Corbett School
Seismic Review

Corbett School District

Associated Consultants, Inc. Structural Engineers

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Associated
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February 6, 2013

Mr. Terry Rommel
The Rommel Architectural Partnership LLP
1200 NW Naito Parkway Suite 550
Portland, Oregon 97209

Re: Corbett School Seismic Review
Corbett School District
Corbett, Oregon

At your request we have visited the above-referenced project, walked through the buildings, and have performed limited structural observation. We have also received original drawings for all buildings except for the Middle School Building. The purpose of the review was to evaluate the structural conditions of the existing buildings and determine whether any structural upgrades would be required. Our site visit consisted of limited observation of readily-accessible areas of the structures. We have not performed any material testing or remote sensing.

At the time these buildings were constructed, seismic awareness was very limited. Over the years, as more studies have been performed, the seismic risks have been more accurately evaluated. Consequently, expected force levels and recurrence intervals are more closely predicted. As a result of more stringent code requirements, many older buildings may now be required to be reinforced and improved to a higher lateral force resisting system.

Our findings, as noted below, are based on our limited site observations and review of the existing construction documents. We have assumed that all buildings were constructed per the original drawings, given our lack of ability to access all construction assemblies to verify.

Please note that our analysis and recommendations are based on minimum code requirements for life/safety purposes. In high seismic or wind events the buildings may suffer considerable amounts of damage which may require substantial repairs or even replacement.

For structural analysis and design we have used following references:
- 2009 International Building Code "IBC".
- 2010 Oregon Structural Specialty Code "OSSC".
- ASCE/SEI 31-03 Seismic Evaluation of Existing Building.
- ACI 530-05 Building Code Requirement for Masonry Structures
- Principals of engineering

1. High School Building

Constructed originally as the Middle School in 1977, this single story building is 22,100 square feet. Roof construction consists of 2x8 joists spaced at 16", supported on glue-laminated beams and columns spaced at 15 feet above the commons area and the east wing. Other areas are framed with 16" deep TJI's, at 16" on center, which are supported on beams and columns spaced at 30 feet. All exterior and bearing walls are constructed with 2x6 wood studs. The lateral support system for this building is comprised of a 5/8" plywood roof diaphragm and 3/8" plywood sheathing on the exterior walls.

Our review and analysis determined that this building has adequate gravity and lateral load paths, and the existing walls are adequate for supporting earthquake and wind forces. It is our opinion that no structural upgrade for this building is required.

2. Multi-Purpose Building

The original Multi-Purpose Building is a single story building that is approximately 9,000 square feet and was constructed in 1970. The roof over the stage and multi-purpose area is constructed with 2½" thick tectum roof deck supported on 4x8 sawn lumber spaced at 3'-6". The 4x8 purlins are supported by glue-laminated beams spanning east west direction spaced at 16'-0". The beams are supported by wood posts at each end in the walls. The roofs above the Kitchen, Storage Rooms, and triangular shaped roof at the northeast corner of the building are at a lower elevation and framed with 5/8" plywood over 2x joists spaced at 16". Walls which support the higher roof are framed with 2x6 studs, while shorter walls are constructed with 2x4 studs.

During our site observation we detected one Tectum roof panel that was stained due to roof leakage. The panel appeared to be damaged and inadequate to support loads. This area of roof is unsafe to step on and the panel requires removal and replacement.

Roof framing appears to be adequate for gravity loads. The 4x8 purlins appear to be sagging excessively. These purlins are adequate to support 20 psf dead load and 25 psf snow load. However, since they are so shallow they lack adequate stiffness and they have deflected under the roof dead weight. Even though the purlin is sagging, it is structurally sound.

The tectum roof diaphragm and the lower roof plywood diaphragm above the Kitchen have adequate strength and appropriate load paths to resist lateral forces. Existing walls appear to have adequate shear capacity to resist seismic and wind forces; however, the wall at the east side of the building, as constructed, appears to be deficient to support wind force at the area of doors and windows.

Framing around the windows consists of glue-lam columns which supports the roof beams. At mid-height there are glue-lam beams which are hung from the inside edges of the columns. These beams provide lateral support for the wall above the windows as well as creating a niche for lighting fixtures. The beams are inadequate for wind support and reinforcing is required. For repair we believe the exterior soffit above the doors and windows may be removed to install a new 2x10 (Select Structural DF) or 2x10 Timber Strand LSL at the bottom of the existing 2x4 framing per attached detail 'A' .

3. - Gymnasium Building

Single story approximately 9,350 square foot Gym Building was originally constructed in 1954. In 1960 the single story, approximately 2,340 s.f., Science Building was added at the west side of the building. In 1970 the two story, approximately 6300 s.f., Physical Education building was added on the south side of the gym and a single story 3,535 s.f. Industrial-Arts building was added on the east side of the gym, now converted into the Wrestling Room.

Some of the building's exterior walls are brick veneer with wood stud framed walls. Usually the brick veneer is anchored to the framed wall with corrugated metal strap ties for lateral support. These straps ties are fastened to the framed walls, with nails or screws, and cast back into the brick mortar beds. Over time, the light-gauge galvanized metal strap ties may have rusted and deteriorated due to exposure to moisture and minerals from the brick and mortar. For the older buildings, we recommend verifying that the existing ties are still in good shape. This can only be done by exposing the ties randomly for visual inspection. If needed, new anchors may be installed through the mortar joints.

a) Original Gymnasium Building:

The building is constructed with 2" wood decking over 3¼"x9¾" glue laminated purlins spaced at 8 feet. The purlins are supported by 9 inch wide glue-lam arches which are spaced at 16 feet. The exterior walls are constructed with wood studs sheathed with 1" nominal sheathing and sided with brick veneer.

Our review of the drawings determined that the building is structurally satisfactory for gravity loads. At the east and west sides there are sections of glass blocks at top of walls which cause discontinuity between the roof diaphragm and the shear walls below the glass block panels. We recommend removing at least two bays of glass block at each wall and infilling with studs and plywood per attached detail 'B'

At the north side of the building there are two brick wing walls, one each side of the entry. These walls are constructed with double wythe un-reinforced brick. The walls are supported on a foundation stem wall, however, the top of the walls stop approximately two feet from bottom of the roof beams. Since the wall tops lack lateral support, they have tilted and appear to be out of plumb. The cantilevered glue-lam beams above the walls also appear to have rotated. This location is the entry and exit for the building and there is concern regarding safety during a seismic event. We recommend removing and replacing the walls and extending to the roof so the walls are made laterally stable. Or as an alternate, provide new columns at each side of the wall ends and fasten it to the foundation and the roof structure above to support the walls to keep them from falling.

b) Science Building Addition on the west side:

The building construction consists of 5/8" plywood sheathing on 2x6 rafters, spaced at 24", supported on pony walls on triple ceiling joists. The ceiling joists are supported by glue-lam beams spaced at 8 feet. The walls are framed with 2x6 studs covered with plywood sheathing and siding.

Vertical load supporting elements appear to be structurally satisfactory. The walls have adequate strength to support earthquake and wind loads, however the shear path from the existing roof diaphragm to the shear-wall at the west side of the corridor is lacking. We recommend installing new ½" plywood, per attached detail 'B', on the face of the pony wall, from the ceiling framing to the underside of the roof above that wall.

c) P.E. Addition on the south side of Gymnasium Building:

This building is constructed with 3/8" plywood diagonally installed over a 2" roof deck, supported on 4x6 purlins spaced at 4 feet. The purlins are supported by glue-lam beams at the ridge and every 11 feet. The beams are supported on 6x8 wood posts. Walls are framed with 2x6 studs and sheathed with 3/8" thick plywood. The floor is framed with 2x14 joists spaced at 16". The joists are supported by a line of concrete masonry block wall and a line of beams and posts. The block wall appears to be un-grouted except for each side of openings which are reinforced with 2- ½" diameter reinforcing bars in grouted cells. Over the large opening there are grouted and reinforced lintels. Exterior foundation walls at the east and west side of the lower floor are constructed with concrete and a generous amount of steel reinforcing.

Our review and analysis determined that this building has adequate gravity and lateral load paths, and the existing walls are adequate for supporting earthquake and wind forces. Recent building code does not allow un-reinforced masonry walls; however, we have performed the analysis on the concrete block wall and determined that the flexural tension stresses on the wall do not exceed allowed values. The wall appears to be stable.

d) Industrial-Arts Addition, now the Wrestling Room on the east side of Gymnasium Building:

This building is constructed with 3/8" plywood diagonally installed over 2" roof deck supported on 4x6 sawn purlins spaced at 4 feet. The purlins are supported by glue-lam beams spaced at 12'-2" on center. The beams are supported on 6x8 wood posts. Walls are framed with 2x6 studs and sheathed with 3/8" thick plywood and siding.

Our review and analysis determined that this building has adequate gravity and lateral load paths and the existing walls are adequate for supporting earthquake and wind forces. No upgrade is required.

1- Middle School Building

Constructed originally as the High School in early1920's, this single story building with full basement is approximately 15,770 square feet in plan. Roof construction consists of 2x rafters and ceiling joists spaced at 24 or 16 inches. The roof over the gymnasium section is supported by fabricated trusses. The trusses appear to bear on the masonry walls directly. We could not detect any positive anchorage. The roof framing above the entry hall, administrative offices and classroom west of the entry hall appear to have been upgraded. Drawings prepared by Soderstrom Architects, dated March 17, 1990 indicate replacing as much as 75% of roof framing members. Some of the pony wall studs appear to be bowed or out of plumb.

Exterior walls are constructed with un-reinforced clay tile combined with brick veneer on the outside face. The interior bearing walls of the old Gymnasium appear to be constructed with same type of clay tile. The cellular clay tiles are approximately 8 or 12 inch wide, 12" long and 6" tall with the cells running horizontally so the wall could not be grouted. At the gymnasium, walls appear to be approximately 19' tall. It is not clear if there are any anchors at the top of walls to tie the walls to the roof framing above, so the walls may be laterally unsupported. The north wall of the building includes several oversized windows that are over 8 feet tall with approximately 12" piers between the windows. The piers appear to be overstressed for gravity as well as lateral loads.

The floor framing is constructed with lumber framing supported by the exterior and interior bearing walls, and lines of post and beams. It appears that in earlier remodel work the posts were improved by adding anchor ties at the base and straps at the top of the posts to tie them to the beams at the top. Walls below the main floor are constructed with concrete. These walls are most likely un-reinforced and in most cases they support the roof, floor, and the weight of the masonry walls above. The basement floor is approximately 8'-6" below exterior grade at the front entry. The grade slopes to the south and the basement floor is 4'-6" below grade at the back side of the building. In addition to

vertical loads, the exterior basement walls are subjected to soil pressure for retaining as much as 8'-6" of soil.

The east, west, and the south side basement walls originally had windows which have been in-filled with concrete blocks. Stress concentration on the concrete piers between the windows has caused some horizontal cracks which have resulted in moisture intrusion from exterior. It appears that in an earlier time as an effort to repair this issue, 4x4 wood braces have been installed on the inside face of the wall with mechanical anchors. The 4x4 wood posts do not have adequate strength to support the wall in the event of an earthquake.

In the event of an anticipated earthquake, this building does not have adequate strength and load paths to resist forces. The masonry walls may fail and there is a chance that the building will collapse.

This building has many structural issues and it should be noted that it is likely that the costs required for upgrades, repairs, and remodeling will exceed the value of a replacement building. However, if it is desired to restore the building for historic reasons, the following is a list of required improvements:

1. Roof framing may need additional reinforcing. Extent of this work will be determined when structure is exposed for review and evaluations.
2. New ½" plywood roof diaphragm is required. Existing roofing should be removed so plywood can be installed directly to existing roof structure.
3. New ½" plywood may be required on some of the attic floors on top of ceiling joists to create diaphragms for lateral support of walls.
4. New blocking and connections to new lateral support system will be required for every diaphragm
5. Provide new posts at each end of the existing roof trusses in the Gym section
6. To improve the masonry wall support, new 3x8 studs or light gage metal studs at 16" on center will be required on the inside of walls. These framing members will be anchored to the existing masonry walls with a special type of epoxy anchors with screens. The anchors should be so spaced that not more than two square feet area of

the wall is supported by each anchor. This will provide vertical support for the roof and the existing masonry will be treated as non-structural veneer. For the interior masonry wall, this type of support should be installed on each face.

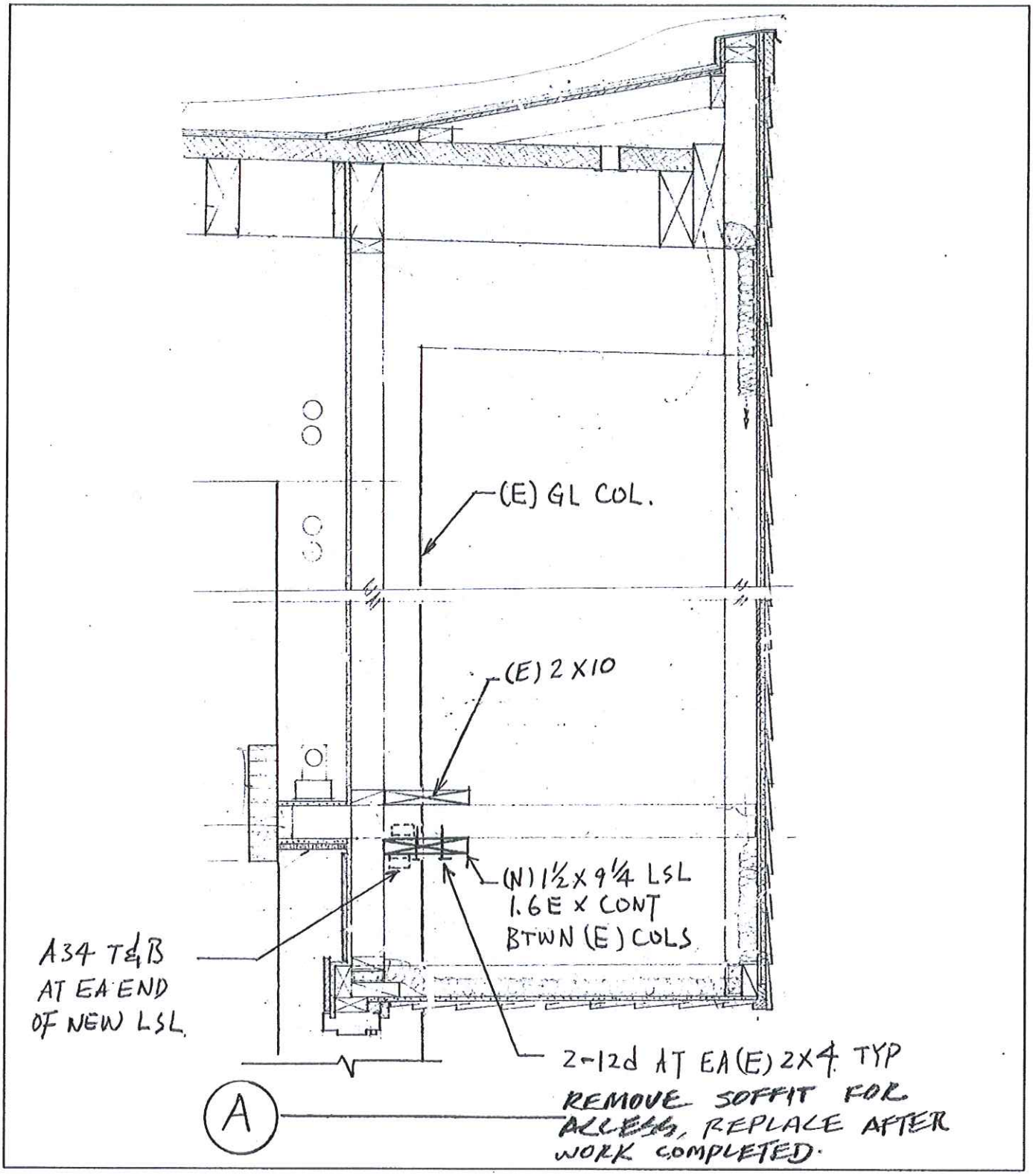
7. The new walls will be fastened to the new roof diaphragm and the main floor, and it will be sheathed with ½" plywood. The plywood will be designed to provide lateral support for wind and seismic loads.
8. The main floor may need some improvement for vertical loads that are required by the recent Building Code.
9. Main floor framing will require anchorage to the new foundation walls in the basement.
10. The new building code does not allow un-reinforced concrete foundation walls. In addition, the existing walls are cracked and lack adequate strength to support the building. These walls require repairs which will consist of installing minimum 6" shot-crete with reinforcing.
11. The foundation condition is not clear; we believe investigations will be required to verify whether footings exist and if they are adequate.

This is like building a structure inside the existing building to hold it together during an earthquake event.

Please do not hesitate to call if you have any questions or require further information.

Best Regards,

Manouch Yaganeh, P.E.
Associated Consultants, Inc
Consulting Structural Engineers



By: cmp

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	Location: Corbett, Oregon.	Date: 01-18-13
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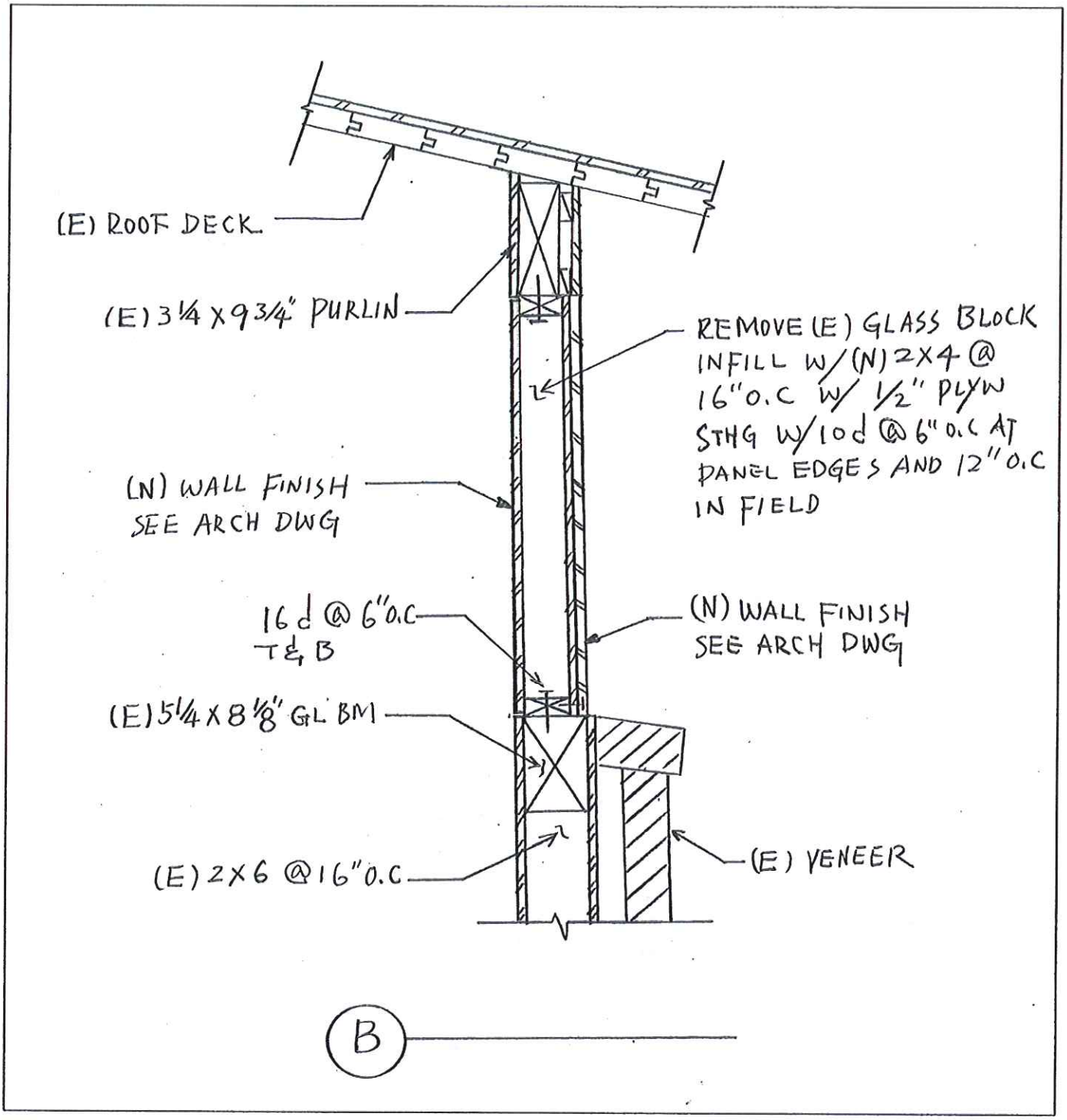

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