too great. This support would greatly insure the safe occupancy of the main level. To further use the upper structure will require up-grading the floor joist and rafter connections note above.

I realize this letter is rather general in nature, so please call with any and all questions, comments or suggestions. Up-grade structural drawings is well beyond the scope of this report, so again, please call if we can be of further assistance. Our office can follow-up with the structural up-grade drawings or if you so choose, we will be more than willing to share our structural analysis results with another engineering or architectural firm.

Sincerely,
BEAUDETTE CONSULTING ENGINEERS
Tom R. Beaudette, P.E.

attachment - plan & sketches