City of Aurora Public Works Department

ACKNOWLEDGEMENT OF SPECIAL INSPECTIONS

Building Division • 15151 E. Alameda Parkway, Ste 2400 • Aurora, CO 80012 • 303.739.7420
Email: permitcounter@auroragov.org

Project Address: 445 North Picadilly Rd.		
Project Title: The Reserves at Eagle Point		
Inspection Agency: TRIAX Engineering	Phone: 720-230-1931	Email: info@triaxgeo.com
Agency Contact Person: Chris Echols	Phone: 720-213-2064	Email: cechols@triaxgeo.com
Project Owner: OPG Eagle Point Partners, LLC	Phone: 973-914-4572	Email: rzent@overlandpg.com
Staff Person Reviewing Submittal		Date
Comments		

A pre-construction meeting is recommended for every project whose elements are subject to special inspections. This meeting can take place at any time either here within the City building or on the job site.
Check Required Special Inspections - Per International Building Code, Section 1704:

- ☐ Structural Steel (1705.2)
- ☒ Structural Concrete and Reinforcing Steel (1705.3)
- ☒ Anchor Bolts in Concrete (1705.3)
- ☐ Prestressed Concrete and PT tendons (1705.3)
- ☒ Post-installed Anchors in Concrete (1705.3)
- ☐ Shotcrete Concrete Placement (1705.3)
- ☐ Masonry (1705.4)
- ☒ Structural Wood (1705.5)
- ☒ Soils (1705.6)
- ☐ Driven Deep Foundations (1705.7)
- ☐ Cast-in-place Deep Foundations (1705.8)
- ☐ Helical Pile Foundations (1705.9)
- ☐ Sprayed Fire-Resistant Materials (1705.14)
- ☐ Mastic and Intumescent Coatings (1705.15)
- ☐ Exterior Insulation and Finish System (1705.16)
- ☐ Fire-resistant Penetrations and Joints (1705.17)
- ☐ Smoke Control (1705.18)
- ☐ Other inspections as required by the Design Professional or the Building Official (1705.1.1)

SPECIAL INSPECTIONS REQUIREMENTS - 2021 IBC 1704
Prior to the start of construction, the owner or owner's authorized agent shall employ one or more approved agencies to provide special inspections and tests during construction as required by the structural engineer in their statement of special inspections. The special inspector's qualifications and written reports shall be reviewed by the engineer of record and made available to the building inspector on the jobsite. The building division will only issue a certificate of occupancy after all special inspection reports, and the final special inspection report, have been submitted and accepted.

In accordance to Section 1704 of the International Building Code (IBC), the owner or the owner's authorized agent, other than the contractor, shall employ one or more approved agencies to provide special inspections and tests during construction on the types of work specified in section 1705 and identify the approved agencies to the building official.

A. Registered Design Professional Responsibilities

1. Prepare a Statement of Special Inspections in accordance with IBC section 1704.3.1. The statement of special inspections shall identify the materials, systems, components and work required to have special inspections or tests. Note whether the special inspections are continuous or periodic. May be provided on the structural drawings or in document form. NOTE: This form does not take the place of the required statement of special inspections.
2. Review the special inspection reports and provide corrective action for work that may not conform to the approved plans. Provide this information to the Building Division.

B. Contractor's Responsibilities

1. The approved plans shall be readily accessible at the job site.
2. The contractor shall provide reasonable access to all work requiring special inspection.
3. The contractor is also responsible for retaining at the job site all special inspection records submitted by the special inspector, and providing these records for review by the Building Division's inspector upon request.

C. Duties of the Special Inspector

1. Provide written documentation to the Building Division demonstrating the competence and relevant experience or training of the special inspectors who perform the special inspections and tests during construction. Discrepancies shall be brought to the immediate attention of the contractor for correction. If any item is not corrected the special inspector shall notify both the engineer of record and the Building Division.
2. A final report documenting required special inspections and tests, and correction of any discrepancies noted in the inspections or tests, shall be submitted to the Building Division prior to issuance of a certificate of occupancy.

D. Jurisdiction

1. The jurisdiction will review the implementation of Structural Tests and Special Inspection requirements.
2. The Building Division will only issue a Certificate of Occupancy after all special inspection reports and the final special inspection report, have been submitted and accepted.

ACKNOWLEDGMENTS

I have read and understand my responsibilities regarding special inspections.

Project Owner: ______________________ Date: 10/25/2023

Or

Owner's Authorized Agent: ______________________ Date: ______________________

Geotech

GEOTECHNICAL ENGINEERING REPORT

Proposed Eagle Ridge Mixed-Use Development
SWC of Stephen D. Hogan Parkway and Picadilly Road
Aurora, Colorado

Prepared for:
EVC-WDG Aurora, LLC
3501 SW Fairlawn Road, Suite 200
Topeka, Kansas 66614

Prepared by:
Cole Garner Geotechnical
CGG Project No.: 23.22.003

April 4, 2023

Approved For Two Years From This Date	
City Engineer	Date

Cole Garner Geotechnical
1070 W. 124th Ave, Ste. 300
Westminster, CO 80234
303.996.2999

April 4, 2023

EVC-WDG Aurora, LLC
3501 SW Fairlawn Road, Suite 200
Topeka, Kansas 66614

Attn: Mr. Kevin W. Beck, P.E.

Re: Geotechnical Engineering Report
Proposed Eagle Ridge Mixed-Use Development
SWC of Stephen D. Hogan Parkway and Picadilly Road
Aurora, Colorado
CGG Project No. 23.22.003

Cole Garner Geotechnical (CGG) has completed a geotechnical exploration for the proposed mixed-use development to be located at the southwest corner of the referenced intersection in Aurora, Colorado. This summary letter should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

- **Subsurface Conditions:** The near surface soils at the site consist of sandy lean clays, as well clayey to silty sands. In general, the clays extended to depths of about 4 to 13 feet below existing site grades, and were underlain by the sand soils, but in some borings, the soil types were interbedded. The sand soils extended the full depth of exploration in most of the borings. Sedimentary claystone bedrock was encountered in two of the borings (Boring Nos. M1 and M2, in the southern portion of the site) at a depth of about 23 feet below existing site grades. The bedrock (where encountered) extended to the maximum depth of exploration. Other specific information regarding the subsurface conditions is shown on the attached Boring Logs.

- **Demolition and Site Preparation:** Existing development on the parcel will be demolished and removed from the site as part of the new development. Demolition and removal of this development will likely expose or generate soft or loose soil conditions. Demolition should include removal of existing fills, foundations, underground utilities, and mitigation of any loose or otherwise unsuitable backfill materials. The existing soils should be suitable for reuse in new fills and backfill, provided debris, organics and other unsuitable materials are substantially removed. Some inert construction debris may be blended into the soils at the discretion of the geotechnical engineer.

- **Expansive Soils:** Variably expansive clay soils are present on the site. ***In our opinion, these materials have significant potential for volume change when subjected to post-construction wetting, causing movement and damage to structures, flatwork, pavements, et cetera.*** This report provides recommendations to help reduce the effects of soil expansion on the structures and reduce post-construction movement to levels that are typical in this geologic region. Eliminating the potential for movement is generally not considered economically feasible; however, recommendations in this report are intended to reduce the potential for extreme movements caused by expansive soils that experience moisture content variations within a normal range. ***Because many site conditions (floods, droughts, sub-freezing temperatures, etc.) cannot be controlled, larger movements should still be expected if expansive soils become very wet or very dry. It may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction.***

- **Structural Considerations:** ***It is our opinion that the expansive materials present at the site pose a moderate to high risk of movement of foundations; therefore, mitigation of the expansive materials will be required in order to utilize shallow foundations.*** After mitigation, the use of shallow foundations should be feasible (such as spread footings or post-tensioned slab-on-grade foundations commonly used for multi-family residential construction).

  On this site, we recommend that mitigation include removal, moisture conditioning, and recompaction of the expansive materials to create a zone of low expansive engineered fill below each structure. Subexcavation should extend beneath each structure down to the underlying silty sand soils and 5 feet beyond the outer foundation edges. ***The actual depth of subexcavation will vary according to the planned site grading (earthen cut and fill depths).*** In general, mitigation will need to extend to depths on the order of 5 to 10 feet below existing site grades for most buildings. In addition, we recommend that the thickness of fill supporting each building be relatively uniform. This type of mitigation is common in the region and will reduce, but not eliminate, the potential for movement. Details are provided in the report.

- **Surface Drainage:** The amount of movement associated with foundations, floor slabs, exterior flatwork, etc. will be related to the wetting of underlying supporting soils. Therefore, it is imperative the recommendations outlined in the “Grading and Drainage” section of this report be followed to reduce potential movement.

- **Future Geotechnical Studies:** This report contains design-level recommendations for the proposed multi-family residential development to be constructed at the southeast portion of the site, as well as, for site infrastructure and pavements. Supplemental design-level geotechnical exploration, with additional structure-specific borings will be required at the remaining commercial building pad locations in order to develop design-level recommendations for structures.

We appreciate being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. Please do not hesitate to contact us if you have any questions concerning this report or any of our testing, inspection, design and consulting services.

Sincerely,
Cole Garner Geotechnical

COLORADO LICENSED GLENN D. OHLSEN 41250 4/4/2023 PROFESSIONAL ENGINEER

Glenn D. Ohlsen, P.E.
Project Engineer

Andrew J. Garner, P.E.
Principal, COO

Copies to: Addressee (1 PDF copy)

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Cole Garner Geotechnical
1070 W. 124th Ave, Ste. 300
Westminster, CO 80234
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GEOTECHNICAL ENGINEERING REPORT

PROPOSED EAGLE RIDGE MIXED-USE DEVELOPMENT
SWC of STEPHEN D. HOGAN PARKWAY and PICADILLY ROAD
AURORA, COLORADO

CGG Project No. 23.22.003
April 4, 2023

INTRODUCTION

This report contains the results of our geotechnical engineering exploration for the proposed mixed-use development to be constructed at the southwest corner of the referenced intersection in Aurora, Colorado. These services were performed in general accordance with our proposal (CGG No. P22.22.258) executed January 6, 2023.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Geologic conditions
- Subsurface soil and bedrock conditions
- Groundwater conditions
- Foundation design and construction
- Lateral earth pressures
- Floor slab design and construction
- Below-grade construction
- Pavement thickness design and construction
- Swimming pool design and construction
- Retaining walls
- Earthwork
- Drainage

The recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, our experience with similar soil conditions and structures, and our understanding of the proposed project.

PROJECT INFORMATION

We understand that this phase of the project will include development of approximately 18 acres of currently vacant property located at the southwest corner of the subject intersection in Aurora, Colorado. Development will include site grading, underground utility installation, and the construction of paved private drives and fire lanes to support the development. As currently planned, approximately the southern 8 acres will be developed for multifamily residential use while the northern portion of the site will include various retail and restaurant uses. We assume that the residential buildings will include three to four-stories of wood framing supported on at-grade foundations, such as a post-tensioned slab-on-grade foundation (PT slabs). A leasing and clubhouse building, along with an outdoor swimming pool, is also assumed.

We have no information regarding proposed grading; however, we anticipate that site grading may include maximum earthen cuts and fills of about 3 to 5 feet or more based on current site topography. ***We should be provided with the site development and grading plans (as soon as available) for our review, so that we can supplement/modify our geotechnical recommendations, as needed.***

If our understanding of the project, or assumptions above, is not accurate, or if you have additional useful information, please inform us as soon as possible.

SITE EXPLORATION PROCEDURES

The scope of the services performed for this project included site reconnaissance by a field technician, a subsurface exploration program, laboratory testing and engineering analysis.

Field Exploration: As requested by the client, we investigated the subsurface conditions on the site with a total of eighteen test borings. Of this total, ten borings (Boring Nos. M1 through M10) were located within the portion of the site planned for multi-family residential development. These borings were typically advanced to depths of about 25 to 35 feet below existing site grade, with Boring No. M10 was drilled to a depth of about 10 feet below existing site grade in the location of planned stormwater detention. Borings designated as C1 through C8 were drilled to a depth of about 15 feet below existing site grade within planned private roadways associated with the commercial/retail portion of the site. Borings were located in the field utilizing hand-held GPS units and existing site features as a reference. Ground surface elevations at each boring location (as shown on the Boring Logs) were roughly approximated by interpolation from contours indicated on the site plan and may vary given field conditions and locating methods. ***The accuracy of boring locations and elevations should only be assumed to the level implied by the methods used.*** Refer to Figure 1 – Boring Location Diagram in Appendix A for the approximate boring locations.

Borings were advanced with an ATV-mounted drilling rig utilizing 4-inch diameter, solid stem auger. Borings for the residential development were advanced to depths of about 25 to 35 feet below existing site grades, while borings for the retail/commercial roadway and utility areas were advanced to a depth of about 15 feet below existing site grades.

A lithologic log of each boring was recorded by our field personnel during the drilling operations. At selected intervals, samples of the subsurface materials were obtained by driving modified California barrel samplers. Penetration resistance measurements were obtained by driving the sample barrel into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index to the consistency, relative density or hardness of the materials encountered.

Groundwater measurements were performed in each boring at the time of site exploration and again about five weeks later. Borings were backfilled with the spoils immediately following the subsequent groundwater measurements.

Field infiltration testing (cased borehole) was performed Boring No. M10 (Infiltration Test No. IF1) at an approximate depth of 10 feet below existing site grades. Results of those tests are presented in Appendix B. Infiltration testing was performed in general accordance with local Standards.

Laboratory Testing: Samples retrieved during the field exploration were returned to the laboratory for observation by the project geotechnical engineer, and were visually-manually classified in general accordance with the Unified Soil Classification System described in Appendix C. Bedrock is described according to the notes on Bedrock Classification. At that time, an applicable laboratory-testing program was formulated to determine engineering properties of the subsurface materials. Following the completion of the laboratory testing, the field descriptions were confirmed or modified as necessary, and Boring Logs were prepared. These logs are presented in Appendix A.

Laboratory test results are presented in Appendix B. These results were used for the geotechnical engineering analyses and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable local or other accepted standards.

Selected soil and bedrock samples were tested for the following engineering properties:

- Water content
- Dry density
- Swell/Consolidation potential
- Grain size
- Plasticity Index
- Water-soluble sulfates

SITE CONDITIONS

The project site is comprised of approximately 53.62 acres of mostly undeveloped land located at the southwest corner of the intersection of Stephen D. Hogan Parkway and Picadilly Road in Aurora, Colorado, as shown on the attached Boring Location Diagram in Appendix A. The site is bound by Stephen D. Hogan Parkway to the north, Picadilly Road to the east, and the Coal Creek drainageway to the south and west. Existing development on the northeastern portion of the site included a residential structure and multiple outbuildings. A graded stormwater detention area (approximately 150 feet by 100 feet in plan area) was present in the approximate central site extents. At the time of our exploration, the site was covered with a low to high growth of grass and weeds. Some trees and bushes were present surrounding the existing home, as well as in the southwest portion of the site. Based on review of the site ALTA, site topography is variable, with greater slopes generally present on the northern half of the site, as shown on the attached Boring Location Diagram. The site has a general downward slope to the south and west, with an approximate elevation drop of about 20 feet, or more, across the site.

SUBSURFACE CONDITIONS

Geology: Surficial geologic conditions at the site, as mapped by the U.S. Geological Survey (USGS) ([1]Trimble and Machette, 1979), consist of Eolian (Windblown) Sand of Holocene and Pleistocene Age. These materials are reported to include "fine to medium sand". Soils in closer proximity to Coal Creek to the south of the site consist of Piney Creek Alluvium of Upper Holocene Age. These materials are reported to include gravel, sand, silt, and clay.

Bedrock mapped in the area consists of the Denver Formation of Paleocene and Upper Cretaceous Age. This formation has been reported to include interbedded claystone, siltstone, sandstone, and conglomerate.

Mapping completed by the Colorado Geological Survey ([2]Hart, 1972) indicates the site is located in areas of "Windblown Sand or Silt" and "Low Swell Potential." These categories generally include non- to low expansive (swelling) soils; however, soils with higher expansive potential may also be locally present.

No other geologic hazards were identified. Seismic activity in the region is anticipated to be low. With proper site grading around proposed structures, erosional problems at the site should be reduced.

Soil and Bedrock Conditions: The near surface soils at the site consist of sandy lean clays, as well clayey to silty sands. In general, the clays extended to depths of about 4 to 13 feet below existing site grades, and were underlain by the sand soils, but in some borings, the soil types were interbedded. The sand soils extended the full depth of exploration in most of the borings. Sedimentary claystone bedrock was encountered in two of the borings (Boring Nos. M1 and M2, in the southern portion of the site) at a

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[1] Trimble, D.E., and Machette, M.N., 1979, ***Geologic Map of the Greater Denver Area, Front Range Urban Corridor, Colorado.*** USGS Map I-856-H.

[2] Hart, Stephen S., 1972, ***Potentially Swelling Soil and Rock in the Front Range Urban Corridor, Colorado***, Colorado Geological Survey, Sheet 2 of 4.

depth of about 23 feet below existing site grades. The bedrock (where encountered) extended to the maximum depth of exploration. Other specific information regarding the subsurface conditions is shown on the attached Boring Logs.

Field and Laboratory Test Results: Field test results indicate that the clay soils vary from stiff to hard in consistency, while the sand soils vary from loose to very dense in relative density. The bedrock ranges from medium hard to very hard in hardness based on penetration resistance.

The clayey soils are of moderate plasticity and select samples exhibited **low to moderate expansive potential** at existing moisture contents. The silty sand soils are considered non-plastic and non-expansive. The claystone bedrock is considered moderately plastic and moderately to highly expansive; however, we believe is present at depths that will not adversely affect the planned development. Testing of select samples for the presence of water-soluble sulfates indicated concentrations generally ranging from nil to 2,100 parts per million (ppm).

Groundwater Conditions: Groundwater was encountered in each of our deeper "M" borings and in two of the "C" borings during drilling at depths ranging from about 12 to 27 feet below existing site grades. When checked again five weeks later, groundwater was measured in all of the "M" borings at depths ranging from about 11 to 22 feet below existing site grades.

Based upon review of U.S. Geological Survey Maps ([3]Hillier, et al, 1983), regional groundwater beneath the project area predominates in unconsolidated alluvial deposits at depths generally ranging from about 10 to 20 feet, or more, below the ground surface.

The depth to water is dependent upon several factors including hydrologic conditions, type of site development, irrigation demands on or adjacent to the site, fluctuations in water features, seasonal and weather conditions.

ENGINEERING RECOMMENDATIONS

Geotechnical Considerations: Based on the information obtained from our subsurface exploration, laboratory testing, and a cursory review of geologic conditions, it is our opinion that the site appears suitable for development of the proposed project provided the recommendations in this report are followed. The following primary geotechnical considerations were identified:

- **Demolition and Site Preparation:** Existing development on the parcel will be demolished and removed from the site as part of the new development. Demolition and removal of this development will likely expose or generate soft or loose soil conditions. Demolition should include

[3] Hillier, Donald E.; Schneider, Paul A., Jr.; and Hutchinson, E. Carter, 1983, ***Depth to Water Table (1976-1977) in the Greater Denver Area, Front Range Urban Corridor, Colorado***, United States Geological Survey, Map I-856-K.

removal of existing fills, foundations, underground utilities, and mitigation of any loose or otherwise unsuitable backfill materials. The existing soils should be suitable for reuse in new fills and backfill, provided debris, organics and other unsuitable materials are substantially removed. Some inert construction debris may be blended into the soils at the discretion of the geotechnical engineer.

- **Expansive Soils:** Variably expansive clay soils are present on the site. ***In our opinion, these materials have significant potential for volume change when subjected to post-construction wetting, causing movement and damage to structures, flatwork, pavements, et cetera.*** This report provides recommendations to help reduce the effects of soil expansion on the structures and reduce post-construction movement to levels that are typical in this geologic region. Eliminating the potential for movement is generally not considered economically feasible; however, recommendations in this report are intended to reduce the potential for extreme movements caused by expansive soils that experience moisture content variations within a normal range. ***Because many site conditions (floods, droughts, sub-freezing temperatures, etc.) cannot be controlled, larger movements should still be expected if expansive soils become very wet or very dry. It may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction.***

- **Structural Considerations:** ***It is our opinion that the expansive materials present at the site pose a moderate to high risk of movement of foundations; therefore, mitigation of the expansive materials will be required in order to utilize shallow foundations.*** After mitigation, the use of shallow foundations should be feasible (such as spread footings or post-tensioned slab-on-grade foundations commonly used for multi-family residential construction).

  On this site, we recommend that mitigation include removal, moisture conditioning, and recompaction of the expansive materials to create a zone of low expansive engineered fill below each structure. Subexcavation should extend beneath each structure down to the underlying silty sand soils and 5 feet beyond the outer foundation edges. The actual depth of subexcavation will vary according to the planned site grading (earthen cut and fill depths). In general, mitigation will need to extend to depths on the order of 5 to 10 feet below existing site grades for most buildings. In addition, we recommend that the thickness of fill supporting each building be relatively uniform. This type of mitigation is common in the region and will reduce, but not eliminate, the potential for movement. Details are provided in the report.

- **Surface Drainage:** The amount of movement associated with foundations, floor slabs, exterior flatwork, etc. will be related to the wetting of underlying supporting soils. Therefore, it is imperative the recommendations outlined in the "Grading and Drainage" section of this report be followed to reduce potential movement.

- **Future Geotechnical Studies:** This report contains design-level recommendations for the proposed multi-family residential development to be constructed at the southeast portion of the site, as well as, for site infrastructure and pavements. Supplemental design-level geotechnical exploration, with additional structure-specific borings will be required at the remaining commercial building pad locations in order to develop design-level recommendations for structures.

Design and construction recommendations for the foundation system and other earth-connected phases of the project are outlined below.

Site Preparation and Earthwork:

- **General Considerations:** The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth-supported elements including foundations, slabs and pavements are contingent upon following the recommendations outlined in this section.

  Earthwork on the project should be observed and evaluated by the Geotechnical Engineer. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

- **Demolition and Site Preparation:** Strip and remove existing vegetation and any other deleterious materials from proposed construction areas. Stripped materials consisting of vegetation and organic materials should be wasted from the site or used to revegetate landscaped areas or exposed slopes after completion of grading operations.

  Demolition of the existing development (i.e. existing foundations and floor slabs, underground utilities, and pavements) should include complete removal of all foundation elements within the proposed construction area. Demolition should also include removal of any loose backfill found adjacent to or below existing foundations or associated with underground utilities. All non-inert materials derived from the demolition of existing structures should be removed from the site and should not be allowed for use in any on-site fills without approval of the engineer. ***In general, where any loose soils are generated from demolition and removal of any portion of the existing development, or where any unsuitable existing fill soils are present, they can generally be mitigated by removal and recompaction or in-place densification below new foundations, floor slabs, pavements and other critical elements.***

  The on-site soils are considered to be relatively stable based on the conditions at the time of our exploration, but stability may be affected by precipitation, repetitive construction traffic, or other factors. Where unstable conditions, if any, are encountered or develop during construction, workability may be improved by scarifying and aeration during warmer periods. In some areas, removal and recompaction (or replacement with other on-site soils) may be suitable to build a stable base for placement of new fills.

In areas where subgrade soils are very soft/yielding (if any), gravel augmentation (mechanically compacting/kneading crushed rock into the subgrade soils) may be cost-effective. In our experience, crushed rock or recycled concrete materials on the order of 3 to 6 inches in size would be effective in most situations. As an alternative, chemical treatment by blending fly ash, lime or Portland cement into the subgrade could also be considered. Inert construction debris such as concrete and flatwork produced by demolition of the existing development may be crushed and re-used on-site for mitigation of soft conditions. ***The actual mitigation methods used should be based on observation of exposed conditions by the geotechnical engineer.***

- **Expansive Soil Mitigation:** ***Variably expansive clay soils are present on the site and will require special attention in the design and construction of the project.*** The most common method of swell mitigation to allow for shallow foundations involves subexcavation of expansive soils to create a zone of low-expansive engineered fill beneath each building. This subexcavation process as performed in the Denver metro area, typically reduces the risk of foundation movements to tolerable levels.

  The thickness of the near surface clay layer varies across the site; therefore, the depth of mitigation will vary according to earthen cut and fill depths required for development. Mitigation of the clay soils (lean clays and clayey sands) should include subexcavation of the clay soils down to the underlying silty sand soils. Additionally, subexcavation should be performed to a relatively uniform thickness below each building. In general, we estimate that the depth of excavation will vary from about 5 to 10 feet depending on site grading. Mitigation should also extend at least 5 feet beyond the footprint of each new building. Once grading plans are available, we are prepared to review these recommendations in light of planned earthen cut and fill depths.

  We are not aware of a cost-effective method to eliminate damage to pavements and flatwork due to expansive soils or frost heave. For pavement and critical exterior flatwork areas, we recommend the owner consider subexcavation and recompaction to a minimum depth of 3 feet below subgrade elevation. We believe this process will help reduce differential movement. Mitigation to this depth can also be considered below site retaining walls, trash enclosure foundations, and other ancillary structures where more movement can typically be tolerated. New fill used to raise site grades can be considered part of this zone.

  In our experience, it is common for developers to forego the costs associated with this type of mitigation below privately owned/maintained pavements (or reduce the depth of subexcavation), and instead use those funds to perform pavement maintenance in areas where excessive distress occurs. ***However, we believe that at least moderate damage could occur where pavement subgrade becomes substantially wetted after construction is complete (where subexcavation is not completed).*** Additionally, even if these recommendations are followed, some pavement distress (such as longitudinal "edge" cracking, etc.) should be anticipated. ***Since pavements associated with the project are privately maintained, the owner may choose to only perform typical subgrade preparation.***

The onsite soils are suitable for reuse as engineered fill. Earthwork will require special methods to confirm that clay soils are well processed and blended. The contractor should plan on using discs to break down these materials to get them moisture conditioned and processed to produce a uniform fill zone. In order to confirm that the process is properly completed, we recommend surveying of the base of the subexcavation to confirm both vertical and lateral extents prior to backfill. In addition, observation and testing should be performed by a representative of the geotechnical engineer on an essentially full-time basis.

Foundation movement will be directly related to the depth and extents of subsurface wetting beneath foundations. We have provided recommendations to help limit wetting due to storm runoff and irrigation and these measures should be maintained throughout the life of the project. Failure to maintain proper surface drainage surrounding the buildings may result in movement and distress in excess of our estimates.

- **Subgrade Preparation:** All subgrade soils at the base of new fill, slab-on-grade floors, exterior PCC flatwork, and pavements should be scarified to a minimum depth of 12 inches, moisture conditioned and compacted as discussed below just prior to construction of these elements.

- **Excavation and Trench Construction:** It is anticipated that excavations for the proposed construction can be accomplished with conventional heavy-duty earthmoving equipment. Excavations into the clays may stand on relatively steep temporary slopes; however, ***<u>caving sand soils</u>*** are also present at the site. If excavations approach property lines, public right-of-way, or adjacent facilities the contractor should assess the potential need to shore the sides of excavations.

  All excavations must be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards. The individual contractor(s) is responsible for designing and constructing stable and dry, temporary excavations, as required, maintaining stability of both the excavation sides and bottom.

  We expect that groundwater may affect earthwork activities below about 10 feet (or more below existing site grades) and, where encountered, will require temporary dewatering during excavation and backfilling operations. Pumping from low points or sumps may be utilized to

control water within the excavations. Discharge of this water may be subject to regulations of the City of Aurora and/or the State of Colorado.

The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

As a safety measure, it is recommended that all vehicles and soil piles be kept to a minimum lateral distance from the crest of the slope equal to no less than the slope height. The exposed slope face should be protected against the elements.

- **Fill Materials:** Clean on-site soils or approved imported materials may be used as fill material. We should be contacted to evaluate samples of any proposed fill materials prior to importation. Imported soils (if required) should conform to the following:

Gradation	**Percent finer by weight (ASTM C136)**
6"	100
3"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	70 maximum

- Liquid Limit .... 40 (max)
- Plasticity Index .... 20 (max)
- Maximum expansive potential (%)* 0.5

*Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density near optimum water content. The sample is confined under a 500 psf surcharge and submerged.

- **Fill Placement and Compaction:** Engineered fill for site development and grading should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift as recommended in the table below:

Item	Description
Fill Materials	On-site soils (3 to 4 inch fragments max) Imported fill, if required, should meet the specifications above
Fill Lift Thickness	8 to 12 inches or less in loose thickness
Compaction Requirements	Clayey soils: 95% of standard Proctor dry density (ASTM D698) Imported granular soils: 95% of modified Proctor dry density (ASTM D1557)
Moisture Content	Clayey soils: +1% to +4% above optimum moisture content Imported granular soils: -2% below to +2% above of optimum Pavement Subgrade: Optimum to +2% above optimum in pavement areas

Earthwork contractors should use equipment and methods that ensure relatively uniform distribution of added moisture and adequate compaction throughout each lift. ***We recommend engineered fill be tested for moisture content and compaction during placement on a full-time basis during any mass grading and/or sub-excavation work to confirm that earthwork is being performed according to our recommendations and project specifications. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.*** Fill should not be allowed to dry significantly prior to construction. Areas allowed to dry may require additional preparation prior to construction of roadways, flatwork, foundations, et cetera.

Foundation Design and Construction: We understand the client desires the use of post-tensioned slab foundations for the project. Based on the subsurface conditions encountered on the site, we believe that the use of shallow foundations (i.e. spread footings and/or post-tensioned slabs) can be utilized for support of the proposed structures. Provided that the expansive materials are removed, moisture conditioned, and recompacted as described above, we estimate that shallow foundations will provide acceptable support for the structure(s). ***If movement must be further limited, we should be contacted to provide for deep foundation recommendations.***

We believe that post-tensioned slab-on-grade foundations are appropriate for support of residential buildings, in order to limit interior cosmetic distress in finished living spaces. The use of spread footing foundations, shallow drilled foundations, or mat foundations may also be considered for other structures such as trash enclosures, mail kiosks, monument signage, and other ancillary structures.

Additionally, the use of post-tensioned slabs is feasible for support of the residential buildings provided the buildings bear on the recommended zone of newly-placed engineered fill, the owner can tolerate typical movements, and:

- the post-tensioned slabs foundation are properly designed and constructed (with special consideration for the rigidity of the foundation at step-downs),
- approved materials supporting the foundation are properly placed and compacted,
- proper surface drainage is maintained throughout the life of the structures, and
- prudent landscaping measures are used.

Based on our experience with post-tensioned slab foundations in this geologic region, foundation movements could result in periodic, and possibly seasonal, cosmetic distress to drywall, window frames, door fames and other features. We would anticipate that the frequency of distress and amount of movement would generally diminish with time provided proper drainage is established and maintained. If the amount of movement and potential distress discussed cannot be tolerated, the use of deep foundations and structural floor systems should be considered.

Shallow foundations and post-tensioned slabs may be designed using criteria outlined below:

SHALLOW FOUNDATION DESIGN CRITERIA (MULTI-FAMILY RESIDENTIAL DEVELOPMENT)

Criteria	Design Values
Bearing Strata	Moisture-treated and recompacted on-site soils, as discussed above
Maximum net allowable bearing pressure[1]	2,500 psf
Minimum dead-load (for footings only)[2]	800 psf or as high as practical
Void thickness (if needed to increase dead-load)	4 inches
Modulus of Subgrade Reaction, k	50 pci
Estimated Total Foundation Movement	1 inch
Estimated Differential Foundation Movement	½ to ¾ of total
Min. depth below grade, exterior edge beam[3]	36 inches
Min. depth below grade, interior grade beams[3]	12 inches
POST-TENSIONED SLAB-ON-GRADE FOUNDATIONS	
Edge moisture variation distance[4], e_m	• 9.0 feet Center (shrink) • 4.7 feet Edge (swell)
Differential Soil Movement[4], y_m	• -0.70 inch Center (shrink) • +0.40 inch Edge (swell)
Slab subgrade friction coefficient	2.00 for on-site soils

1. The design bearing pressure above applies to dead loads plus one-half of design live load conditions. The design bearing pressure may be increased by 1/3 when considering total loads that include wind or seismic conditions.
2. In order to maintain the minimum dead load pressure, it may be necessary to design and construct a system of grade beams and isolated footing pads using void space beneath the grade beams between footing pads (if utilized).

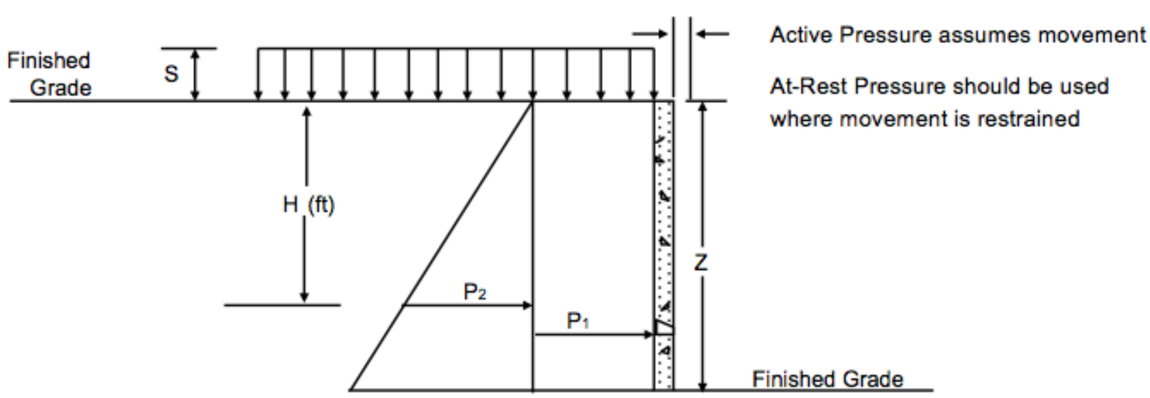
3. Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.
4. Post-Tensioning Institute, (2004, Third Edition), ***Design of Post-Tensioned Slabs-on-Ground.*** It should be noted that y_m is the estimated vertical movement at the edges of a uniformly loaded slab. These are theoretical values that are used in the design of post-tensioned slabs-on-grade and do not represent the movements that would be expected from the actual loading conditions. As previously discussed, the use of post-tensioned slabs assumes that some movement is considered acceptable.

The movement estimates above are contingent upon providing and maintaining good surface drainage away from structures for the life of the project. Excessive foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage should be provided in the final design and during construction. Failure to maintain proper surface drainage could result in soil-related foundation movement exceeding the above estimation.

Foundation excavations and subexcavation operations should be observed by the geotechnical engineer during construction. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations may be required.

Seismic Considerations: Based on the soil and bedrock conditions encountered in the test holes drilled on the site, we estimate that a Site Class D is appropriate for the site according to the 2018 International Building Code (Section 1613 referencing ASCE 7, Chapter 20). This parameter was estimated based on extrapolation of data beyond the deepest depth explored, using methods allowed by the code. Actual shear wave velocity testing/analysis and/or exploration to 100 feet was not performed.

Lateral Earth Pressures: Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction, wetting of backfill materials, and/or compaction and the strength of the materials being restrained. Loads that should be considered by the structural engineer on walls are shown below.



Active earth pressure is commonly used for design of freestanding cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall rotation. Walls with unbalanced backfill levels on opposite sides (i.e. basement, crawlspace, or site retaining walls) should be designed for earth pressures at least equal to those indicated in the following table. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.

EARTH PRESSURE COEFFICIENTS

Earth pressure conditions	Coefficient for backfill type	Equivalent Fluid Pressure, pcf	Surcharge Pressure P_1, psf	Earth Pressure P_2, psf
Active (Ka)	On-site clay soils - 0.38	45	(0.38)S	(45)H
At-Rest (Ko)	On-site clay soils - 0.54	65	(0.54)S	(65)H
Passive (Kp)	On-site clay soils – 2.1	250	---	---

Conditions applicable to the above conditions include:

- for active earth pressure, wall must rotate about base, with top lateral movements 0.01 Z to 0.02 Z, where Z is wall height
- for passive earth pressure, wall must move horizontally to mobilize resistance
- uniform surcharge, where S is surcharge pressure
- in-situ soil backfill weight a maximum of 120 pcf
- horizontal backfill, compacted to at least 95 percent of standard Proctor maximum dry density
- loading from heavy compaction equipment not included
- no groundwater acting on wall
- no safety factor included
- ignore passive pressure in frost zone

Backfill placed against structures may consist of the on-site soils processed with maximum particle sizes on the order of 4 to 6 inches. To calculate the resistance to sliding, a value of 0.35 may be used as the coefficient of friction between the footing and the underlying soil.

If the project contains any walls that will retain unbalanced soil loads (i.e. basement, crawlspace, or site retaining walls), we recommend installation of a drainage system at the base of the retained soil mass to control the water level behind the wall. If this is not possible, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively. These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

Below-Grade Construction: We understand that the buildings will not include any interior, below-grade spaces. We should be contacted if basement or crawlspace construction (or other below-grade building feature) is planned, in order to provide additional recommendations regarding subsurface drainage systems.

Interior (Non-Structural) Floor Slab Recommendations: We understand that post-tensioned slab-on-grade foundations are desired for the project. Recommendations below apply only to non-reinforced or lightly-reinforced floor slabs, if any, that will be included in the development (not applicable to slab-on-grade foundations). ***Conventional, lightly-reinforced slab-on-grade construction is acceptable on the site, provided mitigation of the expansive soils is performed below the entire building footprint (as outlined above) and the owner can tolerate movement of these slabs. We estimate that floor slab movement will be limited to about 1 to 2 inches when bearing on the recommended zone of newly-placed engineered fill.***

The movement estimates outlined above assume that the other recommendations in this report are followed. ***As discussed, additional movement could occur should the subsurface soils become wetted to significant depths, which could result in potential excessive movement causing uneven floor slabs and severe cracking.*** We typically recommend minimal landscaping be installed and downspouts be hard-piped to storm sewer systems as described in subsequent sections of this report.

Slabs-on-grade constructed on expansive soils, whether in their natural state or moisture-conditioned and recompacted to a certain depth will move. The following additional recommendations are typically provided for conventional slab-on-grade floors:

- Moisture condition and recompact the upper 12 inches of the slab subgrade soils just prior to concrete placement

- Positive separations and/or isolation joints should be provided between slabs and all foundations, columns or utility lines to allow independent movement.

- Control joints should be provided in slabs to control the location and extent of cracking.

- A minimum 2-inch void space should be constructed below non-bearing partition walls placed on the floor slab. This typically involves suspending drywall 3 to 4 inches above the slab and utilizing a “bottom plate” in the framing to which baseboards can be connected (no connection from baseboards to drywall). Corner beads and other elements must also be isolated from the slab.

- Doorjambs and frames within partition walls should be trimmed to allow for floor slab movement and avoid potential distortion (we understand that about ½-inch is typical).

- The thickness of the partition void and gap at the base of door frames should be checked periodically and adjusted as needed to maintain a void space and avoid transferring slab movement to upper level framing.

- Interior trench backfill placed beneath slabs should be compacted in accordance with recommended specifications outlined below.

- The use of a vapor retarder/barrier should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder/barrier, the slab designer and slab contractor should refer to ACI 302 for procedures and cautions regarding the use and placement of a vapor retarder/barrier.

- Floor slabs should not be constructed on frozen subgrade.

- Other design and construction considerations, as outlined in Section 302.1R of the *ACI Design Manual*, are recommended.

Site Retaining Walls: We assume that site retaining walls will be required for portions of the site. While structural concrete or CMU walls may be utilized, we assume site walls may also include modular block faced (or faux stone-faced) walls using a geogrid-reinforced backfill system (also known as mechanically-stabilized earth (MSE) retaining walls). Structural walls should be designed using the recommendations outlined in the "Lateral Earth Pressures" section of this report.

MSE walls are typically subcontracted as design-build structures using estimated soil strength parameters, since design details are often manufacturer specific. MSE walls, even shorter walls in a tiered configuration, typically require Geogrid reinforcement behind walls for internal and external stability. Often geogrid lengths need to extend 70 to 100 percent of the wall height. In a tiered configuration, the geogrid lengths may approach the overall slope height.

MSE walls are flexible and are commonly subject to both vertical and lateral movement that may cause visible cosmetic damage while not necessarily experiencing structural "failure". To limit the potential for excessive movement, the use of imported structural fill (CDOT Class 1) is recommended in the reinforced zone behind MSE walls. We understand that this can add substantial cost to the project, however, we believe it significantly reduces the risk of excessive wall movement.

For MSE walls, internal stability analyses should conform to the latest design methodology accepted for use by either the Federal Highway Administration (FHWA), AASHTO or the National Concrete Masonry Association (NCMA). Since these analysis procedures are based on the use of drained strength parameters, the backfill used for the geogrid reinforced backfill section should be a drainable, granular material to conform with the assumptions of the analysis. ***The on-site clays are not considered drainable and should not be allowed in the geogrid reinforced backfill zone unless provisions are made to provide backslope and surface drainage that would prevent water from entering the backfill.*** The designer should state in the construction specifications the backfill material description and design strength parameters so that unsuitable materials are not allowed in the backfill zone during construction.

Global stability of systems of retaining walls should be analyzed by the design engineer using the long-term drained strength parameters; this is particularly important for walls retaining sloped backfill, with slopes at the toe of the wall, or walls in tied configurations. We are available to provide guidance on subsurface profiles and conditions affecting the analyses upon request. Parameters used in the analysis should not exceed the values summarized in the following table for the native and fill materials encountered or placed on site for the project. These parameters are based on laboratory testing performed as part of this study and/or our past experience with similar materials. ***These values should be confirmed by the Geotechnical Engineer based on site observations and/or additional design-level testing.*** The wall contractor/designer should be required to provide the global stability analyses based on the planned final cross sections, including the building loads, and the topography above and below the wall, using the generalized subsurface stratigraphy discussed in this report. CGG should be provided the opportunity to review and comment on the wall system design and analysis prior to construction. Testing and monitoring during construction by qualified geotechnical personnel is recommended.

RECOMMENDED MSE WALL DESIGN and GLOBAL STABILITY PARAMETERS

Material Type	Total Unit weight, γ (pcf)	Cohesion, c' (psf)	Angle of internal friction, ϕ (degrees)
Foundation and Retained Soils	120	250	24
Reinforced Backfill* CDOT Class 1	130	0	32

* We recommend the use of CDOT Class 1 structural fill or crushed stone in the reinforced zone. Actual values should be determined for the materials used.

Retaining Wall Drainage Systems: To reduce hydrostatic loading on retaining walls, subsurface drain systems should be placed behind the base of each wall. Drain systems should consist of free-draining, granular soils containing less than 5 percent fines (by weight) passing a No. 200 sieve placed adjacent to the wall. The free-draining, granular material should be graded to prevent the intrusion of fines or encapsulated in a suitable filter fabric. Where used, drain lines should be embedded in a uniformly graded, filter material and provided with adequate clean-outs for periodic maintenance. An impervious soil should be used in the upper layer of backfill to reduce the potential for water infiltration. As an alternative, a prefabricated drainage structure such as geocomposite may be used as a substitute for the granular backfill adjacent to walls.

Pavement Thickness Design and Construction: The design of pavements for the project is based on the City of Aurora's "Roadway Design & Construction Specifications" (Standards) dated October 2016. These standards are based on methods outlined in the 1993 *Guideline for Design of Pavement Structures* by the American Association of State Highway and Transportation Officials (AASHTO), the Metropolitan

Government Pavement Engineers Council's (MGPEC) *Pavement Design Standards and Construction Specifications of Pavement Structures,* and the Colorado Department of Transportation (CDOT) *Pavement Design Manual* (2014). The referenced design methods are based on the subgrade soil support properties and anticipated traffic values.

- **Expansive Soil Mitigation:** As discussed, variably expansive materials were encountered in our borings. Without mitigation, expansive materials are capable of causing distress to pavements and associated flatwork. ***In order to help reduce the potential for movement and distress related to expansive soil conditions, CDOT design standards indicate that pavements should bear on 3 feet of moisture conditioned and recompacted fill soils.*** A combination of subexcavation and/or site grading fill will be needed in order to provide for this zone of fill. For most sites with expansive materials, this will generally provide adequate reduction in surface deflection for these low speed areas. However, even if these recommendations are followed, some pavement distress (such as longitudinal "edge" cracking, etc.) should be anticipated.

  In our experience, it is common for project owners to forego the costs associated with this type of mitigation below privately owned/maintained pavements (or reduce the depth of subexcavation), and instead use those funds to perform pavement maintenance in areas where excessive distress occurs. We believe that at least moderate damage could occur where pavement subgrade becomes substantially wetted after construction is complete. Since pavements associated with the project are privately maintained, the owner may choose to only perform typical subgrade preparation.

- **Subgrade Soil for Pavement Support:** The near surface soils at the site predominantly consist of sandy lean clays and clayey to silty sands. The sandy lean clay soils at proposed pavement subgrade generally classify as AASHTO Type A-6 soils (City of Aurora Soil Group "D") and are considered to generally provide poor pavement support, while the silty sand soils classify as AASHTO Type A-1-b and A-2-4 (City of Aurora Soil Group "A" and "C") and are considered to generally provide good pavement support. Based on the properties of the lean clay soils, we estimated an R-value of 5 (CDOT correlated resilient modulus (M_r) of 3,025) for use in flexible pavement (asphalt) thickness design. For design of rigid concrete pavements, a modulus of subgrade reaction (K-value) of 100 pounds per cubic inch (pci) was utilized for the clayey soils.

- **Design Traffic:** Design traffic values, used to determine pavement thickness, are defined as 18-kip equivalent single axle loads ($ESAL_{20}$) based on a 20-year design, per the Standards. The following traffic designation criteria as outlined in the City of Aurora Standards were utilized for determining pavement thicknesses:

City of Aurora Roadway Classification	Total ESAL's ($ESAL_{20}$)
Multifamily Residential	
Private Parking Areas (All)	40,000
Private Local Streets and Fire Lanes	70,000
Commercial and Business	
Private Parking Areas (Cars Only)	40,000
Private Parking Areas (All Other)	70,000
Private Local Streets & Fire Lanes	200,000

- **Pavement Section Alternatives:** Pavement sections for private improvements were determined based on the City of Aurora Standards. Utilizing Aurora design methods, the recommended alternatives for flexible and rigid pavements are summarized for each traffic area as follows:

City of Aurora Traffic Area	Alternative	Minimum Pavement Thickness (Inches)		
		Asphalt Concrete Surface	Aggregate Base Course	Portland Cement Concrete
Multifamily Residential				
Private Parking (All)	A	4	7	--
	B	6	--	--
	C	--	--	6
Private Local Street & Fire Lane	A	5	7	--
	B	7	--	--
	C	--	--	6
Commercial and Business				
Private Parking (Cars Only)	A	4	7	--
	B	6	--	--
	C	--	--	6
Private Parking (All Other)	A	4-½	7	--
	B	6-½	--	--
	C	--	--	6
Private Local Street & Fire Lane	A	6	7	--
	B	8	--	--
	C	--	--	7

Each alternative should be investigated with respect to current material availability and economic conditions. Pavement thicknesses recommended are based on approved subgrade materials being properly moisture conditioned and compacted prior to paving.

In our opinion, PCC pavements typically provide good performance under the heavy loads associated with trash trucks, etc. In our experience, HMA pavements can rut under heavy loads or "shove" beneath turning axles of these heavy vehicles. ***For areas subject to concentrated and repetitive loading conditions such as dumpster pads, and ingress/egress aprons, heavy truck parking, we recommend using the 6-inch Portland cement concrete pavement alternative. For dumpster pads, the concrete pavement area should be large enough to support the container and tipping axle of the refuse truck.***

- **Temporary Unpaved Access Drives:** In our opinion, the use of aggregate base course or crushed stone may be considered for use in constructing temporary access roads for construction traffic and/or all-weather fire truck access. In order to provide an all-weather surface, we recommend that the section include a minimum of 12 inches of aggregate base course (CDOT Class 5 or 6) or a minimum of 8 inches of 3-inch minus crushed aggregate (or recycled concrete). In our opinion, these sections would be suitable for the support of delivery and concrete trucks and occasional fire truck access (85,000 pounds maximum) for the anticipated duration of a typical project of this magnitude. The contractor should be responsible for monitoring the condition of unpaved drive lanes, including the repair and maintenance of the drive lanes throughout its use in order to provide the required access. We believe it is likely that these aggregate materials will be "contaminated" with soil and other constituents over the course of construction; therefore, the aggregate materials should not be considered part of the final pavement section unless otherwise evaluated and approved by the Geotechnical Engineer.

- **Subgrade Preparation:** We recommend the pavement areas be rough graded and then thoroughly proof rolled with a loaded tandem axle dump truck, water truck, or other heavy equipment approved by the observing engineer prior to final grading and paving. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted engineered fills.

  At a minimum, in order to provide a more uniform subgrade for site pavements, we recommend that all pavements be constructed on a minimum of 12 inches of properly moisture conditioned and recompacted on-site soils. Confirmation of the moisture content and compaction level of the subgrade soils should be confirmed within 24 hours prior to paving.

- **Pavement Materials:** Pavement materials and construction methods used for the project should be in general accordance with the requirements and specifications of the City of Aurora and the Colorado Department of Transportation (CDOT). In addition, mix designs should be submitted prior to construction to verify their adequacy.

  Aggregate base course (if used on the site) should consist of a blend of sand and gravel meeting strict specifications for quality and gradation and have a minimum R-value of 77. Use of materials meeting City of Aurora Class 2 specifications is recommended for base course. Aggregate base course should be placed in lifts not exceeding 6 inches and compacted to a minimum of 95 percent of the modified Proctor density (AASHTO T180/ASTM D1557), within a moisture content range of 2 percent below to 2 percent above optimum. Where base course thickness exceeds 6 inches, the material should be placed and compacted in 2 or more lifts of equal thickness.

  Hot-mix asphalt should be composed of a mixture of aggregate, filler and additives (if required) and approved bituminous material. Hot-mix asphalt should be obtained from City of Aurora approved mix designs stating the Hveem properties, optimum asphalt content, job mix formula (JMF), and recommended mixing and placing temperatures.

  Aggregate used in hot-mix asphalt should meet particular gradations. Material meeting Aurora Grading G (lower lifts), S (top lift only) or SX (top lift only) specifications or equivalent is recommended for asphalt concrete. Grading S (top lift only) should be utilized for Collector and Arterial roadways. Asphalt binder PG 76-28 or 58-28 is recommended. Mix designs should be submitted prior to construction to verify their adequacy. Asphalt material should be placed in appropriate lifts (CDOT specs per table below) and compacted within a range of 92 to 96 percent of the theoretical maximum (Rice) density (ASTM D2041).

  CDOT specifications for asphalt pavement lift thickness per grading size:

CDOT HMA Grade	Nominal Maximum Aggregate Size	Structural Layer Lift Thickness (Inches)	
		Minimum	Maximum
SX	1/2“	2.00	3.00
S	3/4”	2.25	3.50
SG (G)	1”	3.00	4.00

* Alternative lift thicknesses can be considered provided the contractor uses equipment and procedures to obtain the required compaction.

Concrete utilized for rigid pavements should meet CDOT Class P requirements and be obtained from an approved mix design with the following minimum properties:

- Modulus of Rupture @ 28 days .... 650 psi minimum
- Strength Requirements..ASTM C94
- Cement Type...Type II Portland
- Entrained Air Content .... 5 to 7%
- Concrete Aggregate .... ASTM C33 and CDOT Section 703

Concrete should be deposited by truck mixers or agitators and placed a maximum of 90 minutes from the time the water is added to the mix. Other specifications outlined by CDOT should be followed.

Longitudinal and transverse joints should be provided as needed in concrete pavements for expansion/contraction and isolation. The location and extent of joints should be based upon the final pavement geometry. Sawed joints should be cut within 24 hours of concrete placement and should be a minimum of 25 percent of slab thickness plus 1/4 inch. All joints should be sealed to prevent entry of foreign material and doweled where necessary for load transfer.

- **Compliance:** Recommendations for pavement design and construction presented depend upon compliance with recommended material specifications. To assess compliance, observation and testing should be performed under the observation of the geotechnical engineer.

- **Pavement Performance and Maintenance:** Future performance of pavements constructed on the subgrade at this site will be dependent upon several factors, including:

  - Maintaining stable moisture content of the subgrade soils.
  - Providing for a planned program of preventative maintenance.

  The performance of all pavements can be enhanced by minimizing excess moisture, which can reach the subgrade soils. The following recommendations should be considered at minimum:

  - Site grading at a minimum 2 percent grade onto or away from pavements.
  - Water should not be allowed to pond behind curbs.
  - Compaction of any utility trenches for landscaped areas to the same criteria as the pavement subgrade.
  - Sealing all landscaped areas in or adjacent to pavements to minimize or prevent moisture migration to subgrade soils.
  - Placing compacted backfill against the exterior side of curb and gutter.

- Placing curb, gutter and/or sidewalk directly on subgrade soils without the use of base course materials.

Preventative maintenance should be planned and provided for an ongoing pavement management program in order to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment.

Preventative maintenance consists of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements.

Swimming Pool Design and Construction: We understand that an outdoor pool is planned for the project; however, the final location had yet to be determined at the time of our report. We should be provided with this information, once available, in order to confirm or modify our recommendations. Due to the presence of variably expansive clays across the site, we recommend these soils be removed below the proposed pool, moisture-conditioned and recompacted as outlined above for the buildings. We recommend the subexcavation also extend below the proposed pool deck and other critical flatwork areas. ***We estimate that the pool itself would be subject to an inch or less of movement when bearing on a zone of newly-placed engineered fill soils.***

We recommend that a drainage system be installed beneath the pool. The drain should consist of a minimum 6-inch layer of clean gravel (minimum 3/4-inch size) beneath the pool, sloped so that it will drain into tiles or perforated drainpipe. The layout of the perforated pipe should include at least one pipe running down the center of the pool lengthwise. Cross-connecting pipes, spanning with the pool, should be placed at regular intervals (i.e. 20-foot centers). The cross-connecting pipes should be joined to the center pipe with solid "tees" or "cross" connections. The center pipes should be sloped to a positive gravity outlet or sloped to a sump located in the equipment room, permitting pump discharge.

The bottom of the excavation beneath the gravel layer and the pipe should be lined with an impervious membrane (polyethylene film or equal) to reduce potential moisture fluctuations in the subgrade soils. Pressure relief valves should be provided in the base of the pool to prevent excessive uplift pressures from developing in the event of drain system failure.

The soils that will support deck slabs around the pool will be subject to movement due to shrink and swell of the supporting clayey soils as well as freeze-thaw cycles. To reduce possible damage that could be caused by soil movements, we recommend:

- deck slabs be supported on fill with no, or very low, expansion potential.
- strict moisture-density control during placement of subgrade fill.

- placement of effective control joints on relatively close centers and isolation joints between slabs and other structural elements.
- provision for adequate drainage in areas adjoining the slabs.
- use of designs which allow vertical movement between the deck slabs and adjoining structural elements.

Fill, backfill, and surface drainage in the pool area should be placed in accordance with the recommendations presented in the "Earthwork" section of this report. Grading should be provided for diversion of deck surface runoff away from the pool area. In no case should water be allowed to pond around the slab perimeter.

Final Grading, Surface Drainage and Landscaping: All grades must be constructed to provide positive drainage away from structures during construction, and it is imperative that grades be maintained throughout the life of the proposed project. Infiltration of water into utility or foundation excavations must be prevented during construction. Landscaped irrigation adjacent to the foundation system should be minimized or eliminated.

Water permitted to pond near or adjacent to the perimeter of structures (either during or post-construction) can result in significantly higher soil movements than those discussed in this report. As a result, any estimations of potential movement described in this report cannot be relied upon if positive drainage is not constructed and maintained, and water is allowed to infiltrate the supporting subgrade.

In our experience, movement of foundations, floor slabs, and other elements is most often due to poor drainage. Therefore, we typically recommend that exposed ground around structures (unpaved, landscaped areas) be sloped at a minimum of 10 percent grade for at least 10 feet beyond the perimeter of the building/structure, where possible. We understand that this may not be feasible in all unpaved areas due to ADA access requirements and existing site constraints. ***In all cases, the grade should slope a minimum of 5 percent away from structures in accordance with the applicable building code.*** Swales, sidewalk chases, area drains may be required to facilitate drainage in some areas. Areas drains should also be considered for the collection of downspout flows.

Backfill against footings, exterior walls and in utility and sprinkler line trenches should be well compacted and free of construction debris to reduce the possibility of moisture infiltration. ***After building construction and prior to project completion, we recommend that verification of final grading be performed to document that positive drainage, as described above, has been achieved.***

Roof drains should discharge via solid pipe into area drain or storm sewer systems, if possible. Where this is not possible, roof drain flows should be directed onto pavements or discharge away from structures a minimum of 5 feet through the use of splash blocks or downspout extensions.

Flatwork will be subject to post construction movement due to soil heave/settlement and frost action. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post-construction movement of flatwork, particularly if such movement would be critical. Where paving or flatwork abuts the structure, care should be taken that joints are properly sealed and maintained to prevent the infiltration of surface water.

Planters located adjacent to the structure should preferably be self-contained. Landscaping in close proximity to the foundation should be limited to well-maintained and timed drip irrigation only. Sprinkler mains and spray heads should be located a minimum of 5 feet away from the building line.

Stormwater Management Improvements: Field infiltration testing (cased borehole) was performed in Boring No. M10 at an approximate depth of 10 feet below existing site grades; these tests were performed within the silty sand soil layer. Results of testing indicated an average infiltration rate of the silty sand soils of 45 inches per hour (a factor of safety has not been applied to this value). Results of infiltration testing are presented in Appendix B. Infiltration testing was performed in general accordance with local Standards. ***Additional testing will likely be required once site development plans are finalized that show the extent of the stormwater basin area.***

Design of stormwater related improvements should follow applicable City of Aurora standards and the Mile High Flood District (MHFD) *Drainage Criteria Manual*. The data presented herein is provided for use by the project Civil Engineer for design of these features. We are available to discuss our results, upon request.

We recommend the Civil Engineer design storm water facilities to discharge into areas at least 8 feet away from foundations, including the new buildings and any existing foundations (if present) on adjacent properties.

Additional Design and Construction Considerations:

- **Exterior Slab Design and Construction:** Compacted subgrade or existing clayey soils/bedrock will be subject to volume change with varying moisture and freeze/thaw conditions; therefore, exterior concrete grade slabs may heave resulting in cracking or vertical offsets. In addition, exterior flatwork adjacent to buildings may be supported on foundation or trench backfill soils that may be prone to settlement. The amount of heave and/or settlement movement will be related to the amount of wetting of the subgrade soils and seasonal conditions. The potential for damage would be greatest where exterior slabs are constructed adjacent to the building or other structural elements.

To reduce the potential for damage, the following could be considered:

- exterior slabs could be supported on a zone of fill with no, or very low, expansion potential as discussed above.
- strict moisture-density control should be used during placement of subgrade fills.
- placement of effective control joints on relatively close centers and isolation joints between slabs and other structural elements.
- provision for adequate drainage in areas adjoining the slabs.
- use of designs that allow vertical movement between the exterior slabs and adjoining structural elements.
- support of critical flatwork on haunches attached to the foundation

- **Underground Utility Systems:** All underground utility lines penetrating below foundations should be installed deep enough to avoid direct contact with foundations or be designed with flexible couplings (if available), so minor deviations in alignment do not result in breakage or distress. Utility knockouts in foundation walls should be oversized to accommodate differential movements.

  It is strongly recommended that a representative of the geotechnical engineer provide full-time observation and compaction testing of trench backfill within building and pavement areas.

- **Corrosion Protection:** Select samples were tested for the soil corrosion properties outlined in the table below. These values should be used to determine potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials that will be used for project construction.

Summary of Corrosion Test Results

Boring	Depth (ft)	Material	Water-Soluble Sulfates (ppm)	ACI Sulfate Exposure Class	Laboratory Minimum Resistivity (ohm-cm)	pH
M4	4	Sandy Lean Clay	400	S1	--	--
M8	4	Sandy Lean Clay	600	S1	--	--
C1	2	Sandy Lean Clay	2,100	S2	1,000	7.89
C2	2	Clayey Sand	900	S0	1,000	7.72
C3	4	Clayey to Silty Sand	0	S0	--	--
C4	0 to 5	Silty Sand	--	--	5,500	7.18
C5	0 to 5	Clayey to Silty Sand	--	--	2,300	7.51
C6	0 to 5	Clayey to Silty Sand	--	--	4,600	7.43
C7	4	Silty Sand	100	S0	3,200	7.44
C8	0 to 5	Sandy Lean Clay to Clayey Sand	--	--	4,500	7.03

As noted in the table above, select soil samples likely to be in contact with project concrete were tested for the presence of water-soluble sulfates in order to determine corrosion characteristics and the appropriate concrete mixtures. Results of testing indicate these soils are categorized as American Concrete Institute (ACI) Sulfate Exposure Class S0, S1, and S2. Therefore, project concrete should be designed for ACI Sulfate Exposure Class S2 in accordance with Chapter 19 of the ACI design manual, *Building Code Requirements for Structural Concrete (ACI 318-14)*. Requirements for project concrete (placed on or below grade) are also summarized in the table below.

ACI Sulfate Exposure Class	Portland Cement Type (ASTM C150)	Maximum Water/Cement Ratio	Minimum Concrete Compressive Strength (psi)
S2	V (or equivalent)	0.45	4,500

GENERAL COMMENTS

Supplemental exploration and analyses should be performed for each of the commercial lots in order to develop final design parameters and to confirm and/or modify the preliminary recommendations and conclusions contained in this report.

CGG should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. CGG should also be retained to provide testing and observation during the excavation, grading, foundation and construction phases of the project.

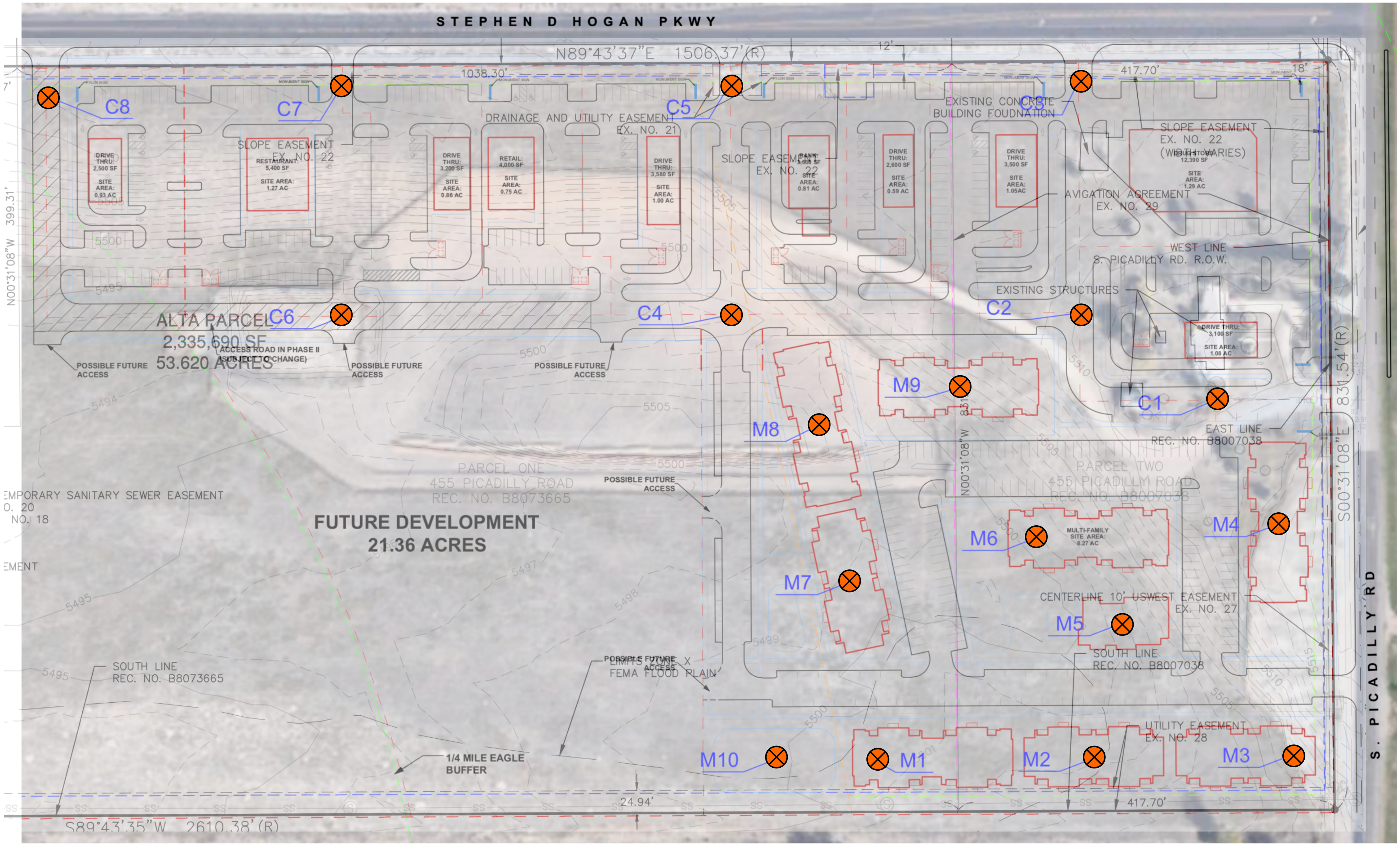
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include, either specifically or by implication, any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes are planned in the nature, design, or location of the project as outlined in this report, the conclusions and recommendations contained in this report shall not be considered valid unless CGG reviews the changes, and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

BORING LOCATION DIAGRAM
BORING LOGS



BORING DESIGNATIONS AND LOCATIONS PROVIDED BY CLIENT

FIGURE 1 - BORING LOCATION DIAGRAM
EAGLE RIDGE MIXED-USE DEVELOPMENT
STEPHEN D. HOGAN PARKWAY and S. PICADILLY ROAD
AURORA, COLORADO
CGG PROJECT NO. 23.22.003

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1070 W 124th Ave, Suite 300
Westminster, CO 80234

BORING NUMBER M1

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/1/23 **COMPLETED** 2/1/23
GROUND SURFACE ELEV. 5501 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
∇ **DURING DRILLING** 12.00 ft / Elev 5489.00 ft
LOGGED BY JL **CHECKED BY** AG
▼ **AFTER DRILLING** 11.00 ft / Elev 5490.00 ft WCI - 3/9/23

MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
SANDY LEAN CLAY to CLAYEY SAND, light brown to brown, dry, very stiff	0							
	5	CL/SC	CB	100	27 / 12	4.2	108	-0.7/500
7 — 5494.0								
SILTY SAND, fine- to coarse-grained, calcareous, tan, light brown, dry to wet, loose to medium dense								
	10	SM	CB	100	13 / 12	2.4	102	
▼ (11 ft), ∇ (12 ft)								
	15	SM	CB	100	16 / 12	10.4	115	
	20	SM	CB	100	39 / 12	11.3	121	
23 — 5478.0								
CLAYSTONE BEDROCK, grey, olive-brown, iron-stained, moist, medium hard to very hard								
	25	-	CB	100	36 / 12	14.7	114	
	30							
35 — 5466.0	35	-	CB	100	50 / 6	19.7		

Approximate bottom of borehole at 35.0 feet.

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BORING NUMBER M2

PAGE 1 OF 1

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/1/23 **COMPLETED** 2/1/23
GROUND SURFACE ELEV. 5502 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING 12.00 ft / Elev 5490.00 ft
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING 13.00 ft / Elev 5489.00 ft WCI - 3/9/23

MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
SILTY SAND, fine- to coarse-grained, tan, light brown, dry to wet, loose to medium dense	0							
	5	SM	CB	100	16 / 12	1.5	103	
	10	SM	CB	100	32 / 12	2.0	119	
▽ ▼ (groundwater)								
	15	SM	CB	0	13 / 12			
	20	SM	CB	100	26 / 12	12.3	122	
23 — 5479.0								
CLAYSTONE BEDROCK, grey, olive-brown, iron-stained, moist, very hard								
25 — 5477.0	25	-	CB	100	50 / 6	19.6	107	

Approximate bottom of borehole at 25.0 feet.

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BORING NUMBER M3

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/1/23 **COMPLETED** 2/1/23
GROUND SURFACE ELEV. 5507 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** 15.00 ft / Elev 5492.00 ft
LOGGED BY JL **CHECKED BY** AG
▼ **AFTER DRILLING** 19.00 ft / Elev 5488.00 ft WCI - 3/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	CLAYEY to SILTY SAND, light to dark brown, dry, medium dense to very dense	0							
			SC	CB	100	50 / 7	3.8		
		5	SC/SM	CB	100	31 / 12	1.6	108	
7	5500.0								
	SILTY SAND, fine- to coarse-grained, tan, light brown, dry to wet, medium dense								
		10	SM	CB	100	22 / 12	1.6	107	
	▽	15	SM	CB	100	30 / 12	3.6	118	
	▼	20	SM	CB	100	15 / 12	20.7	106	
25	5482.0	25	SM	CB	100	18 / 12	13.7	117	

Approximate bottom of borehole at 25.0 feet.

BORING NUMBER M4

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CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/1/23 **COMPLETED** 2/1/23
GROUND SURFACE ELEV. 5515 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** 27.00 ft / Elev 5488.00 ft
LOGGED BY JL **CHECKED BY** AG
▼ **AFTER DRILLING** 15.00 ft / Elev 5500.00 ft WCI - 3/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY, brown to dark brown, calcareous, dry to moist, very stiff	0							
		5	CL	CB	100	34 / 12	13.8	105	+3.0/500
8	5507.0								
	SILTY SAND, fine- to coarse-grained, tan, light brown, iron-stained, dry to wet, medium dense								
		10	SM	CB	100	42 / 12	2.2	111	
	▼	15	SM	CB	100	33 / 12	2.4	122	
		20	SM	CB	100	42 / 12	2.4	124	
		25	SM	CB	100	33 / 12	4.1	120	
	▽								
		30							
35	5480.0	35	SM	CB	100	15 / 12	13.8	111	

Approximate bottom of borehole at 35.0 feet.

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BORING NUMBER M5

PAGE 1 OF 1

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/1/23 **COMPLETED** 2/1/23
GROUND SURFACE ELEV. 5502 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** 13.00 ft / Elev 5489.00 ft
LOGGED BY JL **CHECKED BY** AG
▼ **AFTER DRILLING** 14.00 ft / Elev 5488.00 ft WCI - 3/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	CLAYEY SAND, brown to dark brown, dry, medium dense	0							
		5	SC	CB	100	24 / 12	3.6	98	
7	5495.0								
	SILTY SAND, fine- to coarse-grained, tan, light brown, iron-stained, dry to wet, loose to medium dense								
		10	SM	CB	100	17 / 12	1.6	108	
	▽ ▼								
		15	SM	CB	100	24 / 12	10.4	96	
		20	SM	CB	100	22 / 12	10.5	123	
25	5477.0	25	SM	CB	100	14 / 12	14.3	114	

Approximate bottom of borehole at 25.0 feet.

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BORING NUMBER M6

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/1/23 **COMPLETED** 2/1/23
GROUND SURFACE ELEV. 5501 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING 12.00 ft / Elev 5489.00 ft
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING 15.00 ft / Elev 5486.00 ft WCI - 3/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY, brown to dark brown, dry, very stiff	0							
			CL	CB	100	26 / 12	8.7	115	+3.3/500
4	5497.0								
	SILTY SAND, fine- to coarse-grained, light brown to brown, dry to wet, loose to medium dense	5	SM	CB	100	12 / 12	4.3	102	
		10	SM	CB	100	12 / 12	2.0	104	
	▽ (12 ft)								
	▼ (15 ft)	15	SM	CB	100	11 / 12	12.4	110	
		20	SM	CB	100	7 / 12	22.7	103	
25	5476.0	25	SM	CB	100	24 / 12	12.9	118	

Approximate bottom of borehole at 25.0 feet.

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BORING NUMBER M7

CLIENT	EVC-WDG Aurora, LLC	**PROJECT NAME**	Eagle Ridge Mixed-Use Development
PROJECT NUMBER	23.22.003	**PROJECT LOCATION**	Aurora, CO
DATE STARTED	2/1/23 **COMPLETED** 2/1/23	**GROUND SURFACE ELEV.**	5499 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR	Vine Laboratories	**SURFACE CONDITIONS**	Low growth of grass and weeds
DRILLING METHOD	Buggy Rig/Solid Stem Auger	**GROUND WATER LEVELS:**	
HAMMER TYPE	Automatic	**DURING DRILLING**	13.00 ft / Elev 5486.00 ft
LOGGED BY	JL **CHECKED BY** AG	**AFTER DRILLING**	13.00 ft / Elev 5486.00 ft WCI - 3/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SILTY SAND, fine- to coarse-grained, tan, brown, dry to wet, loose to medium dense	0							
		5	SW-SM	CB	100	14 / 12	1.9	107	
		10	SM	CB	100	12 / 12	1.4	107	
		15	SM	CB	100	15 / 12	14.2	115	
		20	SM	CB	100	14 / 12	10.5	112	
25	5474.0	25	SM	CB	100	26 / 12	16.0	113	

Approximate bottom of borehole at 25.0 feet.

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BORING NUMBER M8

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/1/23 **COMPLETED** 2/1/23
GROUND SURFACE ELEV. 5504 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** 17.00 ft / Elev 5487.00 ft
LOGGED BY JL **CHECKED BY** AG
▼ **AFTER DRILLING** 16.00 ft / Elev 5488.00 ft WCI - 3/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY, tan, light brown to brown, calcareous, dry, hard	0							
		5	CL	CB	100	47 / 12	7.6		
7	5497.0								
	SILTY SAND, fine- to coarse-grained, varies to Clayey Sand, tan, light brown, dry to wet, medium dense to dense								
		10	SC/SM	CB	100	50 / 11	3.3	127	
		15	SM	CB	100	23 / 12	4.8	124	
	▼ ▽								
		20	SC/SM	CB	100	39 / 12	3.8	124	
		25	SM	CB	100	16 / 12	15.2	107	
		30							
35	5469.0	35	SM	CB	100	24 / 12	15.4	113	

Approximate bottom of borehole at 35.0 feet.

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BORING NUMBER M9

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/1/23 **COMPLETED** 2/1/23
GROUND SURFACE ELEV. 5505 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** 18.00 ft / Elev 5487.00 ft
LOGGED BY JL **CHECKED BY** AG
▼ **AFTER DRILLING** 22.00 ft / Elev 5483.00 ft WCI - 3/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY to CLAYEY SAND, brown to dark brown, dry, stiff	0							
		5	CL/SC	CB	100	13 / 12	10.7	115	+0.4/500
10	5495.0	10	CL/SC	CB	100	18 / 12	3.5	123	+1.6/500
	SILTY SAND, fine- to coarse-grained, tan, light brown, dry to wet, loose to medium dense								
		15	SM	CB	100	11 / 12	3.0	102	
	▽								
		20	SM	CB	100	33 / 12	10.4	124	
	▼								
25	5480.0	25	SM	CB	100	29 / 12	11.1	115	

Approximate bottom of borehole at 25.0 feet.

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BORING NUMBER M10

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/1/23 **COMPLETED** 2/1/23
GROUND SURFACE ELEV. 5500 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING

GRAPHIC LOG	MATERIAL DESCRIPTION		DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	LEAN CLAY with SAND, brown, dry, stiff to very stiff		0							
				CL	CB	100	27 / 12	6.7	101	+4.8/500
			5	CL	CB	100	17 / 12	8.2	104	
7		5493.0								
	SILTY SAND, fine- to medium-grained, tan, brown, dry, medium dense									
10		5490.0	10	SM	CB	100	22 / 12	2.6	116	

Approximate bottom of borehole at 10.0 feet.

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BORING NUMBER C1

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/9/23 **COMPLETED** 2/9/23
GROUND SURFACE ELEV. 5510 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 2/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY, brown to dark brown, calcareous, dry to moist, very stiff	0							
			CL	CB	100	28 / 12	12.2	113	+3.2/200
		5	SC	CB	100	34 / 12	9.9	120	
7	5503.0								
	SILTY SAND, fine- to coarse-grained, tan, light brown to brown, dry, medium dense								
		10	SM	CB	100	26 / 12	8.7	118	
15	5495.0	15	SM	CB	100	25 / 12	3.0	108	

Approximate bottom of borehole at 15.0 feet.

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BORING NUMBER C2

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/9/23 **COMPLETED** 2/9/23
GROUND SURFACE ELEV. 5510 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 2/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SANDY LEAN CLAY to CLAYEY SAND, brown to dark brown, calcareous, dry, stiff to very stiff	0							
			SC	CB	100	11 / 12	7.4	115	
		5	CL	CB	100	14 / 12	9.7	121	+2.1/200
7	5503.0								
	SILTY SAND, fine- to coarse-grained, tan, light brown, dry, medium dense								
		10	SM	CB	100	22 / 12	2.7	107	
15	5495.0	15	SM	CB	100	29 / 12	1.9	105	

Approximate bottom of borehole at 15.0 feet.

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BORING NUMBER C3

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/9/23 **COMPLETED** 2/9/23
GROUND SURFACE ELEV. 5507.5 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
▽ **DURING DRILLING** None
LOGGED BY JL **CHECKED BY** AG
▼ **AFTER DRILLING** Backfilled - 2/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	CLAYEY to SILTY SAND, fine- to medium-grained, tan, light brown to brown, calcareous, dry, medium dense to very dense	0							
			SC	CB	100	22 / 12	4.0	107	+0.8/200
		5	SC/SM	CB	100	15 / 12	4.5	113	
		10	SC/SM	CB	100	50 / 12	5.6	113	
15	5492.5	15	SC/SM	CB	100	20 / 12	4.1	124	

Approximate bottom of borehole at 15.0 feet.

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Westminster, CO 80234

BORING NUMBER C4

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/9/23 **COMPLETED** 2/9/23
GROUND SURFACE ELEV. 5500 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING 14.00 ft / Elev 5486.00 ft
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 2/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SILTY SAND, fine- to coarse-grained, tan, light brown, dry to wet, medium dense	0							
			SW-SM	CB	100	21 / 12	1.8	111	
		5	SM	CB	100	15 / 12	2.7	104	
		10	SM	CB	100	25 / 12	4.4	114	
15	5485.0	15	SM	CB	100	20 / 12	12.2	119	

Approximate bottom of borehole at 15.0 feet.

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Westminster, CO 80234

BORING NUMBER C5

CLIENT EVC-WDG Aurora, LLC

PROJECT NAME Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003

PROJECT LOCATION Aurora, CO

DATE STARTED 2/9/23 **COMPLETED** 2/9/23

GROUND SURFACE ELEV. 5507 ft **PROPOSED ELEV.** Not Provided

DRILLING CONTRACTOR Vine Laboratories

SURFACE CONDITIONS Low growth of grass and weeds

DRILLING METHOD Buggy Rig/Solid Stem Auger

GROUND WATER LEVELS:

HAMMER TYPE Automatic

▽ **DURING DRILLING** None

LOGGED BY JL **CHECKED BY** AG

▼ **AFTER DRILLING** Backfilled - 2/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	CLAYEY to SILTY SAND, fine- to medium-grained, tan, brown, dry, medium dense	0							
			SM	CB	100	18 / 12	4.1	112	
5	5502.0	5	SM	CB	100	26 / 12	3.6	111	
	SILTY SAND, fine- to coarse-grained, tan, dry, medium dense								
		10	SM	CB	100	24 / 12	3.6	112	
15	5492.0	15	SM	CB	100	28 / 12	3.4	116	

Approximate bottom of borehole at 15.0 feet.

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BORING NUMBER C6

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/9/23 **COMPLETED** 2/9/23
GROUND SURFACE ELEV. 5503 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
∇ **DURING DRILLING** 11.00 ft / Elev 5492.00 ft
LOGGED BY JL **CHECKED BY** AG
▼ **AFTER DRILLING** Backfilled - 2/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SILTY SAND, fine-grained, tan, light brown, dry, medium dense	0							
3	5500.0		SM	CB	100	18 / 12	3.2	103	
	SANDY LEAN CLAY, brown to dark brown, dry, very stiff	5	CL	CB	100	20 / 12	15.6	110	+5.4/200
7	5496.0								
	SILTY SAND, fine- to coarse-grained, tan, brown, dry to wet, medium dense	10	SM	CB	100	20 / 12	4.9	115	
	∇								
15	5488.0	15	SM	CB	100	21 / 12	9.8	115	

Approximate bottom of borehole at 15.0 feet.

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BORING NUMBER C7

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/9/23 **COMPLETED** 2/9/23
GROUND SURFACE ELEV. 5508 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 2/9/23

GRAPHIC LOG	MATERIAL DESCRIPTION	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SILTY SAND, fine- to coarse-grained, tan, light brown, calcareous, dry, medium dense to dense	0							
			SM	CB	100	23 / 12	3.5	105	
		5	SM	CB	100	24 / 12	2.9	107	
		10	SM	CB	100	50 / 11	3.5	127	
15	5493.0	15	SM	CB	100	33 / 12	4.1	111	

Approximate bottom of borehole at 15.0 feet.

GEOTECH BH COLUMNS - GINT STD US LAB.GDT - 3/31/23 14:08 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2022\23.22.003 EAGLE RIDGE.GPJ

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BORING NUMBER C8

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO
DATE STARTED 2/9/23 **COMPLETED** 2/9/23
GROUND SURFACE ELEV. 5511 ft **PROPOSED ELEV.** Not Provided
DRILLING CONTRACTOR Vine Laboratories
SURFACE CONDITIONS Low growth of grass and weeds
DRILLING METHOD Buggy Rig/Solid Stem Auger
GROUND WATER LEVELS:
HAMMER TYPE Automatic
DURING DRILLING None
LOGGED BY JL **CHECKED BY** AG
AFTER DRILLING Backfilled - 2/9/23

GRAPHIC LOG (depth)	MATERIAL DESCRIPTION	Elev.	DEPTH (ft)	USCS SYMBOL	SAMPLE TYPE	RECOVERY %	PENETRATION blows/in	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SWELL-CONSOL /SURCHARGE LOAD, %psf
	SILTY SAND, fine-grained, tan, light brown, dry, loose		0							
				SM	CB	100	13 / 12	2.5	102	
4		5507.0								
	SANDY LEAN CLAY to CLAYEY SAND, brown to dark brown, calcareous, dry, stiff to very stiff		5	CL/SC	CB	100	18 / 12	5.6	109	
			10	CL	CB	100	36 / 12	10.6	113	
13		5498.0								
	SILTY SAND, fine- to medium-grained, tan, light brown, iron-stained, dry to moist, medium dense									
15		5496.0	15	SM	CB	100	35 / 12	2.6	118	

Approximate bottom of borehole at 15.0 feet.

APPENDIX B

LABORATORY TEST RESULTS
FIELD INFILTRATION RATE TEST RESULTS

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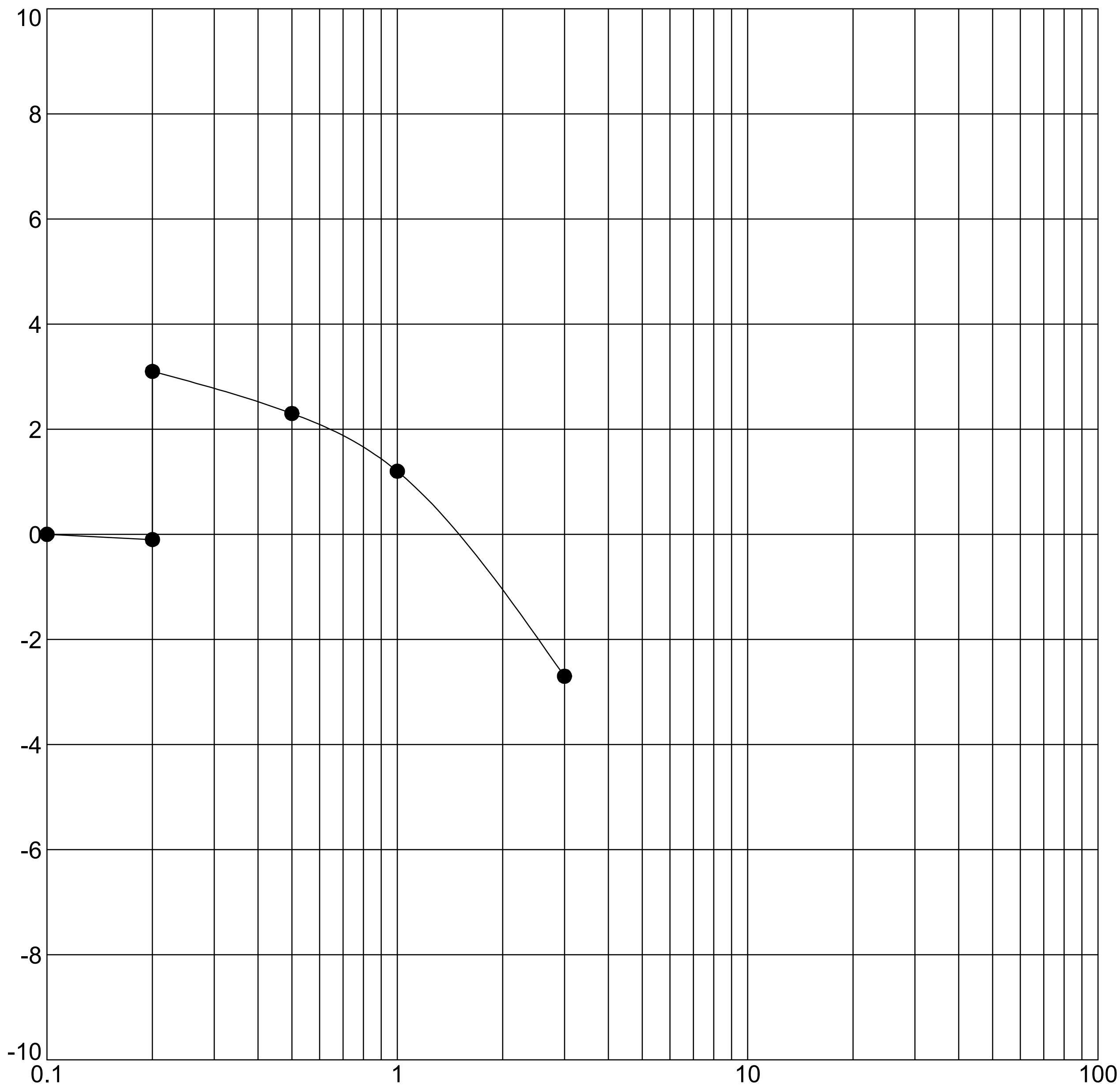
SWELL/CONSOLIDATION TEST

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **C1**	**2.0**	**SANDY LEAN CLAY(CL)**	**113**	**12**

Note: Water Added to Sample at 200 psf. **Date: 2/24/23**

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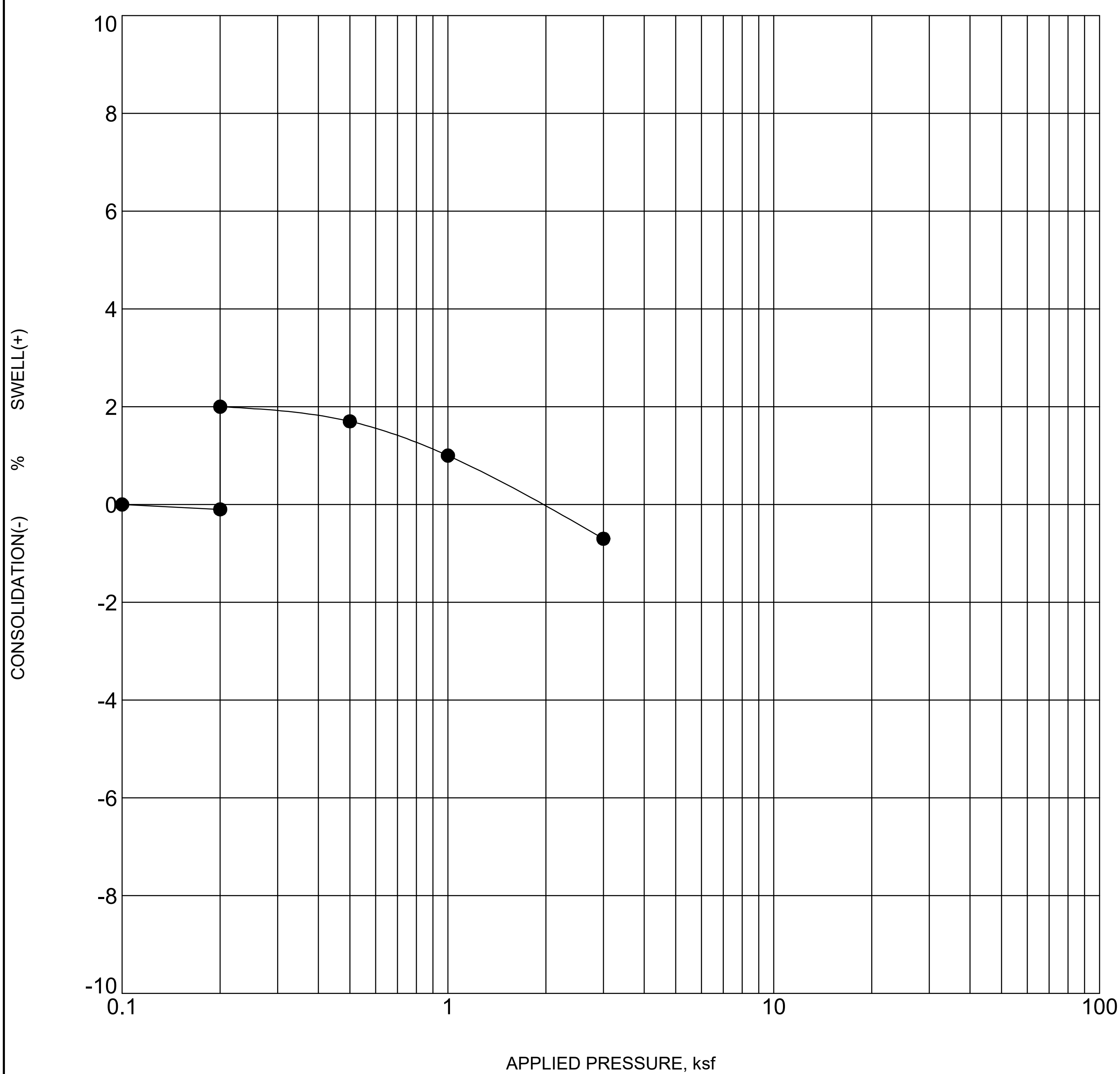
SWELL/CONSOLIDATION TEST

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **C2**	**4.0**	**SANDY LEAN CLAY**	**121**	**10**

Note: Water Added to Sample at 200 psf.

Date: 2/23/23

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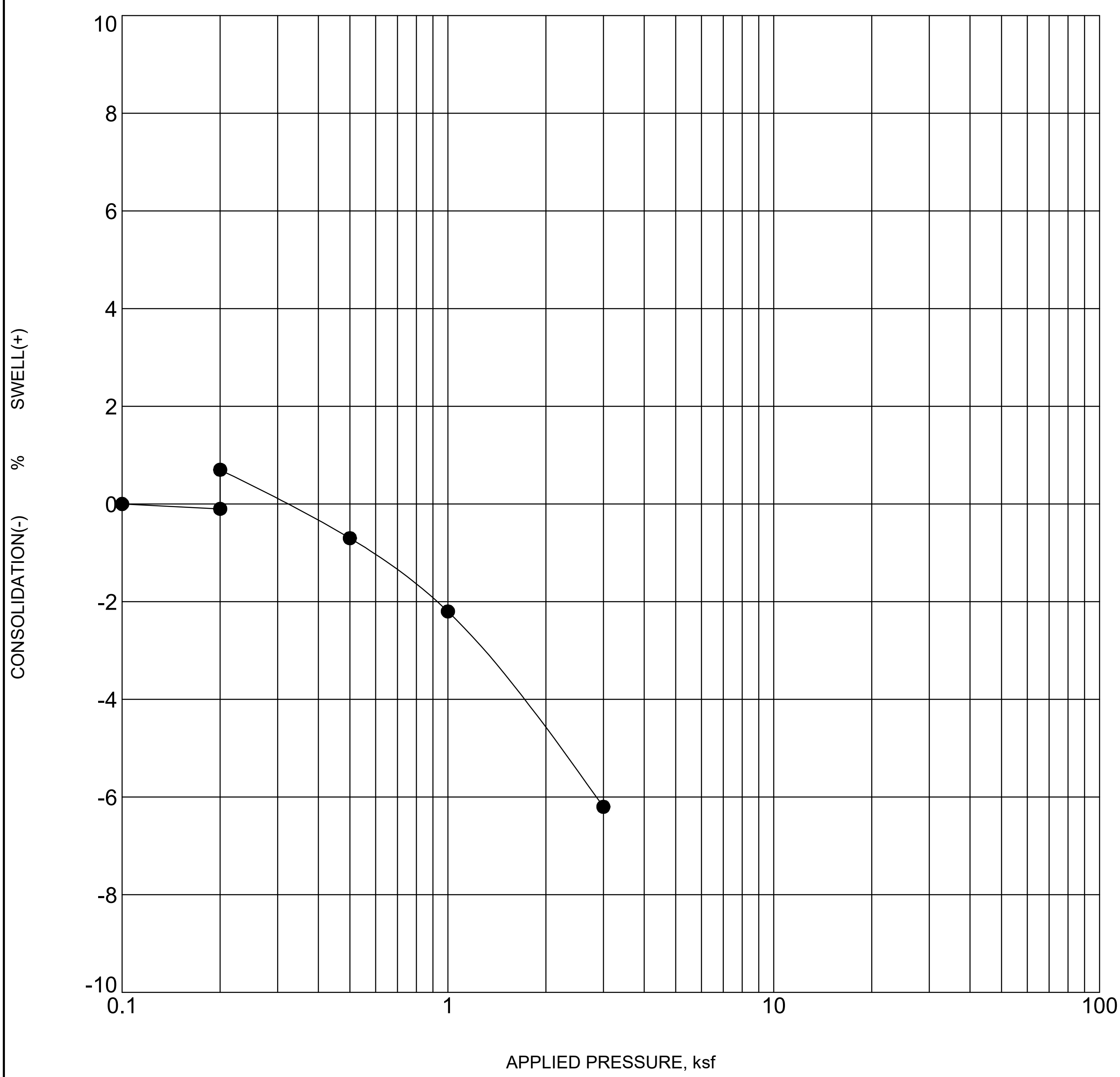
SWELL/CONSOLIDATION TEST

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **C3**	**2.0**	**CLAYEY SAND(SC)**	**107**	**4**

Note: Water Added to Sample at 200 psf. **Date: 2/24/23**

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 3/29/23 16:58 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2022\23.22.003 EAGLE RIDGE.GPJ

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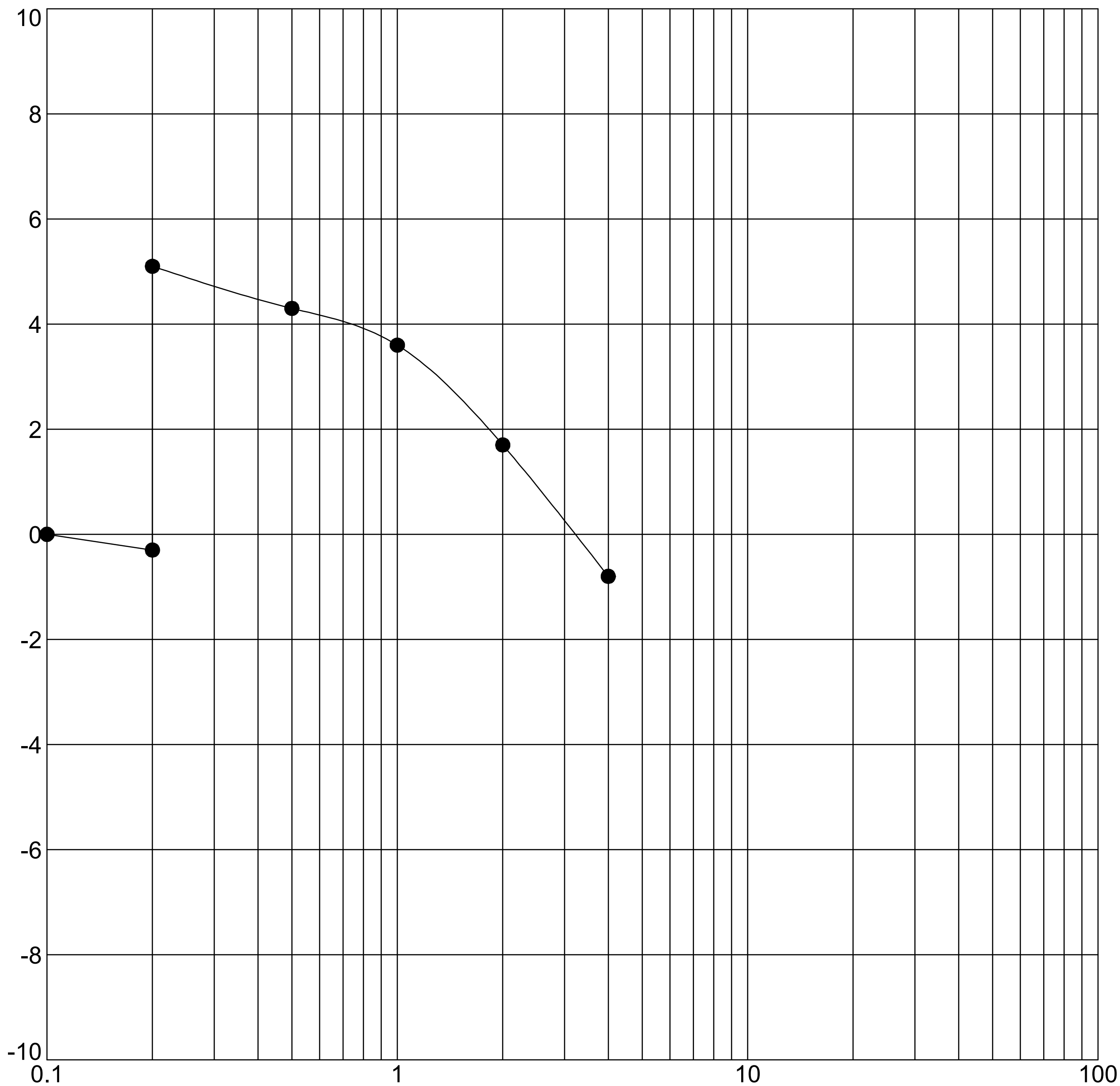
SWELL/CONSOLIDATION TEST

CLIENT EVC-WDG Aurora, LLC **PROJECT NAME** Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003 **PROJECT LOCATION** Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **C6**	**4.0**	**SANDY LEAN CLAY(CL)**	**110**	**16**

Note: Water Added to Sample at 200 psf. **Date: 2/24/23**

SWELL/CONSOLIDATION TEST

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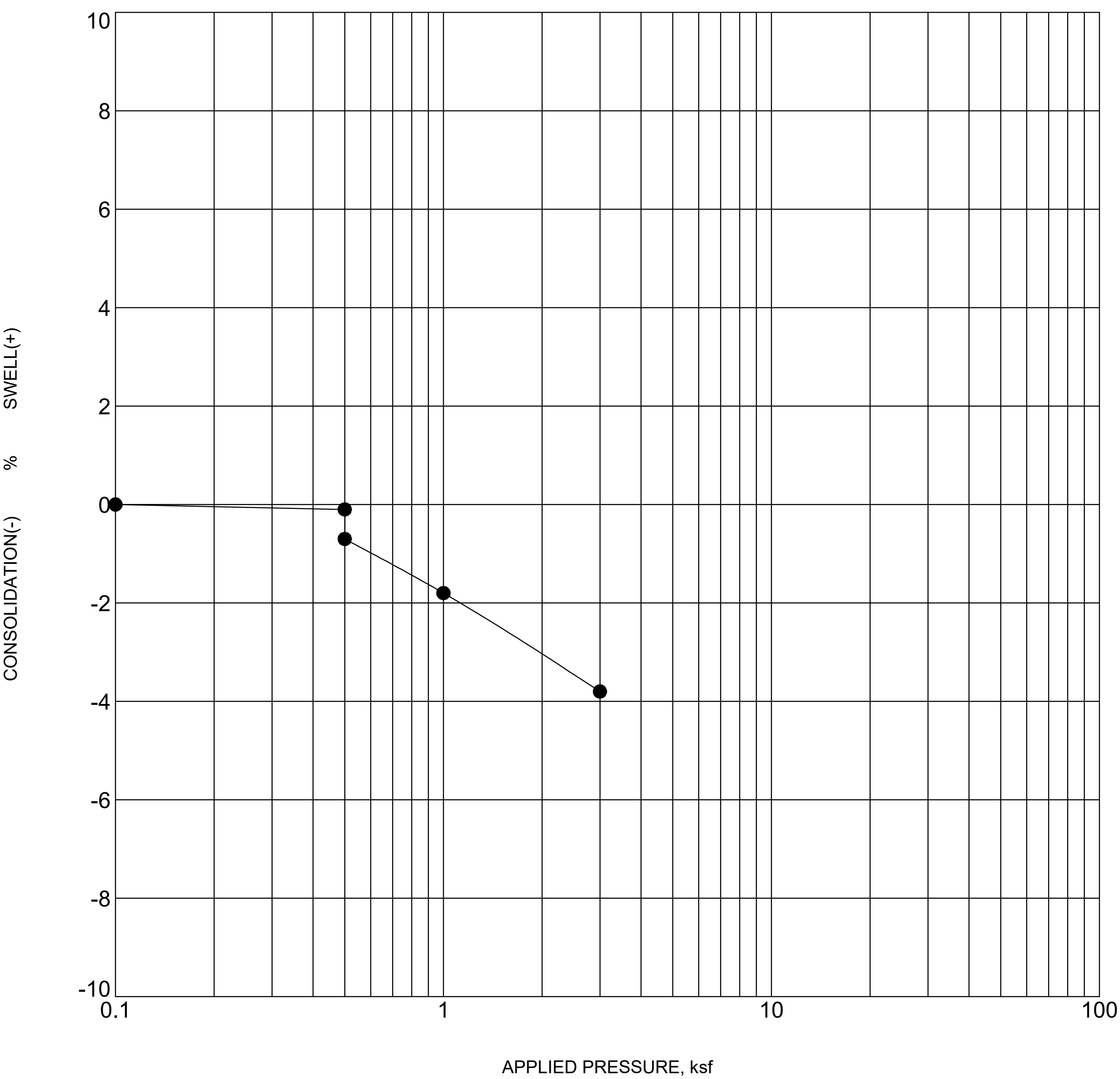
CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **M1**	**4.0**	**SANDY LEAN CLAY to CLAYEY SAND**	**108**	**4**

Note: Water Added to Sample at 500 psf.

Date: 2/8/23

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 3/29/23 16:58 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2022\23.22.003 EAGLE RIDGE.GPJ

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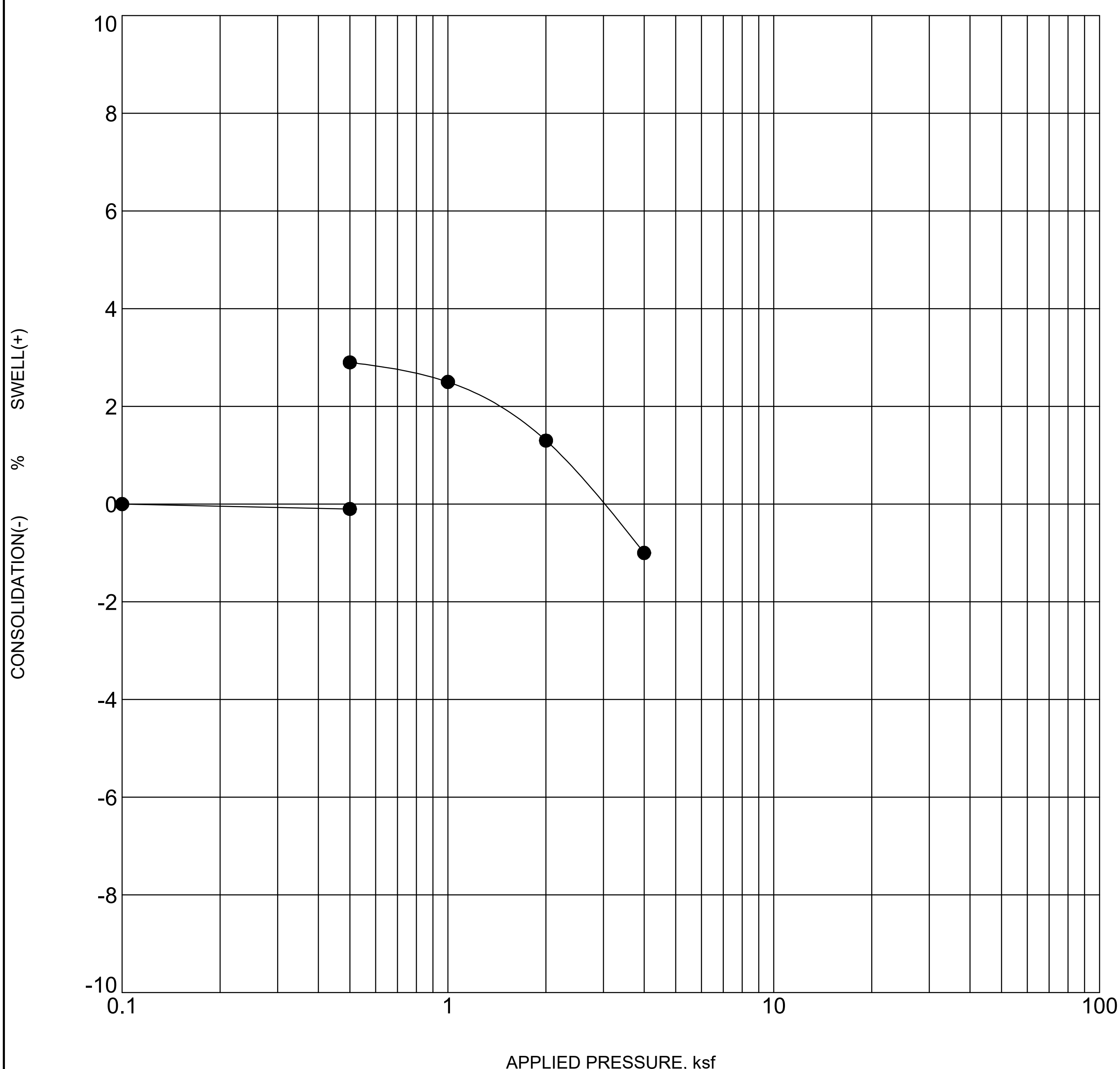
SWELL/CONSOLIDATION TEST

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **M4**	**4.0**	**SANDY LEAN CLAY**	**105**	**14**

Note: Water Added to Sample at 500 psf. **Date: 2/8/23**

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 3/29/23 16:58 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2022\23.22.003 EAGLE RIDGE.GPJ

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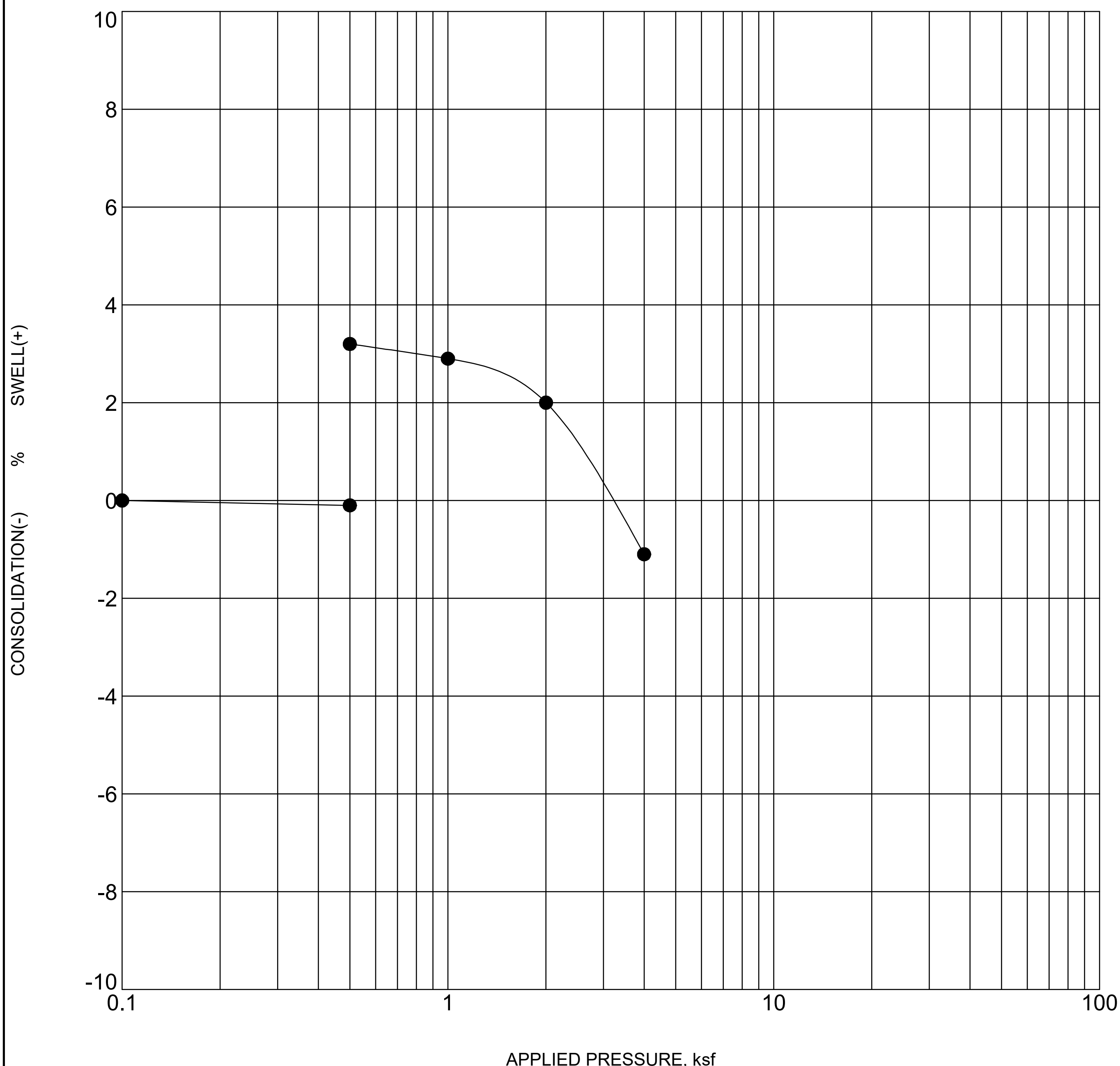
SWELL/CONSOLIDATION TEST

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **M6**	**2.0**	**SANDY LEAN CLAY**	**115**	**9**

Note: Water Added to Sample at 500 psf.

Date: 2/8/23

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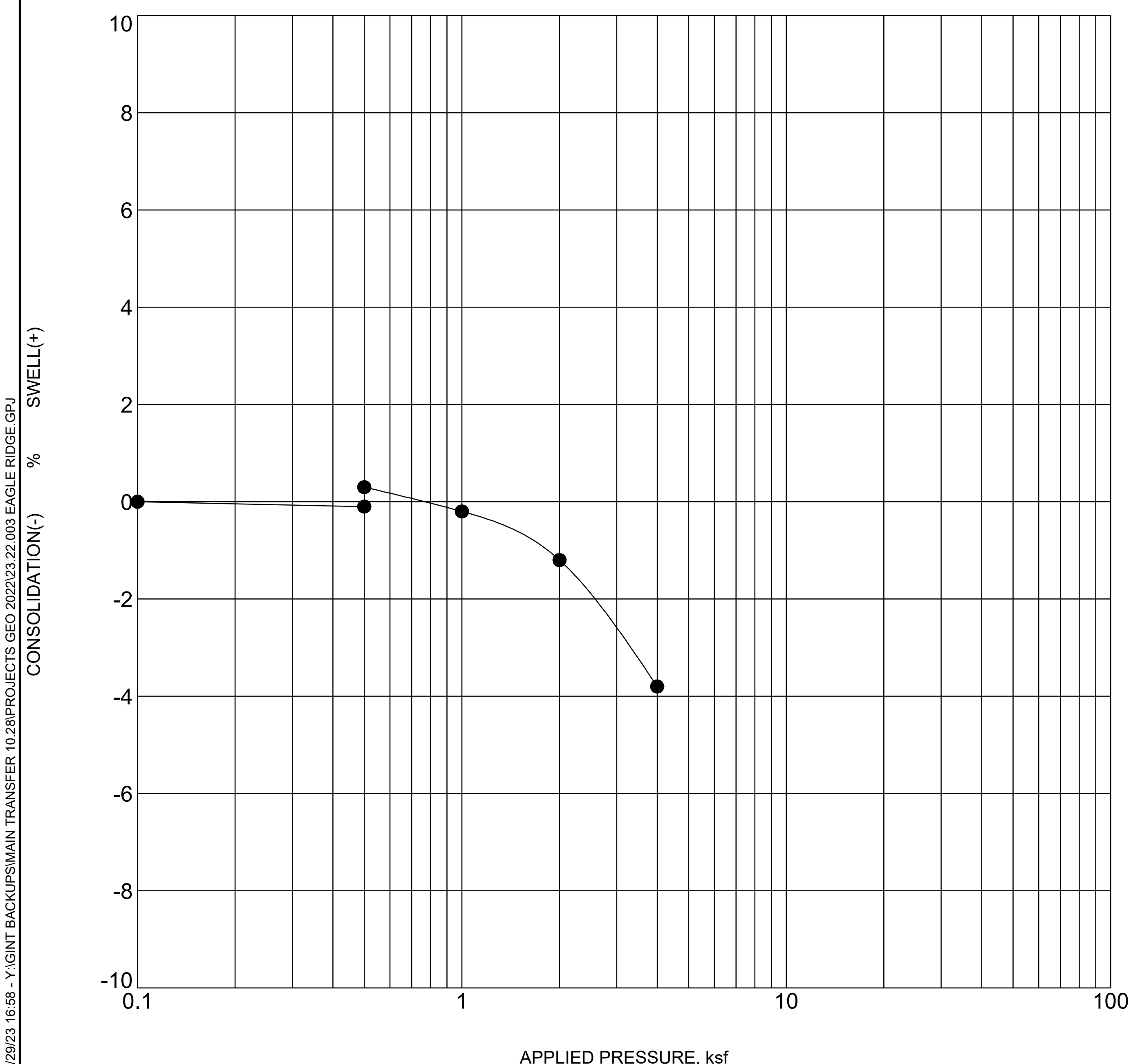
SWELL/CONSOLIDATION TEST

CLIENT EVC-WDG Aurora, LLC

PROJECT NAME Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003

PROJECT LOCATION Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **M9**	**4.0**	**SANDY LEAN CLAY to CLAYEY SAND**	**115**	**11**

Note: Water Added to Sample at 500 psf.

Date: 2/8/23

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 3/29/23 16:58 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2022\23.22.003 EAGLE RIDGE.GPJ

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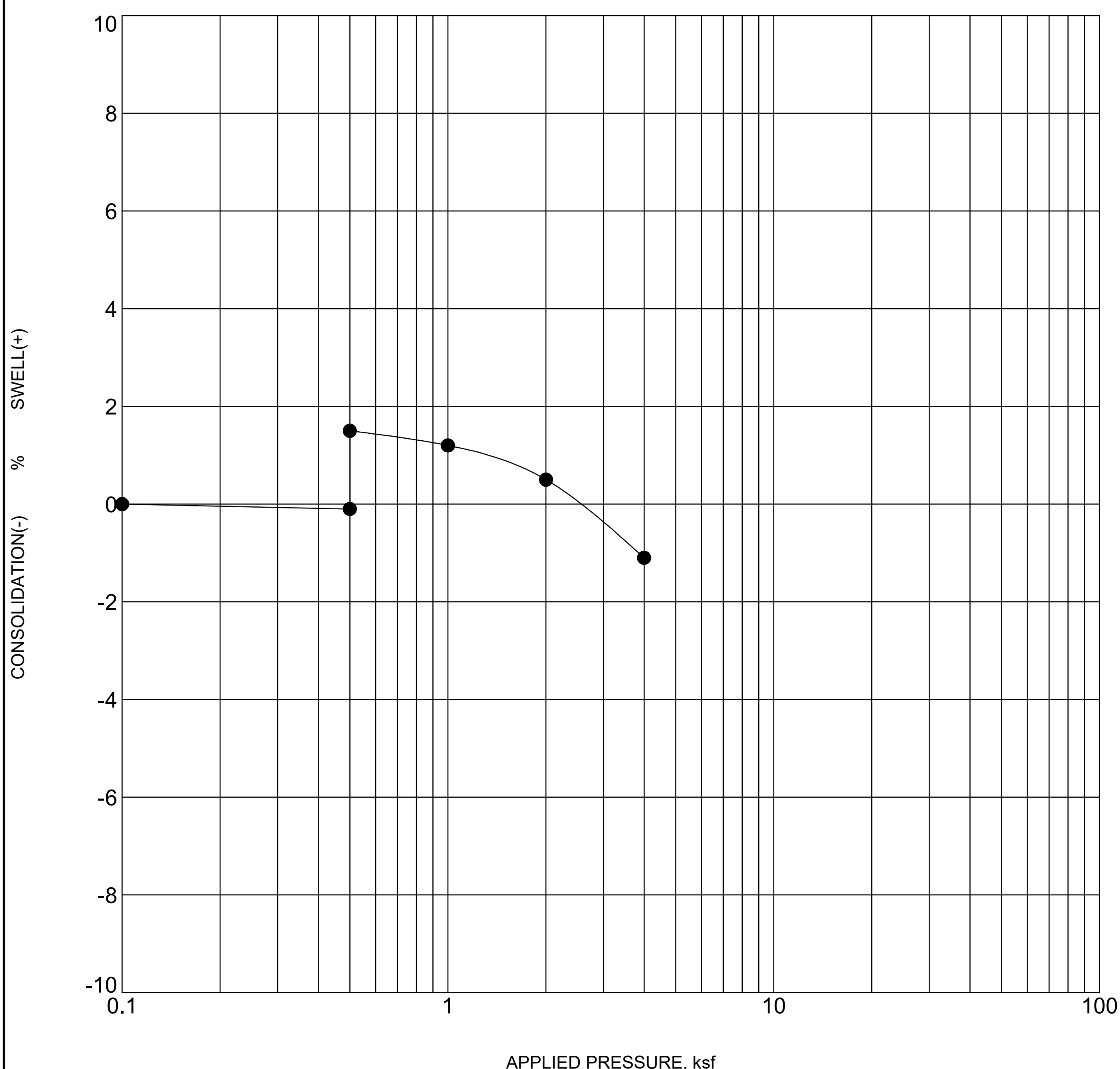
SWELL/CONSOLIDATION TEST

CLIENT EVC-WDG Aurora, LLC **PROJECT NAME** Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003 **PROJECT LOCATION** Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **M9**	**9.0**	**SANDY LEAN CLAY to CLAYEY SAND**	**123**	**4**

Note: Water Added to Sample at 500 psf. **Date: 2/8/23**

CONSOL STRAIN SINGLE - GINT STD US LAB.GDT - 3/29/23 16:58 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2022\23.22.003 EAGLE RIDGE.GPJ

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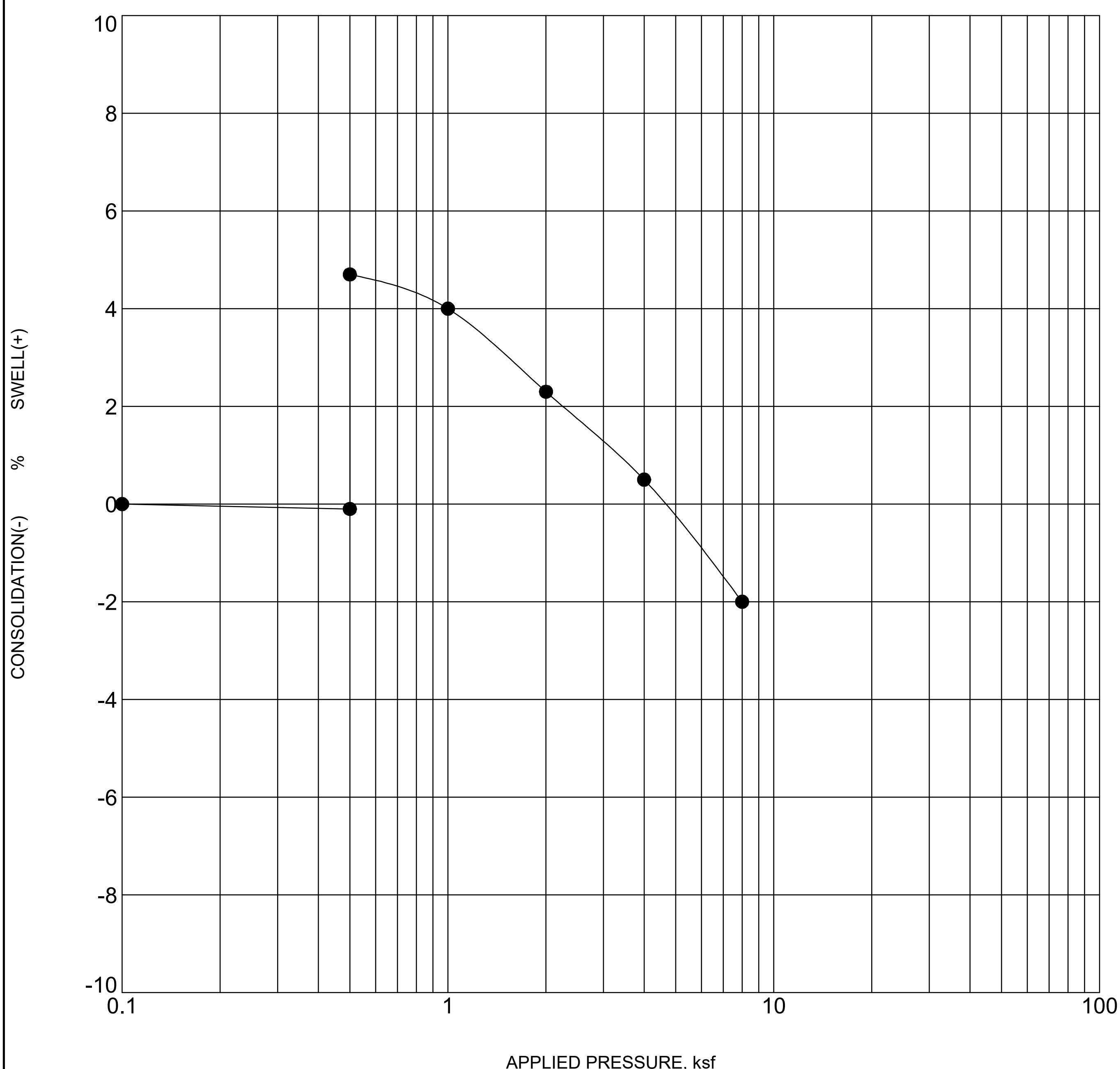
SWELL/CONSOLIDATION TEST

CLIENT EVC-WDG Aurora, LLC
PROJECT NAME Eagle Ridge Mixed-Use Development
PROJECT NUMBER 23.22.003
PROJECT LOCATION Aurora, CO



BOREHOLE	DEPTH	Classification	γ_d	MC%
● **M10**	**2.0**	**LEAN CLAY with SAND(CL)**	**101**	**7**

Note: Water Added to Sample at 500 psf. **Date: 2/8/23**

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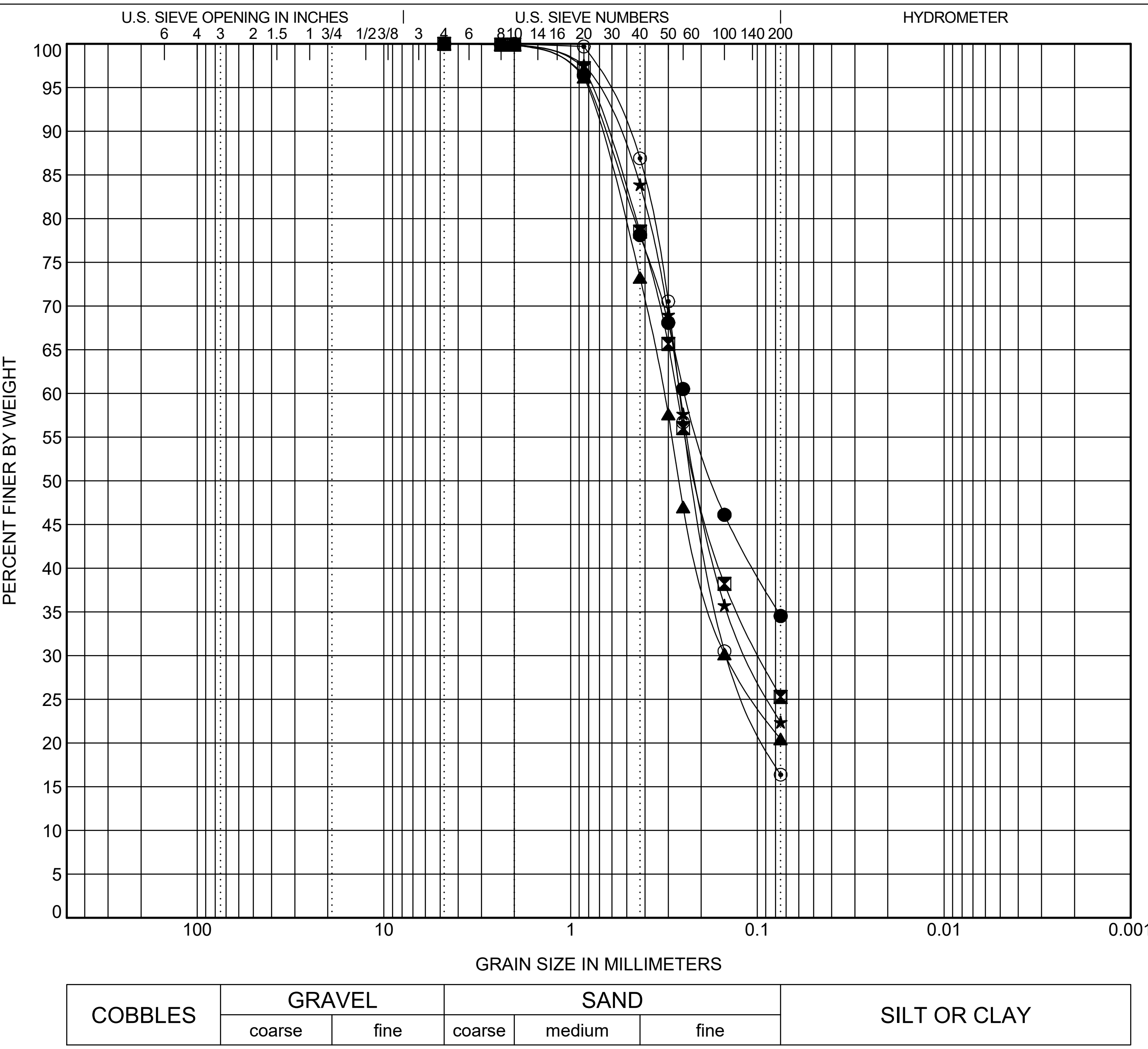
GRAIN SIZE DISTRIBUTION

CLIENT EVC-WDG Aurora, LLC **PROJECT NAME** Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003 **PROJECT LOCATION** Aurora, CO



	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	C3	2.0	CLAYEY SAND(SC)	32	21	11		
⧗	C5	2.0	SILTY SAND(SM)	NP	NP	NP		
▲	C6	2.0	SILTY SAND(SM)	NP	NP	NP		
★	C7	4.0	SILTY SAND(SM)	NP	NP	NP		
⊙	C8	2.0	SILTY SAND(SM)	NP	NP	NP		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	C3	2.0	4.75	0.246			0.0	65.5	34.5	
⧗	C5	2.0	4.75	0.27	0.097		0.0	74.7	25.3	
▲	C6	2.0	4.75	0.316	0.148		0.0	79.5	20.5	
★	C7	4.0	4.75	0.26	0.111		0.0	77.6	22.4	
⊙	C8	2.0	2	0.261	0.146		0.0	83.6	16.4	

GRAIN SIZE - GINT STD US LAB.GDT - 3/8/23 16:31 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2022\23.22.003 EAGLE RIDGE.GPJ

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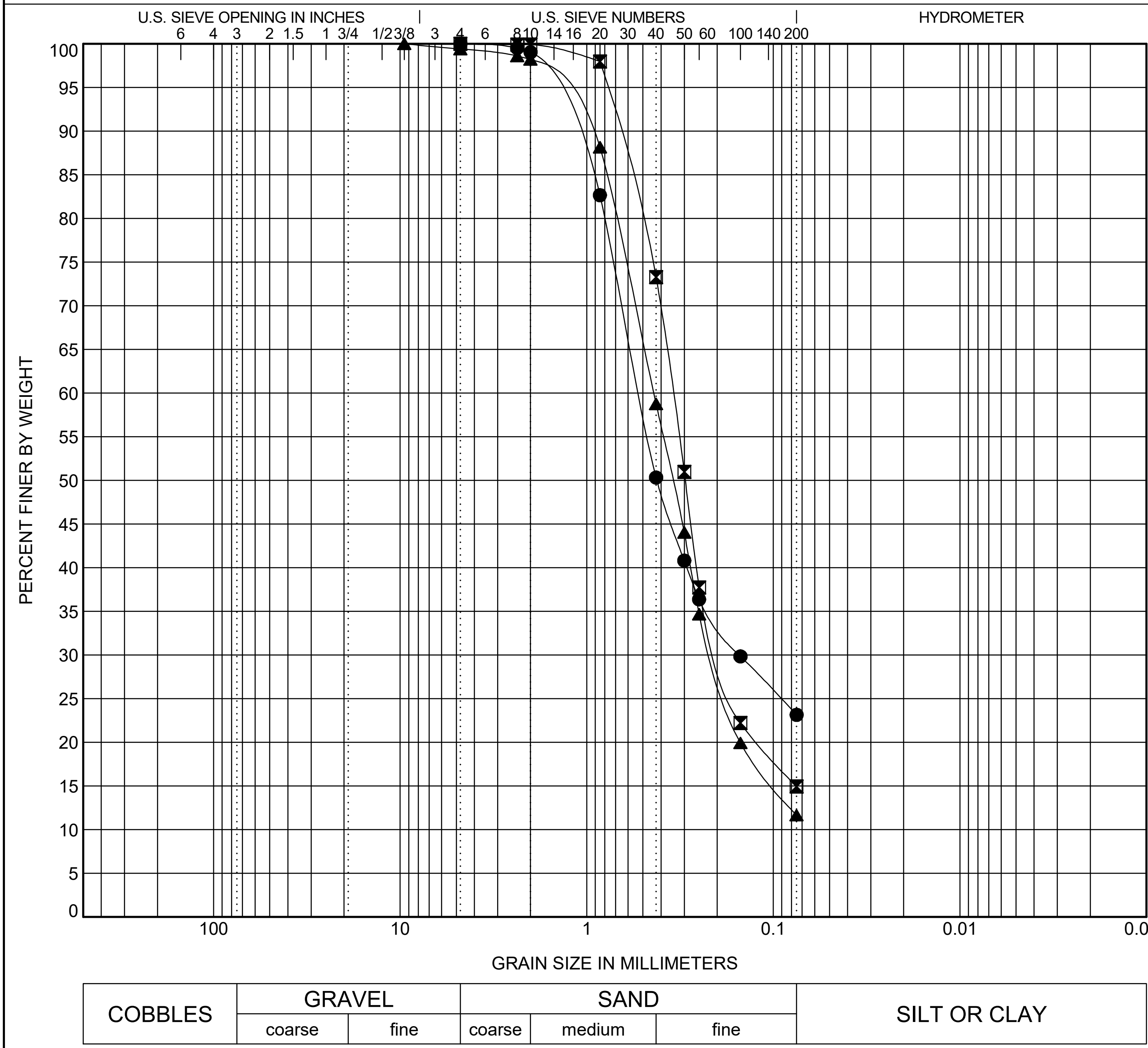
GRAIN SIZE DISTRIBUTION

CLIENT EVC-WDG Aurora, LLC **PROJECT NAME** Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003 **PROJECT LOCATION** Aurora, CO



BOREHOLE		DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**M2**	**9.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
⧗	**M3**	**4.0**	**SILTY SAND(SM)**	**NP**	**NP**	**NP**		
▲	**M7**	**4.0**	**WELL-GRADED SAND with SILT(SW-SM)**	**NP**	**NP**	**NP**	**1.58**	**6.70**

BOREHOLE		DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**M2**	**9.0**	**4.75**	**0.523**	**0.152**		**0.0**	**76.9**	**23.1**	
⧗	**M3**	**4.0**	**4.75**	**0.346**	**0.194**		**0.0**	**85.1**	**14.9**	
▲	**M7**	**4.0**	**9.5**	**0.438**	**0.213**		**0.6**	**87.7**	**11.7**	

GRAIN SIZE - GINT STD US LAB.GDT - 3/8/23 16:31 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2022\23.22.003 EAGLE RIDGE.GPJ

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Westminster, CO 80234

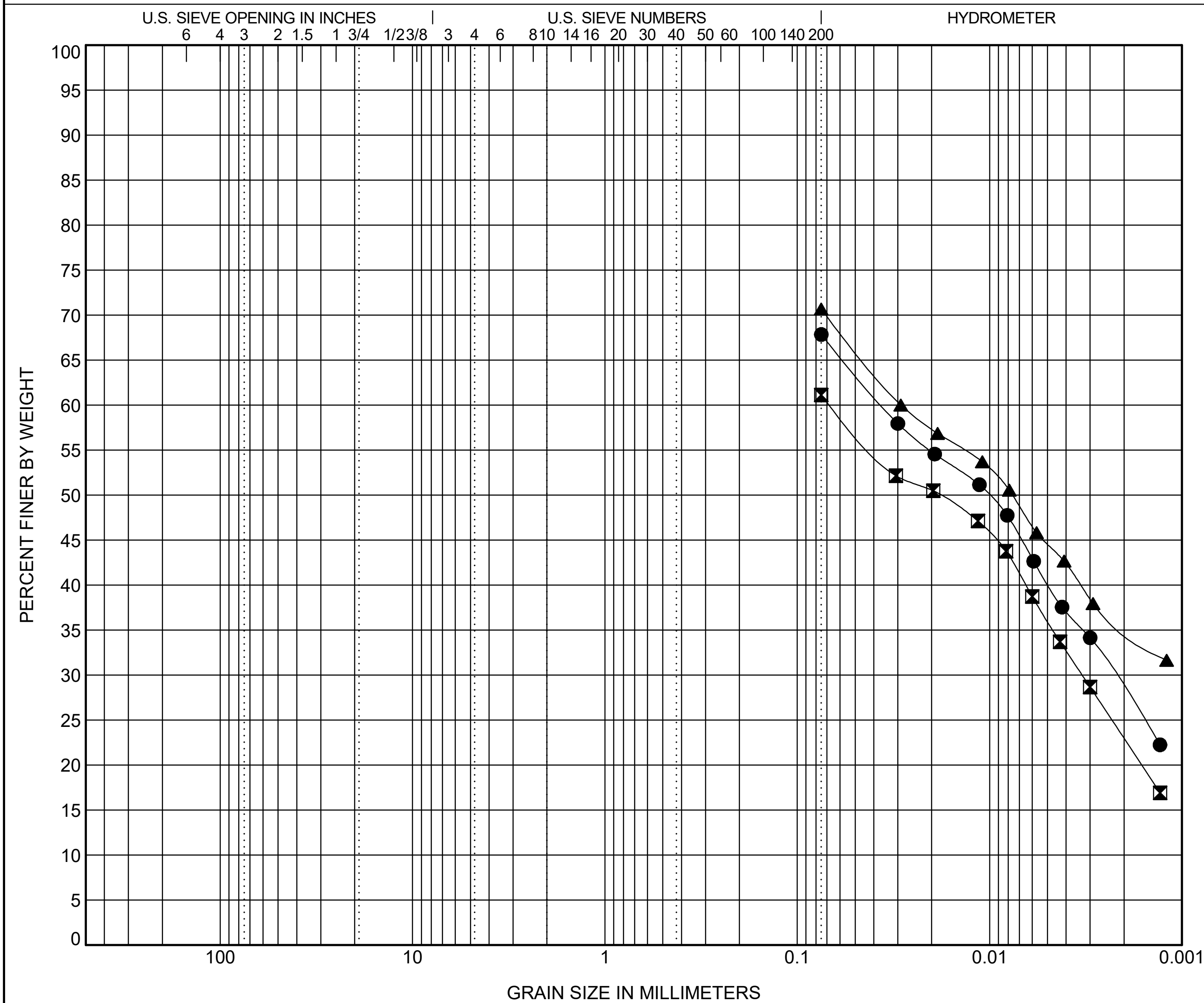
GRAIN SIZE DISTRIBUTION

CLIENT EVC-WDG Aurora, LLC

PROJECT NAME Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003

PROJECT LOCATION Aurora, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**M4**	**4.0**	**SANDY LEAN CLAY(CL)**	**39**	**20**	**19**		
⊠	**M8**	**4.0**	**SANDY LEAN CLAY(CL)**	**38**	**20**	**18**		
▲	**M10**	**2.0**	**LEAN CLAY with SAND(CL)**	**44**	**19**	**25**		

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**M4**	**4.0**	**0.075**	**0.036**	**0.002**				**27.7**	**40.2**
⊠	**M8**	**4.0**	**0.075**	**0.067**	**0.003**				**25.2**	**36.0**
▲	**M10**	**2.0**	**0.075**	**0.029**					**26.1**	**44.6**

GRAIN SIZE - GINT STD US LAB.GDT - 3/6/23 16:47 - Y:\GINT BACKUPS\MAIN TRANSFER 10.28\PROJECTS GEO 2022\23.22.003 EAGLE RIDGE.GPJ

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Westminster, CO 80234

SUMMARY OF LABORATORY RESULTS

CLIENT EVC-WDG Aurora, LLC

PROJECT NAME Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003

PROJECT LOCATION Aurora, CO

Borehole	Depth	Soil Description	Water Content (%)	Dry Density (pcf)	Swell (+) or Consolidation (-)/ Surcharge (%/psf)	Water Soluble Sulfates (ppm)	Passing #200 Sieve (%)	Atterberg Limits		
								Liquid Limit	Plastic Limit	Plasticity Index
M1	4	SANDY LEAN CLAY to CLAYEY SAND	4.2	107.8	-0.7/500					
M1	9	SILTY SAND	2.4	102.0						
M1	14	SILTY SAND	10.4	115.1						
M1	19	SILTY SAND	11.3	121.4						
M1	24	CLAYSTONE BEDROCK	14.7	114.2						
M1	34	CLAYSTONE BEDROCK	19.7							
M2	4	SILTY SAND	1.5	102.7						
M2	9	SILTY SAND(SM)	2.0	118.5			23	NP	NP	NP
M2	19	SILTY SAND	12.3	122.2						
M2	24	CLAYSTONE BEDROCK	19.6	107.2						
M3	2	CLAYEY SAND	3.8							
M3	4	SILTY SAND(SM)	1.6	108.4			15	NP	NP	NP
M3	9	SILTY SAND	1.6	107.4						
M3	14	SILTY SAND	3.6	118.3						
M3	19	SILTY SAND	20.7	105.6						
M3	24	SILTY SAND	13.7	117.5						
M4	4	SANDY LEAN CLAY	13.8	104.8	+3.0/500	400	68	39	20	19
M4	9	SILTY SAND	2.2	110.6						
M4	14	SILTY SAND	2.4	121.6						
M4	19	SILTY SAND	2.4	123.6						
M4	24	SILTY SAND	4.1	120.0						
M4	34	SILTY SAND	13.8	110.7						
M5	4	SANDY LEAN CLAY to CLAYEY SAND	3.6	98.3						
M5	9	SILTY SAND	1.6	107.6						
M5	14	SILTY SAND	10.4	96.4						
M5	19	SILTY SAND	10.5	122.9						
M5	24	SILTY SAND	14.3	114.0						
M6	2	SANDY LEAN CLAY	8.7	114.6	+3.3/500					
M6	4	SILTY SAND	4.3	102.3						
M6	9	SILTY SAND	2.0	104.2						

Cole Garner Geotechnical
1070 W 124th Ave, Suite 300
Westminster, CO 80234

SUMMARY OF LABORATORY RESULTS

CLIENT EVC-WDG Aurora, LLC

PROJECT NAME Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003

PROJECT LOCATION Aurora, CO

Borehole	Depth	Soil Description	AASHTO Class-ification	Group Index	Water Content (%)	Dry Density (pcf)	Swell (+) or Consolidation (-)/ Surcharge (%/psf)	Water Soluble Sulfates (ppm)	Passing #200 Sieve (%)	Atterberg Limits		
										Liquid Limit	Plastic Limit	Plasticity Index
M6	14	SILTY SAND			12.4	109.6						
M6	19	SILTY SAND			22.7	102.8						
M6	24	SILTY SAND			12.9	117.8						
M7	4	WELL-GRADED SAND with SILT(SW-SM)	A-2-4	0	1.9	106.9			12	NP	NP	NP
M7	9	SILTY SAND			1.4	106.7						
M7	14	SILTY SAND			14.2	115.4						
M7	19	SILTY SAND			10.5	111.9						
M7	24	SILTY SAND			16.0	112.9						
M8	4	SANDY LEAN CLAY	A-6	9	7.6			600	61	38	20	18
M8	9	CLAYEY to SILTY SAND			3.3	126.6						
M8	14	SILTY SAND			4.8	123.9						
M8	19	CLAYEY to SILTY SAND			3.8	124.4						
M8	24	SILTY SAND			15.2	106.5						
M8	34	SILTY SAND			15.4	112.6						
M9	4	SANDY LEAN CLAY to CLAYEY SAND			10.7	114.8	+0.4/500					
M9	9	SANDY LEAN CLAY to CLAYEY SAND			3.5	123.1	+1.6/500					
M9	14	SILTY SAND			3.0	101.5						
M9	19	SILTY SAND			10.4	123.8						
M9	24	SILTY SAND			11.1	114.6						
M10	2	LEAN CLAY with SAND(CL)	A-7-6	16	6.7	100.7	+4.8/500		71	44	19	25
M10	4	LEAN CLAY with SAND			8.2	104.2						
M10	9	SILTY SAND			2.6	116.4						

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										Liquid Limit	Plastic Limit	Plasticity Index
C1	2	SANDY LEAN CLAY(CL)	A-6	6	12.2	112.6	+3.2/200	2,100	57	36	20	16
C1	4	SANDY LEAN CLAY			9.9	120.1						
C1	9	SILTY SAND			8.7	118.3						
C1	14	SILTY SAND			3.0	107.9						
C2	2	CLAYEY SAND(SC)	A-6	1	7.4	115.3		900	37	34	22	12
C2	4	SANDY LEAN CLAY			9.7	120.7	+2.1/200					
C2	9	SILTY SAND			2.7	107.0						
C2	14	SILTY SAND			1.9	105.5						
C3	2	CLAYEY SAND(SC)	A-2-6	0	4.0	107.4	+0.8/200		35	32	21	11
C3	4	CLAYEY to SILTY SAND			4.5	113.0		0				
C3	9	CLAYEY to SILTY SAND			5.6	112.8						
C3	14	CLAYEY to SILTY SAND			4.1	124.2						
C4	2	WELL-GRADED SAND with SILT(SW-SM)	A-1-b	0	1.8	111.1			8	NP	NP	NP
C4	4	SILTY SAND			2.7	103.8						
C4	9	SILTY SAND			4.4	113.9						
C4	14	SILTY SAND			12.2	119.0						
C5	2	SILTY SAND(SM)	A-2-4	0	4.1	112.2			25	NP	NP	NP
C5	4	SILTY SAND			3.6	110.7						
C5	9	SILTY SAND			3.6	111.8						
C5	14	SILTY SAND			3.4	115.6						
C6	2	SILTY SAND(SM)	A-2-4	0	3.2	102.6			20	NP	NP	NP
C6	4	SANDY LEAN CLAY(CL)	A-6	6	15.6	109.6	+5.4/200		58	35	20	15
C6	9	SILTY SAND			4.9	114.9						
C6	14	SILTY SAND			9.8	114.6						
C7	2	SILTY SAND			3.5	105.3						
C7	4	SILTY SAND(SM)	A-2-4	0	2.9	107.2		100	22	NP	NP	NP
C7	9	SILTY SAND			3.5	127.4						
C7	14	SILTY SAND			4.1	110.6						
C8	2	SILTY SAND(SM)	A-2-4	0	2.5	102.5			16	NP	NP	NP
C8	4	SANDY LEAN CLAY to CLAYEY SAND			5.6	109.2						

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SUMMARY OF LABORATORY RESULTS

CLIENT EVC-WDG Aurora, LLC

PROJECT NAME Eagle Ridge Mixed-Use Development

PROJECT NUMBER 23.22.003

PROJECT LOCATION Aurora, CO

Borehole	Depth	Soil Description	AASHTO Class-ification	Group Index	Water Content (%)	Dry Density (pcf)	Swell (+) or Consolidation (-)/ Surcharge (%/psf)	Water Soluble Sulfates (ppm)	Passing #200 Sieve (%)	Atterberg Limits		
										Liquid Limit	Plastic Limit	Plasticity Index
C8	9	SANDY LEAN CLAY			10.6	113.0						
C8	14	SILTY SAND			2.6	117.5						

Field Infiltration Rate Testing

Cole Garner Geotechnical
1070 West 124th Avenue, Ste. 300
Westminster, CO 80234
(303) 996-2999

Project Name:	Proposed Eagle Ridge Mixed-Use Development				
Cole Garner Project No.:	23.22.003			Date:	2/21/2022
Test Location or ID:	M10	**Test Type:**	Cased Bore Hole	**Eng./Tech.:**	A. Santiago
Approx. Ground Elev (ft):	5,500	**Approx. Test Depth (in):**	120	**Hole diameter (in):**	4
Soil Type at base of test:	Silty Sand				

Interval Start Time (hh:mm)	Interval End Time (hh:mm)	Length of Interval (min)	Water Level Drop (in)	Infiltration Rate During Interval (min/in)	Infiltration Rate During Interval (in/hr)
10:00	10:30	0:30	15.250	1.97	30.50
10:30	11:00	0:30	15.500	1.94	31.00
11:00	11:30	0:30	21.500	1.40	43.00
11:30	12:00	0:30	24.500	1.22	49.00
12:00	12:30	0:30	26.750	1.12	53.50
12:30	13:00	0:30	26.750	1.12	53.50
13:00	13:30	0:30	27.000	1.11	54.00

Final Infiltration Rate:	**54.00**
Average Infiltration Rate:	**44.93**

APPENDIX C

GENERAL NOTES

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1⅜" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2.5" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
CB:	California Barrel - 1.92" I.D., 2.5" O.D., unless otherwise noted	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the “Standard Penetration” or “N-value”. For 2.5” O.D. California Barrel samplers (CB) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as “blows per inch,” and is not considered equivalent to the “Standard Penetration” or “N-value”.

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling
WCI:	Wet Cave in	WD:	While Drilling
DCI:	Dry Cave in	BCR:	Before Casing Removal
AB:	After Boring	ACR:	After Casing Removal

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

FINE-GRAINED SOILS

(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency
< 3	0-2	Very Soft
3-5	3-4	Soft
6-10	5-8	Medium Stiff
11-18	9-15	Stiff
19-36	16-30	Very Stiff
> 36	> 30	Hard

COARSE-GRAINED SOILS

(CB) Blows/Ft.	(SS) Blows/Ft.	Relative Density
0-5	< 3	Very Loose
6-14	4-9	Loose
15-46	10-29	Medium Dense
47-79	30-50	Dense
> 79	> 50	Very Dense

BEDROCK

(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency
< 24	< 20	Weathered
24-35	20-29	Firm
36-60	30-49	Medium Hard
61-96	50-79	Hard
> 96	> 79	Very Hard

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		Organic	**Liquid limit - oven dried** / **Liquid limit - not dried** < 0.75	OL	Organic clay[K,L,M,N]
					Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		Organic	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay[K,L,M,P]
					Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well graded gravel with silt, GW-GC well graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well graded sand with silt, SW-SC well graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10} \qquad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

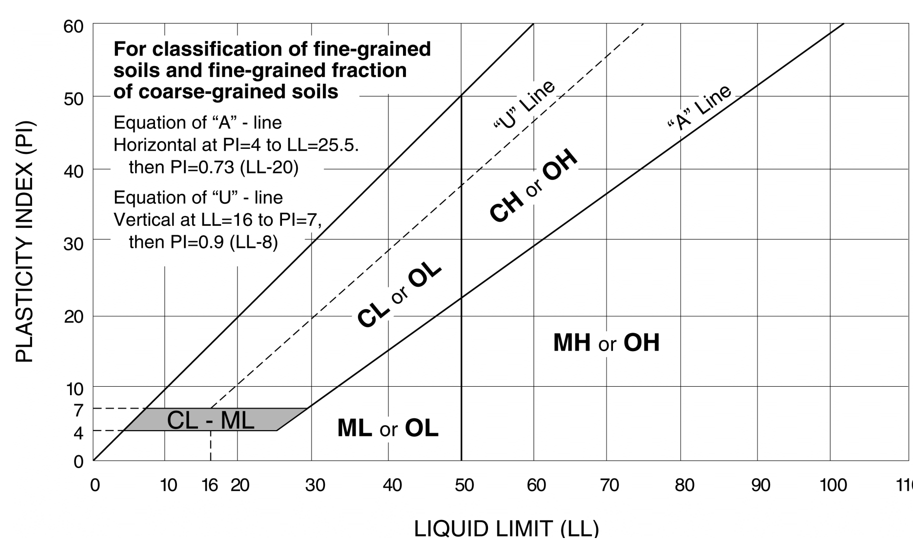
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



ROCK CLASSIFICATION
(Based on ASTM C-294)

Sedimentary Rocks

Sedimentary rocks are stratified materials laid down by water or wind. The sediments may be composed of particles or pre-existing rocks derived by mechanical weathering, evaporation or by chemical or organic origin. The sediments are usually indurated by cementation or compaction.

Chert Very fine-grained siliceous rock composed of micro-crystalline or cyrptocrystalline quartz, chalcedony or opal. Chert is various colored, porous to dense, hard and has a conchoidal to splintery fracture.

Claystone Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Soft massive and may contain carbonate minerals.

Conglomerate Rock consisting of a considerable amount of rounded gravel, sand and cobbles with or without interstitial or cementing material. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other materials.

Dolomite A fine-grained carbonate rock consisting of the mineral dolomite [$CaMg(CO_3)_2$]. May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).

Limestone A fine-grained carbonate rock consisting of the mineral calcite ($CaCO_3$). May contain noncarbonate impurities such as quartz, chert, clay minerals, organic matter, gypsum and sulfides. Reacts with hydrochloric acid (HCL).

Sandstone Rock consisting of particles of sand with or without interstitial and cementing materials. The cementing or interstitial material may be quartz, opal, calcite, dolomite, clay, iron oxides or other material.

Shale Fine-grained rock composed of or derived by erosion of silts and clays or any rock containing clay. Shale is hard, platy, of fissile may be gray, black, reddish or green and may contain some carbonate minerals (calcareous shale).

Siltstone Fine grained rock composed of or derived by erosion of silts or rock containing silt. Siltstones consist predominantly of silt sized particles (0.0625 to 0.002 mm in diameter) and are intermediate rocks between claystones and sandstones and may contain carbonate minerals.

LABORATORY TEST
SIGNIFICANCE AND PURPOSE

TEST	SIGNIFICANCE	PURPOSE
California Bearing Ratio	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	***Pavement Thickness Design***
Consolidation	Used to develop an estimate of both the rate and amount of both differential and total settlement of a structure.	***Foundation Design***
Direct Shear	Used to determine the consolidated drained shear strength of soil or rock.	***Bearing Capacity, Foundation Design, and Slope Stability***
Dry Density	Used to determine the in-place density of natural, inorganic, fine-grained soils.	***Index Property Soil Behavior***
Expansion	Used to measure the expansive potential of fine-grained soil and to provide a basis for swell potential classification.	***Foundation and Slab Design***
Gradation	Used for the quantitative determination of the distribution of particle sizes in soil.	***Soil Classification***
Liquid & Plastic Limit, Plasticity Index	Used as an integral part of engineering classification systems to characterize the fine-grained fraction of soils, and to specify the fine-grained fraction of construction materials.	***Soil Classification***
Permeability	Used to determine the capacity of soil or rock to conduct a liquid or gas.	***Groundwater Flow Analysis***
pH	Used to determine the degree of acidity or alkalinity of a soil.	***Corrosion Potential***
Resistivity	Used to indicate the relative ability of a soil medium to carry electrical currents.	***Corrosion Potential***
R-Value	Used to evaluate the potential strength of subgrade soil, subbase, and base course material, including recycled materials for use in road and airfield pavements.	***Pavement Thickness Design***
Soluble Sulfate	Used to determine the quantitative amount of soluble sulfates within a soil mass.	***Corrosion Potential***
Unconfined Compression	To obtain the approximate compressive strength of soils that possess sufficient cohesion to permit testing in the unconfined state.	***Bearing Capacity Analysis for Foundations***
Water Content	Used to determine the quantitative amount of water in a soil mass.	***Index Property Soil Behavior***

REPORT TERMINOLOGY
(Based on ASTM D653)

Allowable Soil Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Alluvium	Soil, the constituents of which have been transported in suspension by flowing water and subsequently deposited by sedimentation.
Aggregate Base Course	A layer of specified material placed on a subgrade or subbase usually beneath slabs or pavements.
Backfill	A specified material placed and compacted in a confined area.
Bedrock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
Bench	A horizontal surface in a sloped deposit.
Caisson (Drilled Pier or Shaft)	A concrete foundation element cast in a circular excavation which may have an enlarged base. Sometimes referred to as a cast-in-place pier or drilled shaft.
Coefficient of Friction	A constant proportionality factor relating normal stress and the corresponding shear stress at which sliding starts between the two surfaces.
Colluvium	Soil, the constituents of which have been deposited chiefly by gravity such as at the foot of a slope or cliff.
Compaction	The densification of a soil by means of mechanical manipulation
Concrete Slab-on-Grade	A concrete surface layer cast directly upon a base, subbase or subgrade, and typically used as a floor system.
Differential Movement	Unequal settlement or heave between, or within foundation elements of structure.
Earth Pressure	The pressure exerted by soil on any boundary such as a foundation wall.
ESAL	Equivalent Single Axle Load, a criteria used to convert traffic to a uniform standard, (18,000 pound axle loads).
Engineered Fill	Specified material placed and compacted to specified density and/or moisture conditions under observations of a representative of a geotechnical engineer.
Equivalent Fluid	A hypothetical fluid having a unit weight such that it will produce a pressure against a lateral support presumed to be equivalent to that produced by the actual soil. This simplified approach is valid only when deformation conditions are such that the pressure increases linearly with depth and the wall friction is neglected.
Existing Fill (or Man-Made Fill)	Materials deposited throughout the action of man prior to exploration of the site.
Existing Grade	The ground surface at the time of field exploration.

REPORT TERMINOLOGY
(Based on ASTM D653)

Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Finished Grade	The final grade created as a part of the project.
Footing	A portion of the foundation of a structure that transmits loads directly to the soil.
Foundation	The lower part of a structure that transmits the loads to the soil or bedrock.
Frost Depth	The depth at which the ground becomes frozen during the winter season.
Grade Beam	A foundation element or wall, typically constructed of reinforced concrete, used to span between other foundation elements such as drilled piers.
Groundwater	Subsurface water found in the zone of saturation of soils or within fractures in bedrock.
Heave	Upward movement.
Lithologic	The characteristics which describe the composition and texture of soil and rock by observation.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil, sometimes referred to as natural soil.
Optimum Moisture Content	The water content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.
Perched Water	Groundwater, usually of limited area maintained above a normal water elevation by the presence of an intervening relatively impervious continuous stratum.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Skin Friction (Side Shear)	The frictional resistance developed between soil and an element of the structure such as a drilled pier.
Soil (Earth)	Sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.
Strain	The change in length per unit of length in a given direction.
Stress	The force per unit area acting within a soil mass.
Strip	To remove from present location.
Subbase	A layer of specified material in a pavement system between the subgrade and base course.
Subgrade	The soil prepared and compacted to support a structure, slab or pavement system.

STRUCTURAL ENGINEERING CALCULATIONS

FOR

THE RESERVES AT EAGLE POINT
NEW APARTMENT COMPLEX
AURORA, COLORAD

PREPARED BY

JEFFREY L. WRIGHT, P.E.
&
MICHAEL J. FALBE, P.E.
&
RYAN M. HAGEDORN, P.E.

OF

BOB D. CAMPBELL & COMPANY, INC.
STRUCTURAL ENGINEERS
4338 BELLEVIEW AVENUE
KANSAS CITY, MISSOURI 64111
(816) 531-4144

Structural plan review is limited to a general survey for code compliance. No review is implied nor was undertaken to verify structural adequacy.

FOR

JonesGillamRenz ARCHITECTS
1881 MAIN STREET, SUITE 301
KANSAS CITY, MO 64108
785.827.0386

NOVEMBER 2, 2023

BOB D. CAMPBELL & CO.
Structural Engineers Since 1957
4338 Belleview Ave. 816.531.4144
Kansas City, MO 64111 www.bdc-engrs.com

Project:	Reserves at Eagle Point
Project No.:	JGR2304
Location:	Aurora, CO
By:	MJF / RMH
Date:	11/1/2023

Structural Design Criteria

Building Code:
International Building Code (IBC 2021)

Concrete:	ACI 318-19
Steel:	AISC 360-16
Wood:	NDS 2018
Connections:	ASCE 7-16

ANSI as approved in 2016

Basic Load Combinations - Allowable Stress Design (ASCE7-10)
D
D + L
D + (Lr or S or R)
D + 0.75L + 0.75(Lr or S of R)
D + (0.6W or 0.7E)
D + 0.75L + 0.75(0.6W) + 0.75(lR or S or R)
D + 0.75L + 0.75(0.7E) + 0.75S
0.6D + 0.6W
0.6D + 0.7E

Structural Design Loads

Dead Loads:

Roof	20 psf
Floors	40 psf

Live Loads:

Roofs	25 psf
Floors	40 psf
Decks	60 psf
Maintenance Platform	40 psf

Geotechnical Report

Report #	23.22.003
By:	Cole Garnger Geotechnical
Description:	Spread footings and continuous wall footings are designed to bear on soil capable of safely sustaining **2,500psf**

Materials

Steel:	Beams & Columns:	ASTM A992, Grade 50
	Miscellaneous steel:	ASTM A36
	Tubes & Pipes:	ASTM A500, Grade B

Concrete: 3500 psi (footings, grade beams)
4000 psi (interior flatwork)
4500 psi w/ 6% +/- 1% air entrainment (exterior flatwork)

Reinf. Steel: ASTM A615 or A706 Grade 60 steel

Wood:	Joists, beams, & trusses	No. 2 DF-L or SP
	LVL Members	Fb=2,600psf, E=1,900ksi
	PSL Members	Fb=2,900psf, E=2,000ksi

City of Aurora Public Works Department

ENGINEERING DESIGN CRITERIA

Building Division • 15151 E. Alameda Parkway, Ste 2400 • Aurora, CO 80012
303.739.7420 • Email: permitcounter@auroragov.org

CLIMATIC AND GEOGRAPHIC CRITERIA FOR THE 2021 I-CODES :

Roof Snow Load - P_f P_s	Calculate psf (Pergola 20 psf)
Ground Snow Load - P_g	40 psf
Basic Wind Speed - V_{mph} Linear interpolation is permitted between contours.	105-110 Risk Category II, 110-115 Risk Category III, 115-120 Risk Category IV, 100-105 Risk Category I
Special Wind Region	No
Topographic Effects	No
Exposure Category	IRC R301.2.1.4 or IBC 1609.4.3
Seismic Design Category Residential	B
Seismic Design Category Commercial	Per IBC chapter 16
Weathering	Severe
Minimum Frost Depth for Foundations	36 inches
Winter Design Temperature	1 DEGREE (F)
Ice Barrier Underlayment Required	Yes
Flood Hazard	Varies – See City Code Chapter 70
Air Freezing Index	712
Mean Annual Temperature	50 DEGREES (F)

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Kansas City, MO 64111 www.bdc-engrs.com

Project:	Reserves at Eagle Point
Project No.:	JGR2304
Location:	Aurora, CO
By:	MJF / RMH
Date:	11/1/2023

Wind Loads

International Building Code 2015 / ASCE7-10 *Spreadsheet password = bdc*

ASCE 7-10:

Chapter 26 - General Requirements

Occupancy Risk Category	II		Table 1.5-2, p. 4
Basic Wind Speed, V	115	mph	Figure 26.5-1A, B, C, pp. 191a-193b
Wind Directionality Factor, Kd	0.85		Table 26.6-1, p. 194
Exposure Category	B		26.7.3, p. 195
Topographic Factor, Kzt	1.00		26.8.2, p. 195
Gust Effect Factor, G	0.85		26.9.1, p. 198
Enclosure Classification	Enclosed		26.10, p. 200
Internal Pressure Coefficient, Gcpi (Case 1)	0.18		Table 26.11-1, p. 201
Internal Pressure Coefficient, Gcpi (Case 2)	-0.18		Table 26.11-1, p. 201

Chapter 27 - Wind Loads on Buildings - MWFRS (Directional Procedure)

Windward Wall - Case 1 (Positive Internal Pressure)				
z (ft)	Kz p. 205	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 207	Design Wind Pressure p = qGCp - qi(Gcpi)
0-15	0.57	16.40	0.8	7.22 psf
16-20	0.62	17.84	0.8	8.20 psf
21-25	0.66	18.99	0.8	8.98 psf
26-30	0.70	20.14	0.8	9.76 psf
31-40	0.76	21.87	0.8	10.94 psf
41-50	0.81	23.31	0.8	11.91 psf
51-60	0.85	24.46	0.8	12.70 psf
61-70	0.89	25.61	0.8	13.48 psf
71-80	0.93	26.76	0.8	14.26 psf
81-90	0.96	27.63	0.8	14.85 psf
91-100	0.99	28.49	0.8	15.44 psf

Design Wind Pressure Windward + Leeward
20.45 psf
21.43 psf
22.21 psf
22.99 psf
24.17 psf
25.15 psf
25.93 psf
26.71 psf
27.49 psf
28.08 psf
28.67 psf

Leeward Wall - Case 1 (Positive Internal Pressure)				
Mean Roof Height h (ft)	Kz p. 205	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 264	Design Wind Pressure p = qGCp - qi(Gcpi)
35	0.76	21.87	-0.5	-13.23 psf

Side Wall - Case 1 (Positive Internal Pressure)				
Mean Roof Height h (ft)	Kz p. 205	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 264	Design Wind Pressure p = qGCp - qi(Gcpi)
35	0.76	21.87	-0.7	-16.95 psf

Windward Wall - Case 2 (Negative Internal Pressure)				
z (ft)	Kz p. 205	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 207	Design Wind Pressure p = qGCp - qi(Gcpi)
0-15	0.57	16.40	0.8	15.09 psf
16-20	0.62	17.84	0.8	16.07 psf
21-25	0.66	18.99	0.8	16.85 psf
26-30	0.70	20.14	0.8	17.63 psf
31-40	0.76	21.87	0.8	18.81 psf
41-50	0.81	23.31	0.8	19.79 psf
51-60	0.85	24.46	0.8	20.57 psf
61-70	0.89	25.61	0.8	21.35 psf
71-80	0.93	26.76	0.8	22.14 psf
81-90	0.96	27.63	0.8	22.72 psf
91-100	0.99	28.49	0.8	23.31 psf

Design Wind Pressure Windward + Leeward
20.45 psf
21.43 psf
22.21 psf
22.99 psf
24.17 psf
25.15 psf
25.93 psf
26.71 psf
27.49 psf
28.08 psf
28.67 psf

Leeward Wall - Case 2 (Negative Internal Pressure)				
Mean Roof Height h (ft)	Kz p. 205	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 264	Design Wind Pressure p = qGCp - qi(Gcpi)
35	0.76	21.87	-0.5	-5.36 psf
Side Wall - Case 1 (Negative Internal Pressure)				
Mean Roof Height h (ft)	Kz p. 205	Velocity Pressure, qz qz = 0.00256KzKztKdV^2	Cp p. 264	Design Wind Pressure p = qGCp - qi(Gcpi)
35	0.76	21.87	-0.7	-9.08 psf

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Kansas City, MO 64111 www.bdc-engrs.com

Project:	Reserves at Eagle Point
Project No.:	JGR2304
Location:	Aurora, CO
By:	MJF / RMH
Date:	11/1/2023

Earthquake Loads

International Building Code 2015 / ASCE7-1(*Spreadsheet password = bdc*

			(ASCE 7-10)
Occupancy Risk Category	II		*(Table 1.5-1)*
Ss	18.8	%g	*(Figure 22-1)*
S1	5.4	%g	*(Figure 22-2)*
Site Class (per soil report or assume D	D		*(Table 20.3-1)*
Site Coefficient, Fa	1.6		*(Table 11.4-1)*
Site Coefficient, Fv	2.4		*(Table 11.4-2)*
Importance Factor,	1.0		*(Table 1.5-1)*

11.4.3 Site coefficients and adjusted maximum considered earthquake response acceleration parameter

for short periods, Sms = Fa*Ss	0.301	*(Equation 11.4-1)*
at 1-second period, Sm1 = Fv*S1	0.1296	*(Equation 11.4-2)*

11.4.4 Design spectral response acceleration parameters

Sds = (2/3)*Sms	0.201
Sd1 = (2/3)*Sm1	0.086

Seismic Design Category	B	*(Tables 11.6-1 and 11.6-2)*

12.8 Equivalent Lateral Force Procedure

Seismic Force Resisting System	Light Framed Walls with Shear Panels of other ma	
Response Modification Factor, R	2.0	*(Table 12.2-1)*
Cs = Sds/(R/I)	0.100	
Seismic Base Shear, V = CsW	**0.100 W**	*(12.8-1)*
W = Effective seismic weight per Section 12.7.2		

ASCE 7-16 Wind Forces, Chapter 27, Part 1

Basic Values

Risk Category	2	per ASCE 7-10 Table 1.5.1	Horizontal Dim. in North-South Direction (B or L)	70.0 ft
V : Basic Wind Speed	115.0	per ASCE 7-10 Fig. 26.5-1 A,B,C	Horizontal Dim. in East-West Direction (B or L)	180.0 ft
Kd : Directionality Factor	0.850	per ASCE 7-10 Table 26.6-1	h : Mean Roof height =	35.0 ft

Exposure Category per ASCE 7-10 Section 26.7

North :	Exposure B	East :	Exposure B
South :	Exposure B	West :	Exposure B

Topographic Factor per ASCE 7-10 Sec 26.8 & Figure 26.8-1

North :	K1 =	K2 =	K3 =	Kzt = 1.000
South :	K1 =	K2 =	K3 =	Kzt = 1.000
East :	K1 =	K2 =	K3 =	Kzt = 1.000
West :	K1 =	K2 =	K3 =	Kzt = 1.000

Building Period & Flexibility Category

User has specified the building frequency is >= 1 Hz, therefore considered RIGID for both North-South and East-West directions.

Building Story Data

Level Description	hi ft	Story Ht ft	E_R : X ft	E_R : X ft
Roof Brg	31.91	10.81	0.000	0.000
3rd Floor	21.10	10.55	0.000	0.000
2nd Floor	10.55	10.55	0.000	0.000

Gust Factor

For wind coming from direction indicated

North =	**0.850**	South =	**0.850**
East =	**0.850**	West =	**0.850**

Enclosure

Check if Building Qualifies as "Opei

	North Wall	South Wall	East Wall	West Wall	Roof	Total
Agross	1.0 ft^2	1.0 ft^2	1.0 ft^2	1.0 ft^2	ft^2	4.0 ft^2
Aopenings	ft^2	ft^2	ft^2	ft^2	ft^2	0.0 ft^2
Aopenings >= 0.8 * Agross ?	No	No	No	No		

All four Agross values must be non-zero **Building does NOT qualify as "Open"**

User has specified the Building is to be considered Enclosed when NORTH elevation receives positi

User has specified the Building is to be considered Enclosed when SOUTH elevation receives positi

User has specified the Building is to be considered Enclosed when EAST elevation receives positive

User has specified the Building is to be considered Enclosed when WEST elevation receives positive

Velocity Pressures

When the following walls experience leeward or sidewall pressures, the value of Kh shall be (per Table 27.3-1) :

North Wall = 0.7321 psf South Wall = 0.7321 psf East Wall = 0.7321 psf West Wall = 0.7321 psf

When the following walls experience leeward or sidewall pressures, the value of qh shall be (per Eq 27.3-1) :

North Wall = 21.069 psf South Wall = 21.069 psf East Wall = 21.069 psf West Wall = 21.069 psf

qz : Windward Wall Velocity Pressures at various heights per Eq. 27.3-1

	North Elevation		South Elevation		East Elevation		West Elevation	
Height Above Base (ft)	Kz	qz	Kz	qz	Kz	qz	Kz	qz
0.00	0.575	16.54	0.575	16.54	0.575	16.54	0.575	16.54
4.00	0.575	16.54	0.575	16.54	0.575	16.54	0.575	16.54
8.00	0.575	16.54	0.575	16.54	0.575	16.54	0.575	16.54

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ASCE 7-16 Wind Forces, Chapter 27, Part 1

12.00	0.575	16.54	0.575	16.54	0.575	16.54	0.575	16.54
16.00	0.585	16.85	0.585	16.85	0.585	16.85	0.585	16.85
20.00	0.624	17.96	0.624	17.96	0.624	17.96	0.624	17.96
24.00	0.657	18.92	0.657	18.92	0.657	18.92	0.657	18.92
28.00	0.687	19.77	0.687	19.77	0.687	19.77	0.687	19.77
32.00	0.714	20.54	0.714	20.54	0.714	20.54	0.714	20.54

Pressure Coefficients

GCpi Values when elevation receives positive external pressure

GCpi : Internal pressure coefficient, per sec. 26.11 and Table 26.11-1

North		South		East		West	
+/-	0.180	+/-	0.180	+/-	0.180	+/-	0.180

Specify Cp Values from Figure 27.4-1 for Windward, Leeward & Side Walls

Cp Values when elevation receives positive external pressure

	North	South	East	West
Windward Wall	0.80	0.80	0.80	0.80
Leeward Wall	-0.50	-0.50	-0.50	-0.50
Side Walls	-0.70	-0.70	-0.70	-0.70

Wind Pressures

Wind Pressures when NORTH Elevation receives positive external wind pressure

	Positive Internal	Negative Internal
Leeward Wall Pressures	-12.747 psf	-5.162 psf
Side Wall Pressures	-16.329 psf	-8.744 psf

Windward Wall Pressures . . Height Above Base (ft)	Positive Internal Pressure (psf)	Negative Internal Pressure (psf)
0.00	7.45	15.04
4.00	7.45	15.04
8.00	7.45	15.04
12.00	7.45	15.04
16.00	7.66	15.25
20.00	8.42	16.00
24.00	9.07	16.66
28.00	9.65	17.23
32.00	10.17	17.76

Wind Pressures when SOUTH Elevation receives positive external wind pressure

	Positive Internal	Negative Internal
Leeward Wall Pressures	-12.747 psf	-5.162 psf
Side Wall Pressures	-16.329 psf	-8.744 psf

Windward Wall Pressures . . Height Above Base (ft)	Positive Internal Pressure (psf)	Negative Internal Pressure (psf)
0.00	7.45	15.04
4.00	7.45	15.04
8.00	7.45	15.04
12.00	7.45	15.04
16.00	7.66	15.25
20.00	8.42	16.00
24.00	9.07	16.66
28.00	9.65	17.23
32.00	10.17	17.76

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Kansas City, MO 64111 www.bdc-engrs.com

Project Title: The Reserves at Eagle Point
Engineer: MJF
Project ID: JGR2304
Project Descr: New Apartments

ASCE 7-16 Wind Forces, Chapter 27, Part 1

Project File: JGR2304.ec6

Wind Pressures when EAST Elevation receives positive external wind pressure

	Positive Internal	Negative Internal
Leeward Wall Pressures	-12.747 psf	-5.162 psf
Side Wall Pressures	-16.329 psf	-8.744 psf

Windward Wall Pressures . . Height Above Base (ft)	Positive Internal Pressure (psf)	Negative Internal Pressure (psf)
0.00	7.45	15.04
4.00	7.45	15.04
8.00	7.45	15.04
12.00	7.45	15.04
16.00	7.66	15.25
20.00	8.42	16.00
24.00	9.07	16.66
28.00	9.65	17.23
32.00	10.17	17.76

Wind Pressures when WEST Elevation receives positive external wind pressure

	Positive Internal	Negative Internal
Leeward Wall Pressures	-12.747 psf	-5.162 psf
Side Wall Pressures	-16.329 psf	-8.744 psf

Windward Wall Pressures . . Height Above Base (ft)	Positive Internal Pressure (psf)	Negative Internal Pressure (psf)
0.00	7.45	15.04
4.00	7.45	15.04
8.00	7.45	15.04
12.00	7.45	15.04
16.00	7.66	15.25
20.00	8.42	16.00
24.00	9.07	16.66
28.00	9.65	17.23
32.00	10.17	17.76

Story Forces for Design Wind Load Cases

Values below are calculated based on a building with dimensions B x L x h as defined on the "Basic Values" tab.

Load Case	Windward Wall	Building level	Ht. Range	Trib. Height	Wind Shear Components (k) In "Y" Direction	In "X" Direction	Eccentricity for (ft) "Y" Shear	"X" Shear	Mt, (ft-k)
CASE 1	North	Level 3	26.51' -> 31.9	5.41	-21.94	---	---	---	---
CASE 1	North	Level 2	15.83' -> 26.5	10.68	-41.02	---	---	---	---
CASE 1	North	Level 1	5.28' -> 15.8:	10.55	-38.37	---	---	---	---
CASE 1	South	Level 3	26.51' -> 31.9	5.41	21.94	---	---	---	---
CASE 1	South	Level 2	15.83' -> 26.5	10.68	41.02	---	---	---	---
CASE 1	South	Level 1	5.28' -> 15.8:	10.55	38.37	---	---	---	---
CASE 1	East	Level 3	26.51' -> 31.9	5.41	---	-8.53	---	---	---
CASE 1	East	Level 2	15.83' -> 26.5	10.68	---	-15.95	---	---	---
CASE 1	East	Level 1	5.28' -> 15.8:	10.55	---	-14.92	---	---	---
CASE 1	West	Level 3	26.51' -> 31.9	5.41	---	8.53	---	---	---
CASE 1	West	Level 2	15.83' -> 26.5	10.68	---	15.95	---	---	---
CASE 1	West	Level 1	5.28' -> 15.8:	10.55	---	14.92	---	---	---

CASE 2	North	Level 3	26.51' -> 31.9	5.41	-16.46	---	---	27.00	444.4
CASE 2	North	Level 2	15.83' -> 26.5	10.68	-30.76	---	---	27.00	830.6
CASE 2	North	Level 1	5.28' -> 15.8	10.55	-28.78	---	---	27.00	777.1
CASE 2	South	Level 3	26.51' -> 31.9	5.41	16.46	---	---	27.00	444.4
CASE 2	South	Level 2	15.83' -> 26.5	10.68	30.76	---	---	27.00	830.6
CASE 2	South	Level 1	5.28' -> 15.8	10.55	28.78	---	---	27.00	777.1
CASE 2	East	Level 3	26.51' -> 31.9	5.41	---	-6.40	10.50	---	67.2
CASE 2	East	Level 2	15.83' -> 26.5	10.68	---	-11.96	10.50	---	125.6
CASE 2	East	Level 1	5.28' -> 15.8	10.55	---	-11.19	10.50	---	117.5
CASE 2	West	Level 3	26.51' -> 31.9	5.41	---	6.40	10.50	---	67.2
CASE 2	West	Level 2	15.83' -> 26.5	10.68	---	11.96	10.50	---	125.6
CASE 2	West	Level 1	5.28' -> 15.8	10.55	---	11.19	10.50	---	117.5
CASE 3	North & East	Level 3	26.51' -> 31.9	5.41	-16.46	-6.40	---	---	---
CASE 3	North & East	Level 2	15.83' -> 26.5	10.68	-30.76	-11.96	---	---	---
CASE 3	North & East	Level 1	5.28' -> 15.8	10.55	-28.78	-11.19	---	---	---
CASE 3	North & West	Level 3	26.51' -> 31.9	5.41	-16.46	6.40	---	---	---
CASE 3	North & West	Level 2	15.83' -> 26.5	10.68	-30.76	11.96	---	---	---
CASE 3	North & West	Level 1	5.28' -> 15.8	10.55	-28.78	11.19	---	---	---
CASE 3	South & West	Level 3	26.51' -> 31.9	5.41	16.46	6.40	---	---	---
CASE 3	South & West	Level 2	15.83' -> 26.5	10.68	30.76	11.96	---	---	---
CASE 3	South & West	Level 1	5.28' -> 15.8	10.55	28.78	11.19	---	---	---
CASE 3	South & East	Level 3	26.51' -> 31.9	5.41	16.46	-6.40	---	---	---
CASE 3	South & East	Level 2	15.83' -> 26.5	10.68	30.76	-11.96	---	---	---
CASE 3	South & East	Level 1	5.28' -> 15.8	10.55	28.78	-11.19	---	---	---
CASE 4	North & East	Level 3	26.51' -> 31.9	5.41	-12.35	-4.80	10.50	27.00	384.0
CASE 4	North & East	Level 2	15.83' -> 26.5	10.68	-23.09	-8.98	10.50	27.00	717.8
CASE 4	North & East	Level 1	5.28' -> 15.8	10.55	-21.60	-8.40	10.50	27.00	671.6
CASE 4	North & West	Level 3	26.51' -> 31.9	5.41	-12.35	4.80	10.50	27.00	384.0
CASE 4	North & West	Level 2	15.83' -> 26.5	10.68	-23.09	8.98	10.50	27.00	717.8
CASE 4	North & West	Level 1	5.28' -> 15.8	10.55	-21.60	8.40	10.50	27.00	671.6
CASE 4	South & West	Level 3	26.51' -> 31.9	5.41	12.35	4.80	10.50	27.00	384.0
CASE 4	South & West	Level 2	15.83' -> 26.5	10.68	23.09	8.98	10.50	27.00	717.8
CASE 4	South & West	Level 1	5.28' -> 15.8	10.55	21.60	8.40	10.50	27.00	671.6
CASE 4	South & East	Level 3	26.51' -> 31.9	5.41	12.35	-4.80	10.50	27.00	384.0
CASE 4	South & East	Level 2	15.83' -> 26.5	10.68	23.09	-8.98	10.50	27.00	717.8
CASE 4	South & East	Level 1	5.28' -> 15.8	10.55	21.60	-8.40	10.50	27.00	671.6
Min per ASCE 27.4.	North	Level 3	26.51' -> 31.9	5.41	-15.57	---	---	---	---
Min per ASCE 27.4.	North	Level 2	15.83' -> 26.5	10.68	-30.76	---	---	---	---
Min per ASCE 27.4.	North	Level 1	5.28' -> 15.8	10.55	-30.38	---	---	---	---
Min per ASCE 27.4.	South	Level 3	26.51' -> 31.9	5.41	15.57	---	---	---	---
Min per ASCE 27.4.	South	Level 2	15.83' -> 26.5	10.68	30.76	---	---	---	---
Min per ASCE 27.4.	South	Level 1	5.28' -> 15.8	10.55	30.38	---	---	---	---
Min per ASCE 27.4.	East	Level 3	26.51' -> 31.9	5.41	---	-6.05	---	---	---
Min per ASCE 27.4.	East	Level 2	15.83' -> 26.5	10.68	---	-11.96	---	---	---
Min per ASCE 27.4.	East	Level 1	5.28' -> 15.8	10.55	---	-11.82	---	---	---

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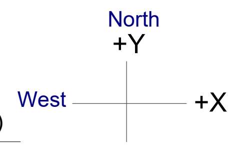
ASCE 7-16 Wind Forces, Chapter 27, Part 1

Min per ASCE 27.4.	West	Level 3	26.51' -> 31.9	5.41	---	6.05	---	---	---
Min per ASCE 27.4.	West	Level 2	15.83' -> 26.5	10.68	---	11.96	---	---	---
Min per ASCE 27.4.	West	Level 1	5.28' -> 15.8:	10.55	---	11.82	---	---	---

Base Shear for Design Wind Load Cas



Values below are calculated based on a building with dimensions B x L x h as defined on the "General" tab.

Load Case	Windward Wall	Leeward Wall	Wind Base Shear Components (k) In "Y" Direction	In "X" Direction	Mt, (ft-k)
Case 1	North	South	-101.34	---	---
Case 1	South	North	101.34	---	---
Case 1	East	West	---	-39.41	---
Case 1	West	East	---	39.41	---
Case 2	North	South	-76.00	---	- 2,052.1
Case 2	South	North	76.00	---	- 2,052.1
Case 2	East	West	---	-29.56	/- 310.3
Case 2	West	East	---	29.56	/- 310.3
Case 3	North & East	South & West	-76.00	-29.56	---
Case 3	North & West	South & East	-76.00	29.56	---
Case 3	South & West	North & East	76.00	29.56	---
Case 3	South & East	North & West	76.00	-29.56	---
Case 4	North & East	South & West	-57.05	-22.19	- 1,773.4
Case 4	North & West	South & East	-57.05	22.19	- 1,773.4
Case 4	South & West	North & East	57.05	22.19	- 1,773.4
Case 4	South & East	North & West	57.05	-22.19	- 1,773.4
Min per ASCE 27.4.7	North	South	-76.71	---	---
Min per ASCE 27.4.7	South	North	76.71	---	---
Min per ASCE 27.4.7	East	West	---	-29.83	---
Min per ASCE 27.4.7	West	East	---	29.83	---

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Kansas City, MO 64111 www.bdc-engrs.com

Project Title: The Reserves at Eagle Point
Engineer: MJF
Project ID: JGR2304
Project Descr: New Apartments

ASCE 7-16 Seismic Base Shear

Project File: JGR2304.ec6

DESCRIPTION: Seismic Base Shear Analysis

Specific Description: --None--

Risk Category

Calculations per ASCE 7-16

Risk Category of Building or Other Structure : "II" : All Buildings and other structures except those listed as Category I, III, and IV — *SCE 7-16, Page 4, Table 1.5-1*

Seismic Importance Factor = 1 — *ASCE 7-16, Page 5, Table 1.5-2*

USER DEFINED Ground Motion

ASCE 7-16 11.4.2

Max. Ground Motions, 5% Damping

S_S = 0.1670 g, 0.2 sec response
S_1 = 0.0560 g, 1.0 sec response

For the closest datapoint grid location . . .

Latitude = 0.000 deg North
Longitude = 0.000 deg West

Site Class, Site Coeff. and Design Category

Classification: "D" : Shear Wave Velocity 600 to 1,200 ft/sec		=	**D** (By Default per 11.4.3)	*ASCE 7-16 Table 20.3-1*
Site Coefficients Fa & Fv	Fa	=	1.60	*ASCE 7-16 Table 11.4-1 & 11.4-2*
(using straight-line interpolation from table val	Fv	=	2.40	
Maximum Considered Earthquake Accelerat	S_{MS} = Fa * Ss	=	0.267	*ASCE 7-16 Eq. 11.4-1*
	S_{M1} = Fv * S1	=	0.134	*ASCE 7-16 Eq. 11.4-2*
Design Spectral Acceleration	$S_{DS} = S_{MS}$ * 2/3	=	0.178	*ASCE 7-16 Eq. 11.4-3*
	$S_{D1} = S_{M1}$ * 2/3	=	0.090	*ASCE 7-16 Eq. 11.4-4*
Seismic Design Category		=	**B**	*\SCE 7-16 Table 11.6-1 & -2*

Resisting System

ASCE 7-16 Table 12.2-1

Basic Seismic Force Resisting System . . . **Bearing Wall Systems**
15.Light-frame (wood) walls sheathed w/wood structural panels rated for shear resistance.

Response Modification Coefficient " I = 6.50
System Overstrength Factor " Wo " = 2.50
Deflection Amplification Factor " Cd " = 4.00

NOTE! See ASCE 7-16 for all applicable footnc

Building height Limits :

Category "A & B" Limit:	No Limit
Category "C" Limit:	No Limit
Category "D" Limit:	Limit = 65
Category "E" Limit:	Limit = 65
Category "F" Limit:	Limit = 65

Lateral Force Procedure

ASCE 7-16 Section 12.8.2

Equivalent Lateral Force Procedure

The "Equivalent Lateral Force Procedure" is being used according to the provisions of ASCE 7-16 12.8

Determine Building Period

Use ASCE 12.8-7

Structure Type for Building Period CalculaAll Other Structural Systems

" Ct " value = 0.020 " hn " : Height from base to highest level 32.0 ft
" x " value = 0.75
" Ta " Approximate fundemental period using Eq. 12.8-7 : Ta = Ct * (hn ^ x) = 0.269 sec
"TL" : Long-period transition period per ASCE 7-16 Maps 22-14 -> 22-17 8.000 sec

Building Period " Ta " Calculated from Approximate Method sele= 0.269

" Cs " Response Coefficient

ASCE 7-16 Section 12.8.1.1

S_{DS} : Short Period Design Spectral Response	=	0.178	From Eq. 12.8-2, Preliminary Cs	=	0.027
" R " : Response Modification Factor	=	6.50	From Eq. 12.8-3 & 12.8-4 , Cs need not excee	=	0.051
" I " : Seismic Importance Factor	=	1	From Eq. 12.8-5 & 12.8-6, Cs not be less than	=	0.010

Cs : Seismic Response Coefficient = = **0.0274**

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Project Title: The Reserves at Eagle Point
Engineer: MJF
Project ID: JGR2304
Project Descr: New Apartments

ASCE 7-16 Seismic Base Shear

Project File: JGR2304.ec6

DESCRIPTION: Seismic Base Shear Analysis

Seismic Base Shear

ASCE 7-16 Section 12.8.1

Cs = 0.0274 from 12.8.1.1

W (see Sum Wi below) = 1,660.00 k

Seismic Base Shear V = Cs * W = 45.49 k

Vertical Distribution of Seismic Forces

ASCE 7-16 Section 12.8.3

NOTE: Includes 20% of uniform design snow load

" k " : hx exponent based on Ta = 1.00

Table of building Weights by Floor Level...

Level #	Wi : Weight	Hi : Height	(Wi * Hi^k)	Cvx	Fx=Cvx * V	Sum Story Shear	Sum Story Moment
3	400.00	31.91	12,764.00	0.3903	17.76	17.76	0.00
2	630.00	21.10	13,293.00	0.4065	18.49	36.25	191.94
1	630.00	10.55	6,646.50	0.2032	9.25	45.49	574.34

Sum Wi = 1,660.00 k Sum Wi * Hi = 32,703.50 k-ft Total Base Shear = 45.49 k

Base Moment = 1,054.3 k-ft

Diaphragm Forces : Seismic Design Category "B" to "F"

ASCE 7-16 12.10.1.1

Level #	Wi	Fi	Sum Fi	Sum Wi	Fpx : Calcd	Fpx : Min	Fpx : Max	Fpx	Dsgn. Force
3	400.00	17.76	17.76	400.00	17.76	14.25	28.50	17.76	17.76
2	630.00	18.49	36.25	1,030.00	22.17	22.44	44.89	22.44	22.44
1	630.00	9.25	45.49	1,660.00	17.27	22.44	44.89	22.44	22.44

Wpx . . . . Weight at level of diaphragm and other structure elements attached to it.
Fi . . . . Design Lateral Force applied at the level.
Sum Fi . . . . Sum of "Lat. Force" of current level plus all levels above
MIN Req'd Force @ Level . . . $0.20 * S_{DS} * I * Wpx$
MAX Req'd Force @ Level . . . $0.40 * S_{DS} * I * Wpx$
Fpx : Design Force @ Level . . Wpx * SUM(x->n) Fi / SUM(x->n) wi, x = Current level, n = Top Level

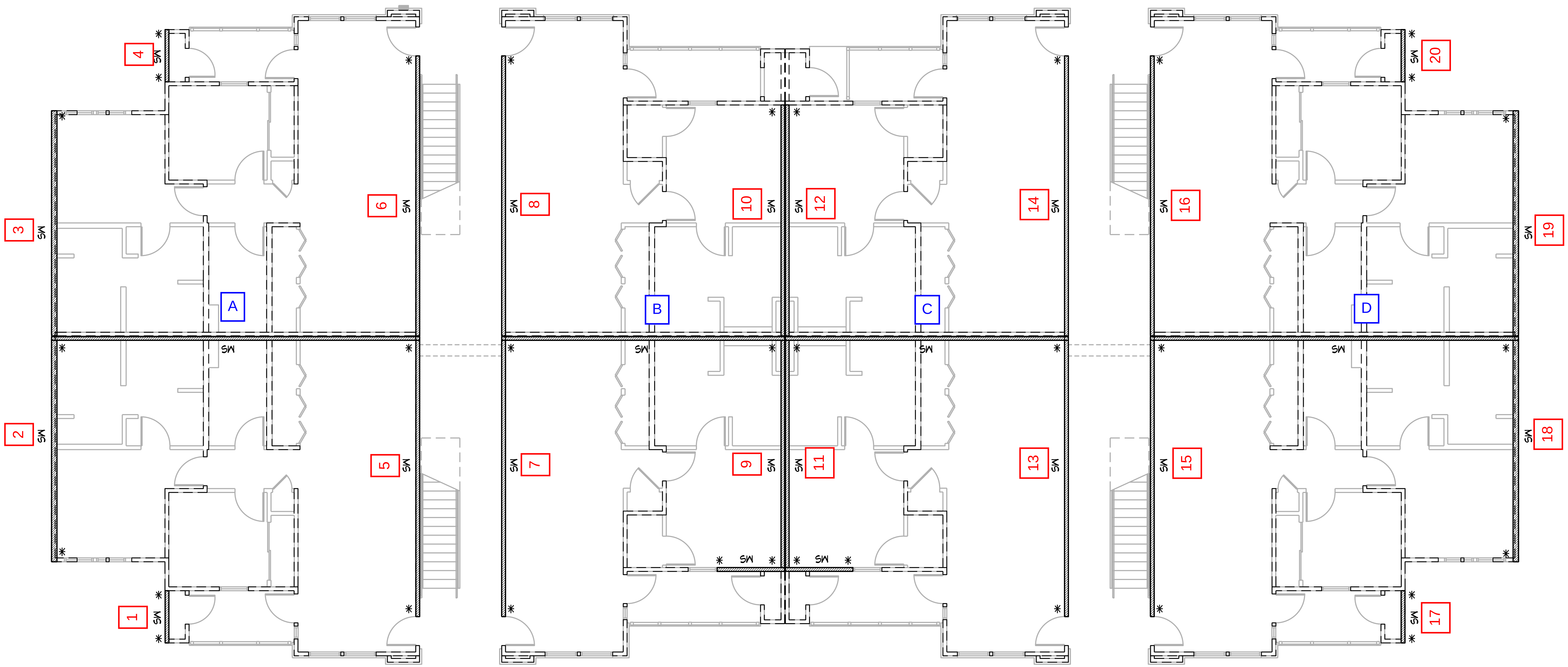
<u>ASD (0.7) STORY FORCES</u>
R - 40.5 kip
3 - 42.1 kip
2 - 31.5 kip

SEISMIC FORCES CONTROL IN BOTH DIRECTIONS

Apply these worst case loads to all building types.

BUILDING 'A', 'B', 'C', AND 'F' SHEARWALL LAYOUT

ALL THREE BUILDINGS SHARE SHEAR WALL LAYOUT



Permit # 2023-2396785-CM
RSN 1762372

BUILDING 'A', 'B', 'C', AND 'F' SHEARWALL DESIGN

JGR2304

Bob D. Campbell & Co.
11/1/2023

DL_{wall} = 0 psf

NO DEAD LOAD CONSIDERED TO RESIST UPLIFT -- CONSERVATIVE

Level	Trib Height	Height to Diaph	Lateral Load at Level	Wall Height	Lateral Load at Level	Trib Width	Lateral Load at Level	Controlling
	(ft)	(ft)	(psf)	(ft)	(plf)	(ft)	(k)	
T/P		31.91						
R	5.405	31.91	41.6	10.81	225	180	40.5	Seismic
3	10.68	21.1	22.0	10.55	235	180	42.1	Seismic
2	10.55	10.55	16.6	10.55	175	180	31.5	Seismic
1	5.275	0	0.0	0	0	180	0.0	Seismic
N/A	0	0	0.0	0	0	180	0.0	Seismic
			Base Shear =				114.1	

Note R = 2 therefore gyp shearwalls are permitted when seismic controls

Shearwall Types			
Type	Description	V_{allow}	G_a
		(plf)	(kips/in.)
A	5/8" Gyp, UnBlocked, S=7	115	6
B	5/8" Gyp, UnBlocked, S=4	145	7.5
C	5/8" Gyp, Blocked, S=7	145	7.5
D	5/8" Gyp, Blocked, S=4	175	8.5
E	(2) 5/8" Gyp, UnBlocked, S=7	230	12
F	(2) 5/8" Gyp, UnBlocked, S=4	290	15
G	(2) 5/8" Gyp, Blocked, S=7	290	15
H	(2) 5/8" Gyp, Blocked, S=4	350	17
J	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 6/12	364	15
K	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 4/12	532	22
L	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 3/12	490	28
M	(2) Layers 5/8" Gyp, One Side w/ Edges Blocked	250	11

Note: V_{allow} loads for APA Rated Sheathing have been increased by 1.4 for shearwalls used to resist wind loads

HDU		
Model No.	T_{allow}	Defl. @ Allowable Load, Δ_a
	lbs	in.
HDU2	3,075	0.088
HDU4	4,565	0.114
HDU5	5,645	0.115
(2)HDU2	6,150	0.088
(2)HDU4	9,130	0.114
(2)HDU5	11,290	0.115
HDU8	7,870	0.116

Sill Anchor Capacity		
20d Nail	272	lbs
1/4"x4 1/2 sds	350	lbs

Shearwall Unity Check Per Floor					
Level	R	5	4	3	2
# of SWs	20	0	0	20	20
Unity	0.02			0.03	0.03

E_{wood}= 1,600,000 (psi) DFL- #2

Transverse							3.00		8,344	27		Additional DL From Bearing							633							1.48					10			
Shear Wall	Level	Trib Width	Length of Shear Wall	Height of Shear Wall	Relative Deflection $\delta_{rel.}$	Relative Stiffness, $K = 1/\delta_{sw}$	Load Dist Coeff	V_{Level}	V_{total}	V_{PLF}	OM_{Level}	Trib Width	DL_{Floor}	DL_{Roof}	Total DL	DL	RM_{Level}	$T=C_{Level}$	$T=C_{total}$	Number of Chord Studs Each End of Shearwall		Hold Down	Shear Wall Type	V_{allow}	Deflection, δ_{sw}	Total Deflection, $\sum\delta_{sw}$	Sill Spacing (inches)		Shearwall Sched	Hold-Down Sched	Diaphragm to Shearwall	Unity Checks		
		(ft)	(ft)	(ft)				(lbs)	(lbs)	(plf)	(lb-ft)	(ft)	(psf)	(psf)	(plf)	(lbs)	(lb-ft)	(lbs)	(lbs)	2x4	2x6			(plf)	(in.)	(in.)	20d Nail	1/4"x4 1/2 sds			(plf)	Sheathing	Holdown	Chord Studs
1	R	5	5	10.81	1.70	2.95	0.00	4	4	1	44				0	0	0	11	11	2		HDU5	J	364	0.50	1.48	32	32			1	0.00	0.00	0.00
	3	5	5	10.55	1.12	4.48	0.00	4	8	2	87				0	0	0	22	33	2		HDU5	J	364	0.49	0.98	32	32			1	0.00	0.01	0.01
	2	5	5	10.55	0.55	9.11	0.00	3	11	2	118				0	0	0	29	62	2		HDU8	K	532	0.49	0.49	32	32			1	0.00	0.01	0.01
	1	5	5	0.00	0.00	0.00	0.00	0	11	2	0				0	0	0	0	62	2		HDU8	K	532	0.00	0.00	32	32			0	0.00	0.01	0.01
	N/A	0	0	0.00	0.00	0.00	0.00	0	11	0	0				0	0	0	0	62	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.01	0.01
2	R	20	20	10.81	0.57	35.27	0.04	194	194	10	2,097				0	0	0	110	110	2		HDU5	J	364	0.13	0.40	32	32			10	0.03	0.02	0.02
	3	20	20	10.55	0.37	54.41	0.04	202	396	20	4,178				0	0	0	220	330	2		HDU5	J	364	0.14	0.27	32	32			10	0.05	0.06	0.06
	2	20	20	10.55	0.17	115.52	0.04	149	545	27	5,748				0	0	0	303	633	2		HDU8	K	532	0.14	0.14	32	32			7	0.05	0.08	0.11
	1	20	20	0.00	0.00	0.00	0.00	0	545	27	0				0	0	0	0	633	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.11
	N/A	0	0	0.00	0.00	0.00	0.00	0	545	0	0				0	0	0	0	633	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.11
3	R	20	20	10.81	0.57	35.27	0.04	194	194	10	2,097				0	0	0	110	110	2		HDU5	J	364	0.13	0.40	32	32			10	0.03	0.02	0.02
	3	20	20	10.55	0.37	54.41	0.04	202	396	20	4,178				0	0	0	220	330	2		HDU5	J	364	0.14	0.27	32	32			10	0.05	0.06	0.06
	2	20	20	10.55	0.17	115.52	0.04	149	545	27	5,748				0	0	0	303	633	2		HDU8	K	532	0.14	0.14	32	32			7	0.05	0.08	0.11
	1	20	20	0.00	0.00	0.00	0.00	0	545	27	0				0	0	0	0	633	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.11
	N/A	0	0	0.00	0.00	0.00	0.00	0	545	0	0				0	0	0	0	633	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.11
4	R	5	5	10.81	1.70	2.95	0.00	4	4	1	44				0	0	0	11	11	2		HDU5	J	364	0.50	1.48	32	32			1	0.00	0.00	0.00
	3	5	5	10.55	1.12	4.48	0.00	4	8	2	87				0	0	0	22	33	2		HDU5	J	364	0.49	0.98	32	32			1	0.00	0.01	0.01
	2	5	5	10.55	0.55	9.11	0.00	3	11	2	118				0	0	0	29	62	2		HDU8	K	532	0.49	0.49	32	32			1	0.00	0.01	0.01
	1	5	5	0.00	0.00	0.00	0.00	0	11	2	0				0	0	0	0	62	2		HDU8	K	532	0.00	0.00	32	32			0	0.00	0.01	0.01
	N/A	0	0	0.00	0.00	0.00	0.00	0	11	0	0				0	0	0	0	62	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.01	0.01
5	R	15	28	10.81	0.46	60.95	0.07	251	251	9	2,718				0	0	0	101	101	2		HDU5	J	364	0.10	0.30	32	32			9	0.02	0.02	0.02
	3	15	28	10.55	0.30	94.48	0.07	263	515	18	5,428				0	0	0	201	302	2		HDU5	J	364	0.10	0.20	32	32			9	0.05	0.05	0.05
	2	15	28	10.55	0.14	203.84	0.08	197	712	25	7,507				0	0	0	278	580	2		HDU8	K	532	0.10	0.10	32	32			7	0.05	0.07	0.11
	1	15	28	0.00	0.00	0.00	0.00	0	712	25	0				0	0	0	0	580	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.07	0.11
	N/A	0	0	0.00	0.00	0.00	0.00	0	712	0	0				0	0	0	0	580	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.07	0.11
6	R	15	28	10.81	0.46	60.95	0.07	251	251	9	2,718				0	0	0	101	101	2		HDU5	J	364	0.10	0.30	32	32			9	0.02	0.02	0.02
	3	15	28	10.55	0.30	94.48	0.07	263	515	18	5,428				0	0	0	201	302	2		HDU5	J	364	0.10	0.20	32	32			9	0.05	0.05	0.05
	2	15	28	10.55	0.14	203.84	0.08	197	712	25	7,507				0	0	0	278	580	2		HDU8	K	532	0.10	0.10	32	32			7	0.05	0.07	0.11
	1	15	28	0.00	0.00	0.00	0.00	0	712	25	0				0	0	0	0	580	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.07	0.11
	N/A	0	0	0.00	0.00	0.00	0.00	0	712	0	0				0	0	0	0	580	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.07	0.11
7	R	10	28	10.81	0.46	60.95	0.07	168	168	6	1,812				0	0	0	67	67	2		HDU5	J	364	0.09	0.28	32	32			6	0.02	0.01	0.01
	3	10	28	10.55	0.30	94.48	0.07	175	343	12	3,619				0	0	0	134	201	2		HDU5	J	364	0.10	0.19	32	32			6	0.03	0.04	0.04
	2	10	28	10.55	0.14	203.84	0.08	131	474	17	5,004				0	0	0	185	386	2		HDU8	K	532	0.10	0.10	32	32			5	0.03	0.05	0.07
	1	10	28	0.00	0.00	0.00	0.00	0	474	17	0				0	0	0	0	386	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.05	0.07
	N/A	0	0	0.00	0.00	0.00	0.00	0	474	0	0				0	0	0	0	386	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.05	0.07
8	R	10	28	10.81	0.46	60.95	0.07	168	168	6	1,812				0	0	0	67	67	2		HDU5	J	364	0.09	0.28	32	32			6	0.02	0.01	0.01
	3	10	28	10.55	0.30	94.48	0.07	175	343	12	3,619				0	0	0	134	201	2		HDU5	J	364	0.10	0.19	32	32			6	0.03	0.04	0.04
	2	10	28	10.55	0.14	203.84	0.08	131	474	17	5,004				0	0	0	185	386	2		HDU8	K	532	0.10	0.10	32	32			5	0.03	0.05	0.07
	1	10	28	0.00	0.00	0.00	0.00	0	474	17	0				0	0	0	0	386	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.05	0.07
	N/A	0	0	0.00	0.00	0.00	0.00	0	474	0	0				0	0	0	0	386	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.05	0.07
	R	10	23	10.81	0.52	44.41	0.05	122	122	5	1,320				0	0	0	60	60	2		HDU5	J	364	0.11	0.34	32	32			5	0.01	0.01	0.01
	3	10	23	10.55	0.34	68.64	0.05	127	250	11	2,633				0	0	0	120	180	2		HDU5	J	364	0.11	0.23	32	32			6	0.03	0.03	0.03

BUILDING 'A', 'B', 'C', AND 'F' SHEARWALL DESIGN

JGR2304

Bob D. Campbell & Co.
11/1/2023

9	2	10	23	10.55	0.16	146.68	0.05	95	344	15	3,630				0	0	0	165	345	2		HDU8	K	532	0.11	0.11	32	32			4	0.03	0.04	0.06
	1	10	23	0.00	0.00	0.00	0.00	0	344	15	0				0	0	0	0	345	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.04	0.06
	N/A	0	0	0.00	0.00	0.00	0.00	0	344	0	0				0	0	0	0	345	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.04	0.06
10	R	10	23	10.81	0.52	44.41	0.05	122	122	5	1,320				0	0	0	60	60	2		HDU5	J	364	0.11	0.34	32	32			5	0.01	0.01	0.01
	3	10	23	10.55	0.34	68.64	0.05	127	250	11	2,633				0	0	0	120	180	2		HDU5	J	364	0.11	0.23	32	32			6	0.03	0.03	0.03
	2	10	23	10.55	0.16	146.68	0.05	95	344	15	3,630				0	0	0	165	345	2		HDU8	K	532	0.11	0.11	32	32			4	0.03	0.04	0.06
	1	10	23	0.00	0.00	0.00	0.00	0	344	15	0				0	0	0	0	345	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.04	0.06
	N/A	0	0	0.00	0.00	0.00	0.00	0	344	0	0				0	0	0	0	345	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.04	0.06
11	R	10	23	10.81	0.52	44.41	0.05	122	122	5	1,320				0	0	0	60	60	2		HDU5	J	364	0.11	0.34	32	32			5	0.01	0.01	0.01
	3	10	23	10.55	0.34	68.64	0.05	127	250	11	2,633				0	0	0	120	180	2		HDU5	J	364	0.11	0.23	32	32			6	0.03	0.03	0.03
	2	10	23	10.55	0.16	146.68	0.05	95	344	15	3,630				0	0	0	165	345	2		HDU8	K	532	0.11	0.11	32	32			4	0.03	0.04	0.06
	1	10	23	0.00	0.00	0.00	0.00	0	344	15	0				0	0	0	0	345	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.04	0.06
	N/A	0	0	0.00	0.00	0.00	0.00	0	344	0	0				0	0	0	0	345	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.04	0.06
12	R	10	23	10.81	0.52	44.41	0.05	122	122	5	1,320				0	0	0	60	60	2		HDU5	J	364	0.11	0.34	32	32			5	0.01	0.01	0.01
	3	10	23	10.55	0.34	68.64	0.05	127	250	11	2,633				0	0	0	120	180	2		HDU5	J	364	0.11	0.23	32	32			6	0.03	0.03	0.03
	2	10	23	10.55	0.16	146.68	0.05	95	344	15	3,630				0	0	0	165	345	2		HDU8	K	532	0.11	0.11	32	32			4	0.03	0.04	0.06
	1	10	23	0.00	0.00	0.00	0.00	0	344	15	0				0	0	0	0	345	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.04	0.06
	N/A	0	0	0.00	0.00	0.00	0.00	0	344	0	0				0	0	0	0	345	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.04	0.06
13	R	10	28	10.81	0.46	60.95	0.07	168	168	6	1,812				0	0	0	67	67	2		HDU5	J	364	0.09	0.28	32	32			6	0.02	0.01	0.01
	3	10	28	10.55	0.30	94.48	0.07	175	343	12	3,619				0	0	0	134	201	2		HDU5	J	364	0.10	0.19	32	32			6	0.03	0.04	0.04
	2	10	28	10.55	0.14	203.84	0.08	131	474	17	5,004				0	0	0	185	386	2		HDU8	K	532	0.10	0.10	32	32			5	0.03	0.05	0.07
	1	10	28	0.00	0.00	0.00	0.00	0	474	17	0				0	0	0	0	386	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.05	0.07
	N/A	0	0	0.00	0.00	0.00	0.00	0	474	0	0				0	0	0	0	386	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.05	0.07
14	R	10	28	10.81	0.46	60.95	0.07	168	168	6	1,812				0	0	0	67	67	2		HDU5	J	364	0.09	0.28	32	32			6	0.02	0.01	0.01
	3	10	28	10.55	0.30	94.48	0.07	175	343	12	3,619				0	0	0	134	201	2		HDU5	J	364	0.10	0.19	32	32			6	0.03	0.04	0.04
	2	10	28	10.55	0.14	203.84	0.08	131	474	17	5,004				0	0	0	185	386	2		HDU8	K	532	0.10	0.10	32	32			5	0.03	0.05	0.07
	1	10	28	0.00	0.00	0.00	0.00	0	474	17	0				0	0	0	0	386	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.05	0.07
	N/A	0	0	0.00	0.00	0.00	0.00	0	474	0	0				0	0	0	0	386	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.05	0.07
15	R	15	28	10.81	0.46	60.95	0.07	251	251	9	2,718				0	0	0	101	101	2		HDU5	J	364	0.10	0.30	32	32			9	0.02	0.02	0.02
	3	15	28	10.55	0.30	94.48	0.07	263	515	18	5,428				0	0	0	201	302	2		HDU5	J	364	0.10	0.20	32	32			9	0.05	0.05	0.05
	2	15	28	10.55	0.14	203.84	0.08	197	712	25	7,507				0	0	0	278	580	2		HDU8	K	532	0.10	0.10	32	32			7	0.05	0.07	0.11
	1	15	28	0.00	0.00	0.00	0.00	0	712	25	0				0	0	0	0	580	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.07	0.11
	N/A	0	0	0.00	0.00	0.00	0.00	0	712	0	0				0	0	0	0	580	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.07	0.11
16	R	15	28	10.81	0.46	60.95	0.07	251	251	9	2,718				0	0	0	101	101	2		HDU5	J	364	0.10	0.30	32	32			9	0.02	0.02	0.02
	3	15	28	10.55	0.30	94.48	0.07	263	515	18	5,428				0	0	0	201	302	2		HDU5	J	364	0.10	0.20	32	32			9	0.05	0.05	0.05
	2	15	28	10.55	0.14	203.84	0.08	197	712	25	7,507				0	0	0	278	580	2		HDU8	K	532	0.10	0.10	32	32			7	0.05	0.07	0.11
	1	15	28	0.00	0.00	0.00	0.00	0	712	25	0				0	0	0	0	580	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.07	0.11
	N/A	0	0	0.00	0.00	0.00	0.00	0	712	0	0				0	0	0	0	580	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.07	0.11
17	R	5	5	10.81	1.70	2.95	0.00	4	4	1	44				0	0	0	11	11	2		HDU5	J	364	0.50	1.48	32	32			1	0.00	0.00	0.00
	3	5	5	10.55	1.12	4.48	0.00	4	8	2	87				0	0	0	22	33	2		HDU5	J	364	0.49	0.98	32	32			1	0.00	0.01	0.01
	2	5	5	10.55	0.55	9.11	0.00	3	11	2	118				0	0	0	29	62	2		HDU8	K	532	0.49	0.49	32	32			1	0.00	0.01	0.01
	1	5	5	0.00	0.00	0.00	0.00	0	11	2	0				0	0	0	0	62	2		HDU8	K	532	0.00	0.00	32	32			0	0.00	0.01	0.01
	N/A	0	0	0.00	0.00	0.00	0.00	0	11	0	0				0	0	0	0	62	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.01	0.01
18	R	20	20	10.81	0.57	35.27	0.04	194	194	10	2,097				0	0	0	110	110	2		HDU5	J	364	0.13	0.40	32	32			10	0.03	0.02	0.02
	3	20	20	10.55	0.37	54.41	0.04	202	396	20	4,178				0	0	0	220	330	2		HDU5	J	364	0.14	0.27	32	32			10	0.05	0.06	0.06
	2	20	20	10.55	0.17	115.52	0.04	149	545	27	5,748				0	0	0	303	633	2		HDU8	K	532	0.14	0.14	32	32			7	0.05	0.08	0.11
	1	20	20	0.00	0.00	0.00	0.00	0	545	27	0				0	0	0	0	633	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.11
	N/A	0	0	0.00	0.00	0.00	0.00	0	545	0	0				0	0	0	0	633	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.11
19	R	20	20	10.81	0.57	35.27	0.04	194	194	10	2,097				0	0	0	110	110	2		HDU5	J	364	0.13	0.40	32	32			10	0.03	0.02	0.02
	3	20	20	10.55	0.37	54.41	0.04	202	396	20	4,178				0	0	0	220	330	2		HDU5	J	364	0.14	0.27	32	32			10	0.05	0.06	0.06
	2	20	20	10.55	0.17	115.52	0.04	149	545	27	5,748				0	0	0	303	633	2		HDU8	K	532	0.14	0.14	32	32			7	0.05	0.08	0.11
	1	20	20	0.00	0.00	0.00	0.00	0	545	27	0				0	0	0	0	633	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.11
	N/A	0	0	0.00	0.00	0.00	0.00	0	545	0	0				0	0	0	0	633	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.11
20	R	5	5	10.81	1.70	2.95	0.00	4	4	1	44				0	0	0	11	11	2		HDU5	J	364	0.50	1.48	32	32			1	0.00	0.00	0.00
	3	5	5	10.55	1.12	4.48	0.00	4	8	2	87				0	0	0	22	33	2		HDU5	J	364	0.49	0.98	32	32			1	0.00	0.01	0.01
	2	5	5	10.55	0.55	9.11	0.00	3	11	2	118				0	0	0	29	62	2		HDU8	K	532	0.49	0.49	32	32			1	0.00	0.01	0.01
	1	5	5	0.00	0.00	0.00	0.00	0	11	2	0				0	0	0	0	62	2		HDU8	K	532	0.00	0.00	32	32			0	0.00	0.01	0.01
	N/A	0	0	0.00	0.00	0.00	0.00	0	11	0	0				0	0	0	0	62	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.01	0.01

BUILDING 'A', 'B', 'C', AND 'F' SHEARWALL DESIGN

JGR2304

Bob D. Campbell & Co.
11/1/2023

DL_{wall}= 5 psf

MINIMAL LOAD CONSIDERED TO RESIST UPLIFT -- CONSERVATIVE

Level	Trib Height	Height to Diaph	Lateral Load at Level	Wall Height	Lateral Load at Level	Trib Width	Lateral Load at Level	Controlling
	(ft)	(ft)	(psf)	(ft)	(plf)	(ft)	(k)	
T/P		31.91						
R	5.405	31.91	107.3	10.81	580	70	40.5	Seismic
3	10.68	21.1	56.6	10.55	605	70	42.1	Seismic
2	10.55	10.55	42.7	10.55	450	70	31.5	Seismic
1	5.275	0	0.0	0	0	70	0.0	Seismic
N/A	0	0	0.0	0	0	70	0.0	Seismic
			Base Shear =				114.1	

Note R = 2 therefore gyp shearwalls are permitted when seismic controls

Shearwall Types			
Type	Description	V_{allow}	G_a
		(plf)	(kips/in.)
A	5/8" Gyp, UnBlocked, S=7	115	6
B	5/8" Gyp, UnBlocked, S=4	145	7.5
C	5/8" Gyp, Blocked, S=7	145	7.5
D	5/8" Gyp, Blocked, S=4	175	8.5
E	(2) 5/8" Gyp, UnBlocked, S=7	230	12
F	(2) 5/8" Gyp, UnBlocked, S=4	290	15
G	(2) 5/8" Gyp, Blocked, S=7	290	15
H	(2) 5/8" Gyp, Blocked, S=4	350	17
J	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 6/12	364	15
K	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 4/12	532	22
L	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 3/12	686	28
M	(2) Layers 5/8" Gyp, One Side w/ Edges Blocked	250	11

Note: V_{allow} loads for APA Rated Sheathing have been increased by 1.4 for shearwalls used to resist wind loads

HDU		
Model No.	T_{allow}	Defl. @ Allowable Load, Δ_a
	lbs	in.
HDU2	2,400	0.109
HDU4	4,270	0.109
HDU5	6,675	0.125
(2)HDU2	9,485	0.124
(2)HDU4	13,080	0.084
(2)HDU5	17,080	0.068
HDU8	21,620	0.056
	-	-
	-	-
	-	-
	-	-

Sill Anchor Capacity		
20d Nail	272	lbs
1/4"x4 1/2 sds	350	lbs

Shearwall Unity Check Per Floor					
Level	R	5	4	3	2
# of SWs	4	0	0	4	4
Unity	0.21			0.44	0.41

E_{wood}= 1,600,000 (psi) DFL- #2

Transvers 3.00 29,430 237 3,501 0.49 88

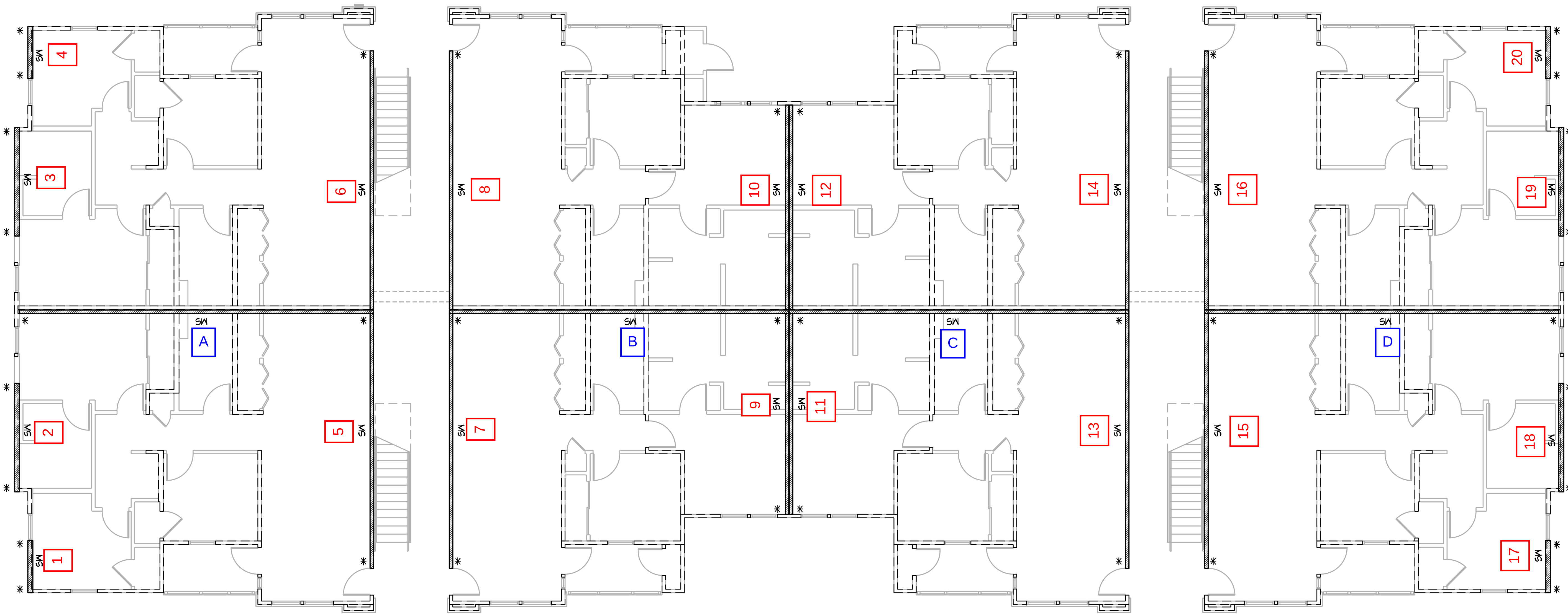
Additional DL From Bearing

Shear Wall	Level	Trib Width (ft)	Length of Shear Wall (ft)	Height of Shear Wall (ft)	Relative Deflection $\delta_{rel.}$	Relative Stiffness, $K = 1/\delta_{sw}$	Load Dist Coeff	V_{Level} (lbs)	V_{total} (lbs)	V_{PLF} (plf)	OM_{Level} (lb-ft)	Trib Width (ft)	DL_{Floor} (psf)	DL_{Roof} (psf)	Total DL (plf)	DL (lbs)	RM_{Level} (lb-ft)	$T=C_{Level}$ (lbs)	$T=C_{total}$ (lbs)
A	R	18	38	10.81	0.37	103.68	0.31	3,205	3,205	84	34,642				0	2,054	39,024	303	303
	3	18	38	10.55	0.22	171.38	0.31	3,337	6,542	172	69,016				0	2,005	38,086	1,248	1,551
	2	18	38	10.55	0.08	471.93	0.30	2,464	9,006	237	95,009				0	2,005	38,086	1,950	3,501
	1	18	38	0.00	0.00	0.00	0.00	0	9,006	237	0				0	0	0	0	3,501
	N/A	0	0	0.00	0.00	0.00	0.00	0	9,006	0	0				0	0	0	0	3,501
B	R	18	28	10.81	0.43	65.21	0.19	2,015	2,015	72	21,786				0	1,513	21,188	336	336
	3	18	28	10.55	0.26	108.24	0.19	2,108	4,123	147	43,499				0	1,477	20,678	1,152	1,488
	2	18	28	10.55	0.09	303.85	0.20	1,586	5,709	204	60,234				0	1,477	20,678	1,771	3,259
	1	18	28	0.00	0.00	0.00	0.00	0	5,709	204	0				0	0	0	0	3,259
	N/A	0	0	0.00	0.00	0.00	0.00	0	5,709	0	0				0	0	0	0	3,259
C	R	18	28	10.81	0.43	65.21	0.19	2,015	2,015	72	21,786				0	1,513	21,188	336	336
	3	18	28	10.55	0.26	108.24	0.19	2,108	4,123	147	43,499				0	1,477	20,678	1,152	1,488
	2	18	28	10.55	0.09	303.85	0.20	1,586	5,709	204	60,234				0	1,477	20,678	1,771	3,259
	1	18	28	0.00	0.00	0.00	0.00	0	5,709	204	0				0	0	0	0	3,259
	N/A	0	0	0.00	0.00	0.00	0.00	0	5,709	0	0				0	0	0	0	3,259
D	R	18	38	10.81	0.37	103.68	0.31	3,205	3,205	84	34,642				0	2,054	39,024	303	303
	3	18	38	10.55	0.22	171.38	0.31	3,337	6,542	172	69,016				0	2,005	38,086	1,248	1,551
	2	18	38	10.55	0.08	471.93	0.30	2,464	9,006	237	95,009				0	2,005	38,086	1,950	3,501
	1	18	38	0.00	0.00	0.00	0.00	0	9,006	237	0				0	0	0	0	3,501
	N/A	0	0	0.00	0.00	0.00	0.00	0	9,006	0	0				0	0	0	0	3,501

Shear Wall	Level	Number of Chord Studs Each End of Shearwall: 2x4	2x6	Hold Down	Shear Wall Type	V_{allow} (plf)	Deflection, δ_{sw} (in.)	Total Deflection, $\sum\delta_{sw}$ (in.)	Sill Spacing (inches): 20d Nail	1/4"x4 1/2 sds	Shearwall Sched	Hold-Down Sched	Diaphragm to Shearwall (plf)	Unity Checks: Sheathing	Holdown	Chord Studs
A	R	2		HDU5	J	364	0.13	0.47	32	32			84	0.23	0.05	0.06
	3	2		HDU5	J	364	0.19	0.34	18	24			88	0.47	0.23	0.28
	2	2		HDU8	K	532	0.15	0.15	13	17			65	0.45	0.16	0.64
	1	2		HDU8	K	532	0.00	0.00	13	17			0	0.45	0.16	0.64
	N/A	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.16	0.64
B	R	2		HDU5	J	364	0.15	0.49	32	32			72	0.20	0.05	0.06
	3	2		HDU5	J	364	0.20	0.34	22	28			75	0.40	0.22	0.27
	2	2		HDU8	K	532	0.14	0.14	16	20			57	0.38	0.15	0.59
	1	2		HDU8	K	532	0.00	0.00	16	20			0	0.38	0.15	0.59
	N/A	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.15	0.59
C	R	2		HDU5	J	364	0.15	0.49	32	32			72	0.20	0.05	0.06
	3	2		HDU5	J	364	0.20	0.34	22	28			75	0.40	0.22	0.27
	2	2		HDU8	K	532	0.14	0.14	16	20			57	0.38	0.15	0.59
	1	2		HDU8	K	532	0.00	0.00	16	20			0	0.38	0.15	0.59
	N/A	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.15	0.59
D	R	2		HDU5	J	364	0.13	0.47	32	32			84	0.23	0.05	0.06
	3	2		HDU5	J	364	0.19	0.34	18	24			88	0.47	0.23	0.28
	2	2		HDU8	K	532	0.15	0.15	13	17			65	0.45	0.16	0.64
	1	2		HDU8	K	532	0.00	0.00	13	17			0	0.45	0.16	0.64
	N/A	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.16	0.64

BUILDING 'D', 'E', 'G', AND 'H' SHEARWALL LAYOUT

ALL THREE BUILDINGS SHARE SHEAR WALL LAYOUT



BUILDING 'D', 'E', 'G', AND 'H' SHEARWALL DESIGN

JGR2304

Bob D. Campbell & Co.
11/1/2023

DL_{wall}=	0	psf

NO DEAD LOAD CONSIDERED TO RESIST UPLIFT -- CONSERVATIVE

Level	Trib Height	Height to Diaph	Lateral Load at Level	Wall Height	Lateral Load at Level	Trib Width	Lateral Load at Level	Controlling
	(ft)	(ft)	(psf)	(ft)	(plf)	(ft)	(k)	
T/P		31.91						
R	5.405	31.91	41.6	10.81	225	180	40.5	Seismic
3	10.68	21.1	22.0	10.55	235	180	42.1	Seismic
2	10.55	10.55	16.6	10.55	175	180	31.5	Seismic
1	5.275	0	0.0	0	0	180	0.0	Seismic
N/A	0	0	0.0	0	0	180	0.0	Seismic
			Base Shear =				114.1	

Note R = 2 therefore gyp shearwalls are permitted when seismic controls

Shearwall Types			
Type	Description	V_{allow}	G_a
		(plf)	(kips/in.)
A	5/8" Gyp, UnBlocked, S=7	115	6
B	5/8" Gyp, UnBlocked, S=4	145	7.5
C	5/8" Gyp, Blocked, S=7	145	7.5
D	5/8" Gyp, Blocked, S=4	175	8.5
E	(2) 5/8" Gyp, UnBlocked, S=7	230	12
F	(2) 5/8" Gyp, UnBlocked, S=4	290	15
G	(2) 5/8" Gyp, Blocked, S=7	290	15
H	(2) 5/8" Gyp, Blocked, S=4	350	17
J	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 6/12	364	15
K	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 4/12	532	22
L	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 3/12	490	28
M	(2) Layers 5/8" Gyp, One Side w/ Edges Blocked	250	11

Note: V_{allow} loads for APA Rated Sheathing have been increased by 1.4 for shearwalls used to resist wind loads

HDU		
Model No.	T_{allow}	Defl. @ Allowable Load, Δ_a
	lbs	in.
HDU2	3,075	0.088
HDU4	4,565	0.114
HDU5	5,645	0.115
(2)HDU2	6,150	0.088
(2)HDU4	9,130	0.114
(2)HDU5	11,290	0.115
HDU8	7,870	0.116

Sill Anchor Capacity		
20d Nail	272	lbs
1/4"x4 1/2 sds	350	lbs

Shearwall Unity Check Per Floor					
Level	R	5	4	3	2
# of SWs	20	0	0	20	20
Unity	0.02			0.04	0.03

E_{wood}= 1,600,000 (psi) DFL- #2

Transverse

Shear Wall	Level	Trib Width	Length of Shear Wall	Height of Shear Wall	Relative Deflection $\delta_{rel.}$	Relative Stiffness, $K = 1/\delta_{sw}$	Load Dist Coeff	V_{Level}	V_{total}	V_{PLF}	OM_{Level}	Trib Width	DL_{Floor}	DL_{Roof}	Total DL	DL	RM_{Level}	$T=C_{Level}$	$T=C_{total}$	Number of Chord Studs Each End of Shearwall		Hold Down	Shear Wall Type	V_{allow}	Deflection, δ_{sw}	Total Deflection, $\sum\delta_{sw}$	Sill Spacing (inches)		Shearwall Sched	Hold-Down Sched	Diaphragm to Shearwall	Unity Checks		
							3.00		8,822	29		Additional DL From Bearing							664							1.09					11			
		(ft)	(ft)	(ft)				(lbs)	(lbs)	(plf)	(lb-ft)	(ft)	(psf)	(psf)	(plf)	(lbs)	(lb-ft)	(lbs)	(lbs)	2x4	2x6			(plf)	(in.)	(in.)	20d Nail	1/4"x4 1/2 sds			(plf)	Sheathing	Holdown	Chord Studs
1	R	10	6.83	10.81	1.29	5.28	0.01	16	16	2	176				0	0	0	30	30	2		HDU5	J	364	0.37	1.09	32	32			2	0.01	0.01	0.01
	3	10	6.83	10.55	0.85	8.05	0.01	17	33	5	349				0	0	0	60	90	2		HDU5	J	364	0.36	0.72	32	32			2	0.01	0.02	0.02
	2	10	6.83	10.55	0.41	16.48	0.01	12	45	7	475				0	0	0	82	172	2		HDU8	K	532	0.36	0.36	32	32			2	0.01	0.02	0.03
	1	10	6.83	0.00	0.00	0.00	0.00	0	45	7	0				0	0	0	0	172	2		HDU8	K	532	0.00	0.00	32	32			0	0.01	0.02	0.03
	N/A	0	0	0.00	0.00	0.00	0.00	0	45	0	0				0	0	0	0	172	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.02	0.03
2	R	10	11.58	10.81	0.84	13.77	0.02	43	43	4	460				0	0	0	43	43	2		HDU5	J	364	0.22	0.65	32	32			4	0.01	0.01	0.01
	3	10	11.58	10.55	0.55	21.10	0.02	44	87	7	913				0	0	0	86	130	2		HDU5	J	364	0.22	0.43	32	32			4	0.02	0.02	0.02
	2	10	11.58	10.55	0.26	43.84	0.02	32	118	10	1,249				0	0	0	118	248	2		HDU8	K	532	0.22	0.22	32	32			3	0.02	0.03	0.04
	1	10	11.58	0.00	0.00	0.00	0.00	0	118	10	0				0	0	0	0	248	2		HDU8	K	532	0.00	0.00	32	32			0	0.02	0.03	0.04
	N/A	0	0	0.00	0.00	0.00	0.00	0	118	0	0				0	0	0	0	248	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.03	0.04
3	R	10	11.58	10.81	0.84	13.77	0.02	43	43	4	460				0	0	0	43	43	2		HDU5	J	364	0.22	0.65	32	32			4	0.01	0.01	0.01
	3	10	11.58	10.55	0.55	21.10	0.02	44	87	7	913				0	0	0	86	130	2		HDU5	J	364	0.22	0.43	32	32			4	0.02	0.02	0.02
	2	10	11.58	10.55	0.26	43.84	0.02	32	118	10	1,249				0	0	0	118	248	2		HDU8	K	532	0.22	0.22	32	32			3	0.02	0.03	0.04
	1	10	11.58	0.00	0.00	0.00	0.00	0	118	10	0				0	0	0	0	248	2		HDU8	K	532	0.00	0.00	32	32			0	0.02	0.03	0.04
	N/A	0	0	0.00	0.00	0.00	0.00	0	118	0	0				0	0	0	0	248	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.03	0.04
4	R	8	6.83	10.81	1.29	5.28	0.01	13	13	2	141				0	0	0	24	24	2		HDU5	J	364	0.37	1.09	32	32			2	0.01	0.00	0.00
	3	8	6.83	10.55	0.85	8.05	0.01	13	26	4	280				0	0	0	48	72	2		HDU5	J	364	0.36	0.72	32	32			2	0.01	0.01	0.01
	2	8	6.83	10.55	0.41	16.48	0.01	10	36	5	380				0	0	0	65	137	2		HDU8	K	532	0.36	0.36	32	32			1	0.01	0.02	0.02
	1	8	6.83	0.00	0.00	0.00	0.00	0	36	5	0				0	0	0	0	137	2		HDU8	K	532	0.00	0.00	32	32			0	0.01	0.02	0.02
	N/A	0	0	0.00	0.00	0.00	0.00	0	36	0	0				0	0	0	0	137	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.02	0.02
5	R	15	28.67	10.81	0.45	63.28	0.09	293	293	10	3,171				0	0	0	115	115	2		HDU5	J	364	0.09	0.29	32	32			10	0.03	0.02	0.02
	3	15	28.67	10.55	0.29	98.12	0.09	307	600	21	6,334				0	0	0	229	343	2		HDU5	J	364	0.10	0.20	32	32			11	0.06	0.06	0.06
	2	15	28.67	10.55	0.14	211.94	0.09	230	831	29	8,764				0	0	0	317	660	2		HDU8	K	532	0.10	0.10	32	32			8	0.05	0.08	0.12
	1	15	28.67	0.00	0.00	0.00	0.00	0	831	29	0				0	0	0	0	660	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.12
	N/A	0	0	0.00	0.00	0.00	0.00	0	831	0	0				0	0	0	0	660	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.12
6	R	15	29	10.81	0.45	64.43	0.09	299	299	10	3,228				0	0	0	115	115	2		HDU5	J	364	0.09	0.29	32	32			10	0.03	0.02	0.02
	3	15	29	10.55	0.29	99.93	0.09	313	611	21	6,450				0	0	0	230	346	2		HDU5	J	364	0.10	0.20	32	32			11	0.06	0.06	0.06
	2	15	29	10.55	0.13	215.96	0.09	235	846	29	8,926				0	0	0	319	664	2		HDU8	K	532	0.10	0.10	32	32			8	0.05	0.08	0.12
	1	15	29	0.00	0.00	0.00	0.00	0	846	29	0				0	0	0	0	664	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.12
	N/A	0	0	0.00	0.00	0.00	0.00	0	846	0	0				0	0	0	0	664	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.12
7	R	15	28.67	10.81	0.45	63.28	0.09	293	293	10	3,171				0	0	0	115	115	2		HDU5	J	364	0.09	0.29	32	32			10	0.03	0.02	0.02
	3	15	28.67	10.55	0.29	98.12	0.09	307	600	21	6,334				0	0	0	229	343	2		HDU5	J	364	0.10	0.20	32	32			11	0.06	0.06	0.06
	2	15	28.67	10.55	0.14	211.94	0.09	230	831	29	8,764				0	0	0	317	660	2		HDU8	K	532	0.10	0.10	32	32			8	0.05	0.08	0.12
	1	15	28.67	0.00	0.00	0.00	0.00	0	831	29	0				0	0	0	0	660	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.12
	N/A	0	0	0.00	0.00	0.00	0.00	0	831	0	0				0	0	0	0	660	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.12
8	R	15	29	10.81	0.45	64.43	0.09	299	299	10	3,228				0	0	0	115	115	2		HDU5	J	364	0.09	0.29	32	32			10	0.03	0.02	0.02
	3	15	29	10.55	0.29	99.93	0.09	313	611	21	6,450				0	0	0	230	346	2		HDU5	J	364	0.10	0.20	32	32			11	0.06	0.06	0.06
	2	15	29	10.55	0.13	215.96	0.09	235	846	29	8,926				0	0	0	319	664	2		HDU8	K	532	0.10	0.10	32	32			8	0.05	0.08	0.12
	1	15	29	0.00	0.00	0.00	0.00	0	846	29	0				0	0	0	0	664	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.12
	N/A	0	0	0.00	0.00	0.00	0.00	0	846	0	0				0	0	0	0	664	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.12
	R	12	20	10.81	0.57	35.27	0.05	131	131	7	1,414				0	0	0	74	74	2		HDU5	J	364	0.13	0.39	32	32			7	0.02	0.01	0.01
	3	12	20	10.55	0.37	54.41	0.05	136	267	13	2,817				0	0	0	148	223	2		HDU5	J	364	0.13	0.26	32	32			7	0.04	0.04	0.04

BUILDING 'D', 'E', 'G', AND 'H' SHEARWALL DESIGN

JGR2304

Bob D. Campbell & Co.
11/1/2023

9	2	12	20	10.55	0.17	115.52	0.05	100	367	18	3,877				0	0	0	204	427	2		HDU8	K	532	0.13	0.13	32	32			5	0.03	0.05	0.08
	1	12	20	0.00	0.00	0.00	0.00	0	367	18	0				0	0	0	0	427	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.05	0.08
	N/A	0	0	0.00	0.00	0.00	0.00	0	367	0	0				0	0	0	0	427	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.05	0.08
	R	12	20	10.81	0.57	35.27	0.05	131	131	7	1,414				0	0	0	74	74	2		HDU5	J	364	0.13	0.39	32	32			7	0.02	0.01	0.01
	3	12	20	10.55	0.37	54.41	0.05	136	267	13	2,817				0	0	0	148	223	2		HDU5	J	364	0.13	0.26	32	32			7	0.04	0.04	0.04
10	2	12	20	10.55	0.17	115.52	0.05	100	367	18	3,877				0	0	0	204	427	2		HDU8	K	532	0.13	0.13	32	32			5	0.03	0.05	0.08
	1	12	20	0.00	0.00	0.00	0.00	0	367	18	0				0	0	0	0	427	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.05	0.08
	N/A	0	0	0.00	0.00	0.00	0.00	0	367	0	0				0	0	0	0	427	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.05	0.08
	R	12	20	10.81	0.57	35.27	0.05	131	131	7	1,414				0	0	0	74	74	2		HDU5	J	364	0.13	0.39	32	32			7	0.02	0.01	0.01
	3	12	20	10.55	0.37	54.41	0.05	136	267	13	2,817				0	0	0	148	223	2		HDU5	J	364	0.13	0.26	32	32			7	0.04	0.04	0.04
11	2	12	20	10.55	0.17	115.52	0.05	100	367	18	3,877				0	0	0	204	427	2		HDU8	K	532	0.13	0.13	32	32			5	0.03	0.05	0.08
	1	12	20	0.00	0.00	0.00	0.00	0	367	18	0				0	0	0	0	427	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.05	0.08
	N/A	0	0	0.00	0.00	0.00	0.00	0	367	0	0				0	0	0	0	427	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.05	0.08
	R	12	20	10.81	0.57	35.27	0.05	131	131	7	1,414				0	0	0	74	74	2		HDU5	J	364	0.13	0.39	32	32			7	0.02	0.01	0.01
	3	12	20	10.55	0.37	54.41	0.05	136	267	13	2,817				0	0	0	148	223	2		HDU5	J	364	0.13	0.26	32	32			7	0.04	0.04	0.04
12	2	12	20	10.55	0.17	115.52	0.05	100	367	18	3,877				0	0	0	204	427	2		HDU8	K	532	0.13	0.13	32	32			5	0.03	0.05	0.08
	1	12	20	0.00	0.00	0.00	0.00	0	367	18	0				0	0	0	0	427	2		HDU8	K	532	0.00	0.00	32	32			0	0.03	0.05	0.08
	N/A	0	0	0.00	0.00	0.00	0.00	0	367	0	0				0	0	0	0	427	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.05	0.08
	R	15	28.67	10.81	0.45	63.28	0.09	293	293	10	3,171				0	0	0	115	115	2		HDU5	J	364	0.09	0.29	32	32			10	0.03	0.02	0.02
	3	15	28.67	10.55	0.29	98.12	0.09	307	600	21	6,334				0	0	0	229	343	2		HDU5	J	364	0.10	0.20	32	32			11	0.06	0.06	0.06
13	2	15	28.67	10.55	0.14	211.94	0.09	230	831	29	8,764				0	0	0	317	660	2		HDU8	K	532	0.10	0.10	32	32			8	0.05	0.08	0.12
	1	15	28.67	0.00	0.00	0.00	0.00	0	831	29	0				0	0	0	0	660	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.12
	N/A	0	0	0.00	0.00	0.00	0.00	0	831	0	0				0	0	0	0	660	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.12
	R	15	29	10.81	0.45	64.43	0.09	299	299	10	3,228				0	0	0	115	115	2		HDU5	J	364	0.09	0.29	32	32			10	0.03	0.02	0.02
	3	15	29	10.55	0.29	99.93	0.09	313	611	21	6,450				0	0	0	230	346	2		HDU5	J	364	0.10	0.20	32	32			11	0.06	0.06	0.06
14	2	15	29	10.55	0.13	215.96	0.09	235	846	29	8,926				0	0	0	319	664	2		HDU8	K	532	0.10	0.10	32	32			8	0.05	0.08	0.12
	1	15	29	0.00	0.00	0.00	0.00	0	846	29	0				0	0	0	0	664	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.12
	N/A	0	0	0.00	0.00	0.00	0.00	0	846	0	0				0	0	0	0	664	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.12
	R	15	28.67	10.81	0.45	63.28	0.09	293	293	10	3,171				0	0	0	115	115	2		HDU5	J	364	0.09	0.29	32	32			10	0.03	0.02	0.02
	3	15	28.67	10.55	0.29	98.12	0.09	307	600	21	6,334				0	0	0	229	343	2		HDU5	J	364	0.10	0.20	32	32			11	0.06	0.06	0.06
15	2	15	28.67	10.55	0.14	211.94	0.09	230	831	29	8,764				0	0	0	317	660	2		HDU8	K	532	0.10	0.10	32	32			8	0.05	0.08	0.12
	1	15	28.67	0.00	0.00	0.00	0.00	0	831	29	0				0	0	0	0	660	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.12
	N/A	0	0	0.00	0.00	0.00	0.00	0	831	0	0				0	0	0	0	660	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.12
	R	15	29	10.81	0.45	64.43	0.09	299	299	10	3,228				0	0	0	115	115	2		HDU5	J	364	0.09	0.29	32	32			10	0.03	0.02	0.02
	3	15	29	10.55	0.29	99.93	0.09	313	611	21	6,450				0	0	0	230	346	2		HDU5	J	364	0.10	0.20	32	32			11	0.06	0.06	0.06
16	2	15	29	10.55	0.13	215.96	0.09	235	846	29	8,926				0	0	0	319	664	2		HDU8	K	532	0.10	0.10	32	32			8	0.05	0.08	0.12
	1	15	29	0.00	0.00	0.00	0.00	0	846	29	0				0	0	0	0	664	2		HDU8	K	532	0.00	0.00	32	32			0	0.05	0.08	0.12
	N/A	0	0	0.00	0.00	0.00	0.00	0	846	0	0				0	0	0	0	664	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.08	0.12
	R	10	6.83	10.81	1.29	5.28	0.01	16	16	2	176				0	0	0	30	30	2		HDU5	J	364	0.37	1.09	32	32			2	0.01	0.01	0.01
	3	10	6.83	10.55	0.85	8.05	0.01	17	33	5	349				0	0	0	60	90	2		HDU5	J	364	0.36	0.72	32	32			2	0.01	0.02	0.02
17	2	10	6.83	10.55	0.41	16.48	0.01	12	45	7	475				0	0	0	82	172	2		HDU8	K	532	0.36	0.36	32	32			2	0.01	0.02	0.03
	1	10	6.83	0.00	0.00	0.00	0.00	0	45	7	0				0	0	0	0	172	2		HDU8	K	532	0.00	0.00	32	32			0	0.01	0.02	0.03
	N/A	0	0	0.00	0.00	0.00	0.00	0	45	0	0				0	0	0	0	172	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.02	0.03
	R	10	11.58	10.81	0.84	13.77	0.02	43	43	4	460				0	0	0	43	43	2		HDU5	J	364	0.22	0.65	32	32			4	0.01	0.01	0.01
	3	10	11.58	10.55	0.55	21.10	0.02	44	87	7	913				0	0	0	86	130	2		HDU5	J	364	0.22	0.43	32	32			4	0.02	0.02	0.02
18	2	10	11.58	10.55	0.26	43.84	0.02	32	118	10	1,249				0	0	0	118	248	2		HDU8	K	532	0.22	0.22	32	32			3	0.02	0.03	0.04
	1	10	11.58	0.00	0.00	0.00	0.00	0	118	10	0				0	0	0	0	248	2		HDU8	K	532	0.00	0.00	32	32			0	0.02	0.03	0.04
	N/A	0	0	0.00	0.00	0.00	0.00	0	118	0	0				0	0	0	0	248	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.03	0.04
	R	10	11.58	10.81	0.84	13.77	0.02	43	43	4	460				0	0	0	43	43	2		HDU5	J	364	0.22	0.65	32	32			4	0.01	0.01	0.01
	3	10	11.58	10.55	0.55	21.10	0.02	44	87	7	913				0	0	0	86	130	2		HDU5	J	364	0.22	0.43	32	32			4	0.02	0.02	0.02
19	2	10	11.58	10.55	0.26	43.84	0.02	32	118	10	1,249				0	0	0	118	248	2		HDU8	K	532	0.22	0.22	32	32			3	0.02	0.03	0.04
	1	10	11.58	0.00	0.00	0.00	0.00	0	118	10	0				0	0	0	0	248	2		HDU8	K	532	0.00	0.00	32	32			0	0.02	0.03	0.04
	N/A	0	0	0.00	0.00	0.00	0.00	0	118	0	0				0	0	0	0	248	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.03	0.04
	R	10	6.83	10.81	1.29	5.28	0.01	16	16	2	176				0	0	0	30	30	2		HDU5	J	364	0.37	1.09	32	32			2	0.01	0.01	0.01
	3	10	6.83	10.55	0.85	8.05	0.01	17	33	5	349				0	0	0	60	90	2		HDU5	J	364	0.36	0.72	32	32			2	0.01	0.02	0.02
20	2	10	6.83	10.55	0.41	16.48	0.01	12	45	7	475				0	0	0	82	172	2		HDU8	K	532	0.36	0.36	32	32			2	0.01	0.02	0.03
	1	10	6.83	0.00	0.00	0.00	0.00	0	45	7	0				0	0	0	0	172	2		HDU8	K	532	0.00	0.00	32	32			0	0.01	0.02	0.03
	N/A	0	0	0.00	0.00	0.00	0.00	0	45	0	0				0	0	0	0	172	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.02	0.03

BUILDING 'D', 'E', 'G', AND 'H' SHEARWALL DESIGN

JGR2304

Bob D. Campbell & Co.
11/1/2023

DL_{wall}=	0	psf

NO DEAD LOAD CONSIDERED TO RESIST UPLIFT -- CONSERVATIVE

Level	Trib Height	Height to Diaph	Lateral Load at Level	Wall Height	Lateral Load at Level	Trib Width	Lateral Load at Level	Controlling
	(ft)	(ft)	(psf)	(ft)	(plf)	(ft)	(k)	
T/P		31.91						
R	5.405	31.91	107.3	10.81	580	70	40.5	Seismic
3	10.68	21.1	56.6	10.55	605	70	42.1	Seismic
2	10.55	10.55	42.7	10.55	450	70	31.5	Seismic
1	5.275	0	0.0	0	0	70	0.0	Seismic
N/A	0	0	0.0	0	0	70	0.0	Seismic
		Base Shear =					114.1	

Note R = 2 therefore gyp shearwalls are permitted when seismic controls

Shearwall Types			
Type	Description	V_{allow}	G_a
		(plf)	(kips/in.)
A	5/8" Gyp, UnBlocked, S=7	115	6
B	5/8" Gyp, UnBlocked, S=4	145	7.5
C	5/8" Gyp, Blocked, S=7	145	7.5
D	5/8" Gyp, Blocked, S=4	175	8.5
E	(2) 5/8" Gyp, UnBlocked, S=7	230	12
F	(2) 5/8" Gyp, UnBlocked, S=4	290	15
G	(2) 5/8" Gyp, Blocked, S=7	290	15
H	(2) 5/8" Gyp, Blocked, S=4	350	17
J	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 6/12	364	15
K	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 4/12	532	22
L	7/16 APA Rated Sheating One Side, Blocked w/ 8d Nails 3/12	686	28
M	(2) Layers 5/8" Gyp, One Side w/ Edges Blocked	250	11

Note: V_{allow} loads for APA Rated Sheathing have been increased by 1.4 for shearwalls used to resist wind loads

HDU		
Model No.	T_{allow}	Defl. @ Allowable Load, Δ_a
	lbs	in.
HDU2	2,400	0.109
HDU4	4,270	0.109
HDU5	6,675	0.125
(2)HDU2	9,485	0.124
(2)HDU4	13,080	0.084
(2)HDU5	17,080	0.068
HDU8	21,620	0.056
	-	-
	-	-
	-	-
	-	-

Sill Anchor Capacity		
20d Nail	272	lbs
1/4"x4 1/2 sds	350	lbs

Shearwall Unity Check Per Floor					
Level	R	5	4	3	2
# of SWs	4	0	0	4	4
Unity	0.19			0.40	0.37

E_{wood}=	1,600,000 (psi)	DFL- #2

Transvers

Shear Wall	Level	Trib Width	Length of Shear Wall	Height of Shear Wall	Relative Deflection $\delta_{rel.}$	Relative Stiffness, $K = 1/\delta_{sw}$	Load Dist Coeff	V_{Level}	V_{total}	V_{PLF}	OM_{Level}	Trib Width	DL_{Floor}	DL_{Roof}	Total DL	DL	RM_{Level}	$T=C_{Level}$	$T=C_{total}$	Number of Chord Studs Each End of Shearwall		Hold Down	Shear Wall Type	V_{allow}	Deflection, δ_{sw}	Total Deflection, $\sum\delta_{sw}$	Sill Spacing (inches)		Shearwall Sched	Hold-Down Sched	Diaphragm to Shearwall	Unity Checks		
							3.00		29,430	201		Additional DL From Bearing							4,555							0.43					74			
		(ft)	(ft)	(ft)				(lbs)	(lbs)	(plf)	(lb-ft)	(ft)	(psf)	(psf)	(plf)	(lbs)	(lb-ft)	(lbs)	(lbs)	2x4	2x6			(plf)	(in.)	(in.)	20d Nail	1/4"x4 1/2 sds			(plf)	Sheathing	Holdown	Chord Studs
A	R	18	38	10.81	0.37	103.68	0.26	2,715	2,715	71	29,348				0	0	0	793	793	2		HDU5	J	364	0.12	0.43	32	32			71	0.20	0.12	0.14
	3	18	38	10.55	0.22	171.38	0.26	2,831	5,546	146	58,508				0	0	0	1,581	2,374	2		HDU5	J	364	0.17	0.30	22	28			74	0.40	0.36	0.43
	2	18	38	10.55	0.08	471.93	0.26	2,102	7,648	201	80,686				0	0	0	2,181	4,555	2		HDU8	K	532	0.13	0.13	16	20			55	0.38	0.21	0.83
	1	18	38	0.00	0.00	0.00	0.00	0	7,648	201	0				0	0	0	0	4,555	2		HDU8	K	532	0.00	0.00	16	20			0	0.38	0.21	0.83
	N/A	0	0	0.00	0.00	0.00	0.00	0	7,648	0	0				0	0	0	0	4,555	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.21	0.83
B	R	18	36	10.81	0.38	95.67	0.24	2,505	2,505	70	27,080				0	0	0	774	774	2		HDU5	J	364	0.13	0.43	32	32			70	0.19	0.12	0.14
	3	18	36	10.55	0.23	158.26	0.24	2,614	5,119	142	54,008				0	0	0	1,543	2,317	2		HDU5	J	364	0.18	0.31	22	29			73	0.39	0.35	0.42
	2	18	36	10.55	0.08	437.26	0.24	1,948	7,067	196	74,557				0	0	0	2,130	4,447	2		HDU8	K	532	0.13	0.13	16	21			54	0.37	0.21	0.81
	1	18	36	0.00	0.00	0.00	0.00	0	7,067	196	0				0	0	0	0	4,447	2		HDU8	K	532	0.00	0.00	16	21			0	0.37	0.21	0.81
	N/A	0	0	0.00	0.00	0.00	0.00	0	7,067	0	0				0	0	0	0	4,447	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.21	0.81
C	R	18	36	10.81	0.38	95.67	0.24	2,505	2,505	70	27,080				0	0	0	774	774	2		HDU5	J	364	0.13	0.43	32	32			70	0.19	0.12	0.14
	3	18	36	10.55	0.23	158.26	0.24	2,614	5,119	142	54,008				0	0	0	1,543	2,317	2		HDU5	J	364	0.18	0.31	22	29			73	0.39	0.35	0.42
	2	18	36	10.55	0.08	437.26	0.24	1,948	7,067	196	74,557				0	0	0	2,130	4,447	2		HDU8	K	532	0.13	0.13	16	21			54	0.37	0.21	0.81
	1	18	36	0.00	0.00	0.00	0.00	0	7,067	196	0				0	0	0	0	4,447	2		HDU8	K	532	0.00	0.00	16	21			0	0.37	0.21	0.81
	N/A	0	0	0.00	0.00	0.00	0.00	0	7,067	0	0				0	0	0	0	4,447	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.21	0.81
D	R	18	38	10.81	0.37	103.68	0.26	2,715	2,715	71	29,348				0	0	0	793	793	2		HDU5	J	364	0.12	0.43	32	32			71	0.20	0.12	0.14
	3	18	38	10.55	0.22	171.38	0.26	2,831	5,546	146	58,508				0	0	0	1,581	2,374	2		HDU5	J	364	0.17	0.30	22	28			74	0.40	0.36	0.43
	2	18	38	10.55	0.08	471.93	0.26	2,102	7,648	201	80,686				0	0	0	2,181	4,555	2		HDU8	K	532	0.13	0.13	16	20			55	0.38	0.21	0.83
	1	18	38	0.00	0.00	0.00	0.00	0	7,648	201	0				0	0	0	0	4,555	2		HDU8	K	532	0.00	0.00	16	20			0	0.38	0.21	0.83
	N/A	0	0	0.00	0.00	0.00	0.00	0	7,648	0	0				0	0	0	0	4,555	2		HDU8	K	532	0.00	0.00	0	0				0.00	0.21	0.83

Headers/Jambs Design

11/1/2023

Level Loadings

Type	DL	LL	TL
Roof Sloped	20 psf	28 psf	48 psf
Roof Flat	20 psf	28 psf	48 psf
Floor	35 psf	40 psf	75 psf
Public Floor	35 psf	100 psf	135 psf
Public Patio	55 psf	100 psf	155 psf
Storage	40 psf	100 psf	140 psf
Private Patio	55 psf	60 psf	115 psf

Header Grade	Fb
Stud	700
No. 2	900
No. 1	1000
LVL	2600
PSL	2900

Jamb Grade	Fc
Stud	850
No. 2	1350
No. 1	1500
Sel. Struct.	1700

Note: Jack Studs assumed to be braced at 24"oc (weak axis) and L = Stud Height - 1 ft

TL Deflection Criteria L/ 360

Interior WL 5 psf
Exterior WL 25 psf

*Refer to Forte reports for additional calcs on specified memebers

REVIEWED TYPE A

							Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	14.0 ft	0 plf	2.0 ft	4 ft	672 plf	(2) 2x	2 x 10	No. 2	Span	1665 plf	0.40	756 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	1512 lb	0.68	2	6000 lb	0.25	9 ft	504 lb	60 in.	2	1096 lb	0.46
Floor	35 psf	40 psf	75 psf	14.0 ft	0 plf	2.0 ft	4 ft	1050 plf	(2) 2x	2 x 10	No. 2	Span	1665 plf	0.63	1181 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	2363 lb	1.06	2	6000 lb	0.39	9 ft	788 lb	60 in.	2	1096 lb	0.72
Floor	35 psf	40 psf	75 psf	14.0 ft	0 plf	2.0 ft	4 ft	1050 plf	(2) 2x	2 x 10	No. 2	Span	1665 plf	0.63	1181 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	2363 lb	1.06	2	6000 lb	0.39	9 ft	2316 lb	60 in.	3	3550 lb	0.65

REVIEWED TYPE B

							Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	4.0 ft	0 plf	2.0 ft	10 ft	192 plf	(2) 2x	2 x 12	No. 2	Span	371 plf	0.52	203 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	1016 lb	0.49	2	6000 lb	0.17	9 ft	136 lb	60 in.	2	646 lb	0.21
Floor	35 psf	40 psf	75 psf	4.0 ft	0 plf	2.0 ft	10 ft	300 plf	(2) 2x	2 x 12	No. 2	Span	371 plf	0.81	318 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	1588 lb	0.76	2	6000 lb	0.26	9 ft	212 lb	60 in.	2	646 lb	0.33
Floor	35 psf	40 psf	75 psf	4.0 ft	0 plf	2.0 ft	10 ft	300 plf	(2) 2x	2 x 12	No. 2	Span	371 plf	0.81	318 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	1588 lb	0.76	2	6000 lb	0.26	9 ft	212 lb	60 in.	2	646 lb	0.33

REVIEWED TYPE C

							Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	6.5 ft	0 plf	2.0 ft	4 ft	312 plf	(2) 2x	2 x 10	No. 2	Span	1665 plf	0.19	351 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	702 lb	0.32	1	3000 lb	0.23	9 ft	234 lb	60 in.	2	1096 lb	0.21
Floor	35 psf	40 psf	75 psf	6.5 ft	0 plf	2.0 ft	4 ft	488 plf	(2) 2x	2 x 10	No. 2	Span	1665 plf	0.29	548 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	1097 lb	0.49	1	3000 lb	0.37	9 ft	366 lb	60 in.	2	1096 lb	0.33
Floor	35 psf	40 psf	75 psf	6.5 ft	0 plf	2.0 ft	4 ft	488 plf	(2) 2x	2 x 10	No. 2	Span	1665 plf	0.29	548 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	1097 lb	0.49	1	3000 lb	0.37	9 ft	861 lb	60 in.	2	1096 lb	0.79

REVIEWED TYPE D

							Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	6.0 ft	0 plf	2.0 ft	7 ft	329 plf	(2) 2x	2 x 10	No. 2	Span	569 plf	0.58	346 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	1210 lb	0.58	1	3000 lb	0.40	9 ft	230 lb	60 in.	3	3184 lb	0.07
Floor	35 psf	40 psf	75 psf	6.0 ft	0 plf	2.0 ft	7 ft	514 plf	(2) 2x	2 x 10	No. 2	Span	569 plf	0.90	540 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	1890 lb	0.91	1	3000 lb	0.63	9 ft	690 lb	60 in.	3	3184 lb	0.22
Floor	35 psf	40 psf	75 psf	6.0 ft	0 plf	2.0 ft	7 ft	514 plf	(2) 2x	2 x 10	No. 2	Span	569 plf	0.90	540 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	1890 lb	0.91	1	3000 lb	0.63	9 ft	2940 lb	60 in.	3	3184 lb	0.92

REVIEWED TYPE E

							Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	3.0 ft	0 plf	2.0 ft	9 ft	160 plf	(2) 2x	2 x 10	No. 2	Span	343 plf	0.47	167 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	753 lb	0.36	1	3000 lb	0.25	9 ft	111 lb	60 in.	2	646 lb	0.17
Floor	35 psf	40 psf	75 psf	3.0 ft	0 plf	2.0 ft	9 ft	250 plf	(2) 2x	2 x 10	No. 2	Span	343 plf	0.73	261 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	1176 lb	0.57	1	3000 lb	0.39	9 ft	174 lb	60 in.	2	646 lb	0.27
Floor	35 psf	40 psf	75 psf	3.0 ft	0 plf	2.0 ft	9 ft	250 plf	(2) 2x	2 x 10	No. 2	Span	343 plf	0.73	261 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	1176 lb	0.57	1	3000 lb	0.39	9 ft	564 lb	60 in.	2	646 lb	0.87

REVIEWED TYPE G/F

							Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	9.0 ft	0 plf	2.0 ft	9 ft	480 plf	3 LVL	9.25	LVL	Span	1337 plf	0.36	502 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	2258 lb	1.09	4	12000 lb	0.19	9 ft	334 lb	60 in.	2	646 lb	0.52
Floor	35 psf	40 psf	75 psf	9.0 ft	0 plf	2.0 ft	9 ft	750 plf	3 LVL	9.25	LVL	Span	1337 plf	0.56	784 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	3527 lb	1.71	4	12000 lb	0.29	9 ft	523 lb	60 in.	2	646 lb	0.81
Floor	35 psf	40 psf	75 psf	9.0 ft	0 plf	2.0 ft	9 ft	750 plf	3 LVL	9.25	LVL	Span	1337 plf	0.56	784 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	3527 lb	1.71	8	7315 lb	0.48	9 ft	3377 lb	60 in.	4	5225 lb	0.65

REVIEWED TYPE H

							Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	15.0 ft	0 plf	2.0 ft	8 ft	720 plf	2 LVL	9.25	LVL	Span	1269 plf	0.57	771 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	3086 lb	1.46	3	9000 lb	0.34	9 ft	514 lb	60 in.	3	3184 lb	0.16

REVIEWED	TYPE J						Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	15.0 ft	0 plf	2.0 ft	4 ft	720 plf	(2) 2x	2 x 12	No. 2	Span	2025 plf	0.36	810 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	1620 lb	0.73	2	6000 lb	0.27	9 ft	540 lb	60 in.	2	1096 lb	0.49

REVIEWED	TYPE K						Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	15.0 ft	0 plf	2.0 ft	4 ft	720 plf	2 LVL	11.25	LVL	Span	3741 plf	0.19	810 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	1620 lb	0.73	3	9000 lb	0.18	9 ft	540 lb	60 in.	2	1096 lb	0.49
Floor	35 psf	40 psf	75 psf	15.0 ft	0 plf	2.0 ft	4 ft	1125 plf	2 LVL	11.25	LVL	Span	3741 plf	0.30	1266 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	2531 lb	1.14	3	9000 lb	0.28	9 ft	844 lb	60 in.	2	1096 lb	0.77
Floor	35 psf	40 psf	75 psf	15.0 ft	0 plf	2.0 ft	4 ft	1125 plf	2 LVL	11.25	LVL	Span	3741 plf	0.30	1266 plf	No. 2	2x4	Exterior	70 plf	16 in. oc	8 ft	2531 lb	1.14	3	9000 lb	0.28	9 ft	844 lb	60 in.	2	1096 lb	0.77

REVIEWED	TYPE L						Header								Jamb Size						Jack (Bearing Studs)						King (Continuous Jamb Studs)					
Level	DL	LL	TL	TW	Adt'l Ld	Truss Spcg	Length	WTTL	Type	Size	Grade	Lu	WAllow	Unity	WTTL	Grade	Jamb Size	Int or Ext	WL	Stud Spcg	HT	Pactual	BRG W Req'd	Jack	Pallow	Unity	HT	Pactual	Lu	King	Pallow	Unity
Roof Sloped	20 psf	28 psf	48 psf	15.0 ft	0 plf	2.0 ft	9 ft	800 plf	2 LVL	11.25	LVL	Span	1538 plf	0.52	836 plf	No. 2	2x4	Exterior	80 plf	16 in. oc	8 ft	3763 lb	1.82	3	9000 lb	0.42	9 ft	557 lb	60 in.	2	646 lb	0.86

RESERVES AT EAGLE POINT

Level Loadings

Type	DL	LL	TL
Roof Sloped	20 psf	28 psf	48 psf
Roof Flat	25 psf	28 psf	53 psf
Floor	35 psf	40 psf	75 psf
Public Floor	35 psf	100 psf	135 psf
Public Patio	55 psf	100 psf	155 psf
Private Patio	55 psf	40 psf	95 psf
Attic No Storage	35 psf	10 psf	45 psf

Wood Properties

Grade	Fb	Fc
Stud	700	850
No. 2	900	1350
No. 1	1000	1500
Sel. Struct.	1500	1700

Wall Type 1 - Exterior 2x4 Bearing Walls **Wood Stud Properties**

Level	DL	LL	TL	TW	Adt'l Ld	TL	Size	Spacing	Grade	Lu (in.)	Height	Wind	P allow.	Unity	Check
Roof Sloped	20 psf	28 psf	48 psf	16.0 ft	0 plf	768 plf	2x4	16 in.	No. 2	12 in.	9 ft	15 psf	1057 plf	73%	OK
Floor	35 psf	40 psf	75 psf	3.0 ft	0 plf	993 plf	2x4	16 in.	No. 2	12 in.	9 ft	15 psf	1057 plf	94%	OK
Floor	35 psf	40 psf	75 psf	3.0 ft	0 plf	1218 plf	2x4	12 in.	No. 2	12 in.	9 ft	15 psf	1589 plf	77%	OK

Wall Type 2 - Exterior 2x4 Bearing Walls **Wood Stud Properties**

Level	DL	LL	TL	TW	Adt'l Ld	TL	Size	Spacing	Grade	Lu (in.)	Height	Wind	P allow.	Unity	Check
Roof Sloped	20 psf	28 psf	48 psf	5.0 ft	0 plf	240 plf	2x4	16 in.	No. 2	12 in.	9 ft	15 psf	1057 plf	23%	OK
Floor	35 psf	40 psf	75 psf	8.0 ft	0 plf	840 plf	2x4	16 in.	No. 2	12 in.	9 ft	15 psf	1057 plf	79%	OK
Floor	35 psf	40 psf	75 psf	8.0 ft	0 plf	1440 plf	2x4	12 in.	No. 2	12 in.	9 ft	15 psf	1589 plf	91%	OK

Wall Type 3 - Interior 2x4 Bearing Walls **Wood Stud Properties**

Level	DL	LL	TL	TW	Adt'l Ld	TL	Size	Spacing	Grade	Lu (in.)	Height	Wind	P allow.	Unity	Check
Roof Sloped	20 psf	28 psf	48 psf	16.0 ft	0 plf	768 plf	2x4	16 in.	No. 2	12 in.	9 ft	5 psf	1460 plf	53%	OK
Floor	35 psf	40 psf	75 psf	3.0 ft	0 plf	993 plf	2x4	16 in.	No. 2	12 in.	9 ft	5 psf	1460 plf	68%	OK
Floor	35 psf	40 psf	75 psf	3.0 ft	0 plf	1218 plf	2x4	12 in.	No. 2	12 in.	9 ft	5 psf	2037 plf	60%	OK

Wall Type 4 - Interior 2x4 Bearing Walls **Wood Stud Properties**

Level	DL	LL	TL	TW	Adt'l Ld	TL	Size	Spacing	Grade	Lu (in.)	Height	Wind	P allow.	Unity	Check
Roof Sloped	20 psf	28 psf	48 psf	3.0 ft	0 plf	144 plf	2x4	16 in.	No. 2	12 in.	9 ft	5 psf	1460 plf	10%	OK
Floor	35 psf	40 psf	75 psf	10.0 ft	0 plf	894 plf	2x4	16 in.	No. 2	12 in.	9 ft	5 psf	1460 plf	61%	OK
Floor	35 psf	40 psf	75 psf	10.0 ft	0 plf	1644 plf	2x4	12 in.	No. 2	12 in.	9 ft	5 psf	2037 plf	81%	OK

BOB D. CAMPBELL & CO.
Structural Engineers Since 1957
4338 Belleview Ave. 816.531.4144
Kansas City, MO 64111 www.bdc-engrs.com

Project:	Eagle Point
Project No.:	JGR2304
Location:	Aurora, CO
By:	MJF / RMH
Date:	11/1/2023

Continuous Footing at Exterior Wall

This spreadsheet calculates the required width of a continuous footing

Given:

Allowable soil bearing capacity (psf)	**2500**

Calculate Roof Load

	Load (psf)	Trib. Width (ft.)	Load (plf)
Roof Dead Load	**25**	**16**	400
Roof Live load	**30**	**16**	480
Roof Total Load			**880**

Calculate Floor Load

	Load (psf)	Trib. Width (ft.)	Load (plf)
Floor Dead Load	**70**	**10**	700
Floor Live load	**80**	**10**	800
Floor Total Load			**1500**

Calculate Wall Load

Material	Load (psf)	Height (ft.)	Load (plf)
4" face brick	**20**	**30**	600
8" masonry	**0**	**0**	0
12" masonry	**0**	**0**	0
stud wall w/ sheathing	**0**	**0**	0
10" precast	**0**	**0**	0
WIND LOAD	***0***	***0***	***0***
Wall Total Load			**600**

Calculate Self Load of Footing

Width of footing (ft)	1.333
Depth of footing (ft)	3
Density (pcf)	150
G.B. Total Load (plf)	**600**

Calculate Load of Soil Displaced by Footing

Width of footing (ft)	1.333
Depth of footing (ft)	3
Density (pcf)	115
Didplaced Soil Total Load (plf)	**460**

Load Summary

Roof Total Load	880
Floor Total Load	1500
Wall Total Load	600
Footing Total Load (plf)	600
Displaced Soil Total Load (plf)	-460
Total Load	**3120**

Design Summary

Total Load (plf)	3120
Required width (ft)	1.25
Width of footing (ft)	**1.333**
Depth of footing (ft)	**3**
Bearing Pressure (psf)	2341

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Project:	Eagle Point
Project No.:	JGR2304
Location:	Aurora, CO
By:	MJF / RMH
Date:	11/1/2023

Continuous Footing at Exterior Wall

This spreadsheet checks that continuous footing is capable of spanning 10'-0" void beneath grade beam

Given:

f'c Compressive Strength of Concrete (psi)	**3500**	**psi**
fy Yield Stress of Tension Reinforcing Steel (ksi)	**60**	**ksi**
fy Yield Stress of Shear Reinforcing Steel - stirrups	**60**	**ksi**
b Width of Beam (in.)	16.00	**in.**
h Depth of Beam (in.)	36.00	**in.**
d Effective Depth (in.)	32.00	**in.**
Quantity of tension reinforcing bars	**3.00**	**bars**
Size of Tension Reinforcing Bars	**#4**	
Area of Steel Per Bar in Tension	**0.20**	**sq. in.**
As (total)	0.6	sq. in.
Size of Stirrup with 2 Vertical Legs	**#4**	
Area of Steel Per Stirrup Bar	**0.20**	**in.**
Spacing of Stirrups	**16**	**in.**
Quantity of Stirrups Per Spacing	**1**	**stirrup(s)**

Check Bending:

Mu = ϕMn = ϕρfybd^2(1-0.59ρfy/f'c)

ϕ	0.90	
ρ=As/(bd)	0.00117	
B1	**0.85**	
ρb = 0.85B1(f'c/fy)(87/(87+fy))	0.02494	
ρmax = (3/4)ρb	0.01871	
ρmin = 3(f'c^0.5)/fy	0.00296	
ρmin = 200/fy	0.00333	
ϕMn	**85.38**	**k*ft**
Moment OK?	**OK**	

Check Shear:

Vu = ϕVc + ϕVs

ϕ	0.75	
ϕVc = ϕ2(f'c^0.5)bd	**45.42**	**kips**
ϕVc / 2	**22.71**	**kips**
Av	0.40	sq. in.
ϕVs = 0.85Avfyd/s	**36.00**	**kips**
ϕVc + ϕVs	**81.42**	**kips**
Shear OK?	**OK**	

Load Criteria:

Beam Self Weight	0.59985	**k/ft**
Additional Dead Load	**0.00**	**psf**
Live Load	**0.00**	**psf**
Tributary Width	1	**ft**
1.4DL	3.22	k/ft
1.2DL + 1.6LL	4.81	k/ft
1.2DL + 1.0WL + 1.0LL	4.04	k/ft
Controlling	**4.81**	**k/ft**
Span (ft.)	**10.00**	**ft**
Max Moment (k-ft.)	**60.10**	**k-ft**
Max Shear (kip)	**24.04**	**kip**

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Project:	Eagle Point
Project No.:	JGR2304
Location:	Aurora, CO
By:	MJF / RMH
Date:	11/1/2023

Spread Footing 4.0

This spreadsheet calculates the allowable load capacity of a square spread footing. *password=bdc*

Given:

Width of Square Footing	4	**ft**
Thickness of Footing	36	**in.**
Rebar Size	#5	
Area of Rebar	0.31	**sq. in.**
Quantity of bottom steel in each direction	5	
f'c Compressive Strength of Concrete (psi)	3500	**psi**
fy Yield Stress of Reinforcing Steel (ksi)	60	**ksi**
Allowable Soil Bearing Pressure	2.5	**ksf**

1. Calculate Maximum Allowable Total Load

Maximum Allowable Load = (area of footing x allowable soil bearing pressure) - (weight of footing + weght of displaced soil)

Area of Footing	16	sf
Density of concrete	150	pcf
Density of soil	120	pcf
Weight of footing	7.20	kips
Weight of displaced soil	5.76	kips
Maximum Allowable Load	**38.6**	**kips**

2. Check Thickness For Two-Way Shear

The critical perimeter is at d/2 from the face of the column.

davg (t - 3"cover - 1")	32	in.
Dimension of square column or loaded area	8	in.
bo Length of Critical Shear Perimeter	160	in.
ϕVc = 0.75*4*((f'c)^1/2)*bo*d	908.7	kips
Load Factor	1.8	
Max. Allowable Load = ϕVc / Load Factor	**504.8**	kips

Controlling Allowable Load =	**38.6**	kips
Maximum Applied Load =	25.0	kips
Check	OK	

4. Check Reinforcement

The critical section for moment is at the face of the column.

Mu = q x (tributary area) x (moment arm)	13.9	k*ft
b	48	in.
d	32	in.
As	1.55	sq. in.
C=0.85f'cba	143	a
T=Asfy	93	kips
a	0.65	in.
ϕMn = 0.9*Asfy(d-a/2)	**220.93**	k*ft

Reinforcement OK?	**OK**

Permit # 2023-2396785-CM
RSN 1762872

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Project Title: The Reserves at Eagle Point
Engineer: MJF
Project ID: JGR2304
Project Descr: New Apartments

Wood Beam

Project File: JGR2304.ec6

LIC# : KW-06017302, Build:20.23.09.30 Bob D. Campbell and Co., Inc. (c) ENERCALC INC 1983-2023

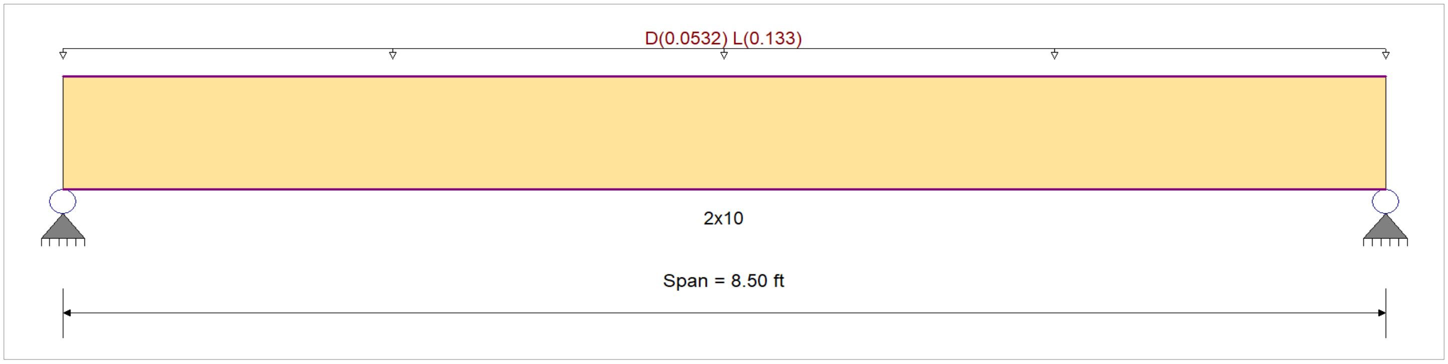
DESCRIPTION: Breezeway Floor Joists

CODE REFERENCES

Calculations per NDS 2018, IBC 2021, ASCE 7-16
Load Combination Set : IBC 2018

Material Properties

Analysis Method :	Allowable Stress Design	Fb +	900.0 psi	*E : Modulus of Elasticity*		
Load Combination :	IBC 2018	Fb -	900.0 psi		Ebend- xx	1,600.0 ksi
		Fc - Prll	1,350.0 psi		Eminbend - xx	580.0 ksi
Wood Species :	Douglas Fir - Larch	Fc - Perp	625.0 psi			
Wood Grade :	No.2	Fv	180.0 psi			
		Ft	575.0 psi		Density	31.210 pcf
Beam Bracing :	Beam is Fully Braced against lateral-torsional buckling				Repetitive Member Stress Increase	



Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Beam self weight calculated and added to loading
Uniform Load : D = 0.040, L = 0.10 ksf, Tributary Width = 1.330 ft

DESIGN SUMMARY

Design OK

Maximum Bending Stress Ratio	=	**0.842** 1	Maximum Shear Stress Ratio	=	**0.398** : 1
Section used for this span		**2x10**	Section used for this span		**2x10**
fb: Actual	=	958.61 psi	fv: Actual	=	71.70 psi
F'b	=	1,138.50 psi	F'v	=	180.00 psi
Load Combination		+D+L	Load Combination		+D+L
Location of maximum on span	=	4.250 ft	Location of maximum on span	=	0.000 ft
Span # where maximum occurs	=	Span # 1	Span # where maximum occurs	=	Span # 1

Maximum Deflection

Max Downward Transient Deflection	0.099 in	Ratio =	1027 >=360	Span: 1 : L Only
Max Upward Transient Deflection	0 in	Ratio =	0 <360	n/a
Max Downward Total Deflection	0.141 in	Ratio =	722 >=180	Span: 1 : +D+L
Max Upward Total Deflection	0 in	Ratio =	0 <180	n/a

Maximum Forces & Stresses for Load Combinations

Load Combination		Max Stress Ratios										Moment Values			Shear Values		
Segment Length	Span #	M	V	CD	CM	C_t	CLx	C_F	Cfu	C_i	C_r	M	fb	F'b	V	fv	F'v
D Only														0.0	0.00	0.0	0.0
Length = 8.50 ft	1	0.278	0.131	0.90	1.00	1.00	1.00	1.100	1.00	1.00	1.15	0.51	284.8	1,024.7	0.20	21.3	162.0
+D+L					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.50 ft	1	0.842	0.398	1.00	1.00	1.00	1.00	1.100	1.00	1.00	1.15	1.71	958.6	1,138.5	0.66	71.7	180.0
+D+0.750L					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.50 ft	1	0.555	0.263	1.25	1.00	1.00	1.00	1.100	1.00	1.00	1.15	1.41	790.2	1,423.1	0.55	59.1	225.0
+0.60D					1.00	1.00	1.00	1.100	1.00	1.00	1.15			0.0	0.00	0.0	0.0
Length = 8.50 ft	1	0.094	0.044	1.60	1.00	1.00	1.00	1.100	1.00	1.00	1.15	0.30	170.9	1,821.6	0.12	12.8	288.0

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Wood Beam

DESCRIPTION: Breezeway Floor Joists

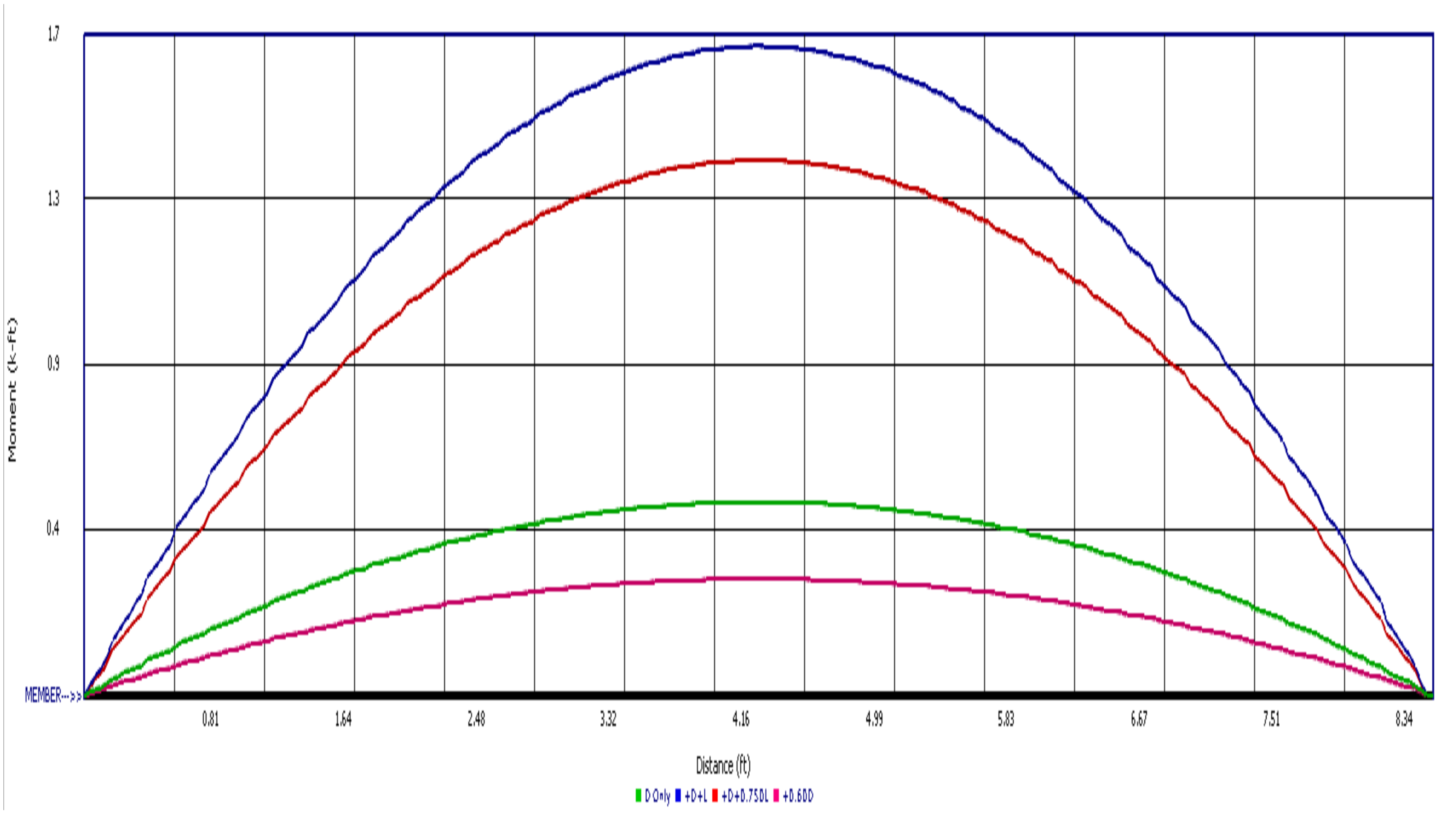
Overall Maximum Deflections

Load Combination	Span	Max. "-" Defl	Location in Span	Load Combination	Max. "+" Defl	Location in Span
+D+L	1	0.1412	4.281		0.0000	0.000

Vertical Reactions

Support notation : Far left is #1 Values in KIPS

Load Combination	Support 1	Support 2
Max Upward from all Load Conditions	0.804	0.804
Max Upward from Load Combinations	0.804	0.804
Max Upward from Load Cases	0.565	0.565
D Only	0.239	0.239
+D+L	0.804	0.804
+D+0.750L	0.663	0.663
+0.60D	0.143	0.143
L Only	0.565	0.565

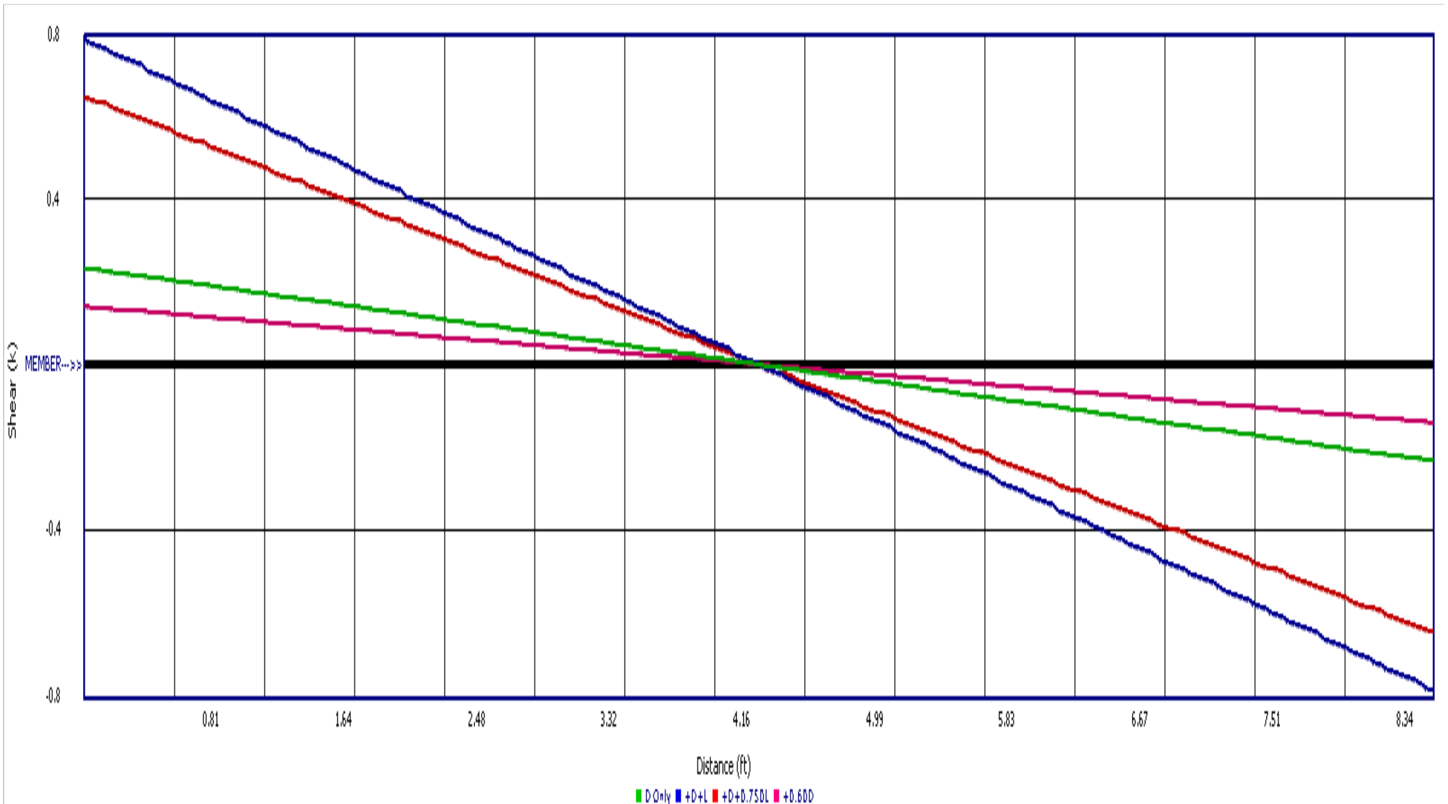


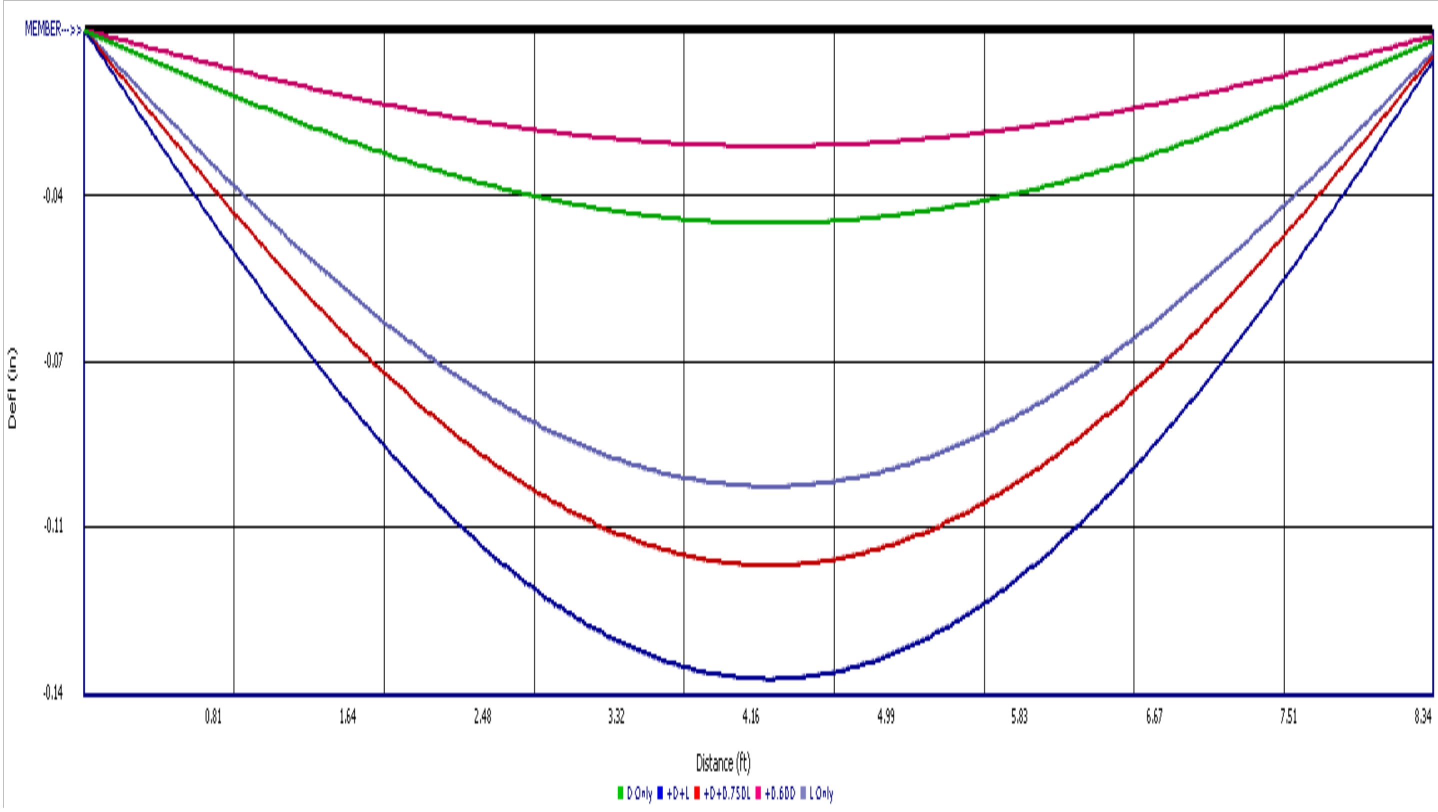
Wood Beam

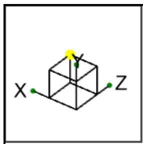
Project File: JGR2304.ec6

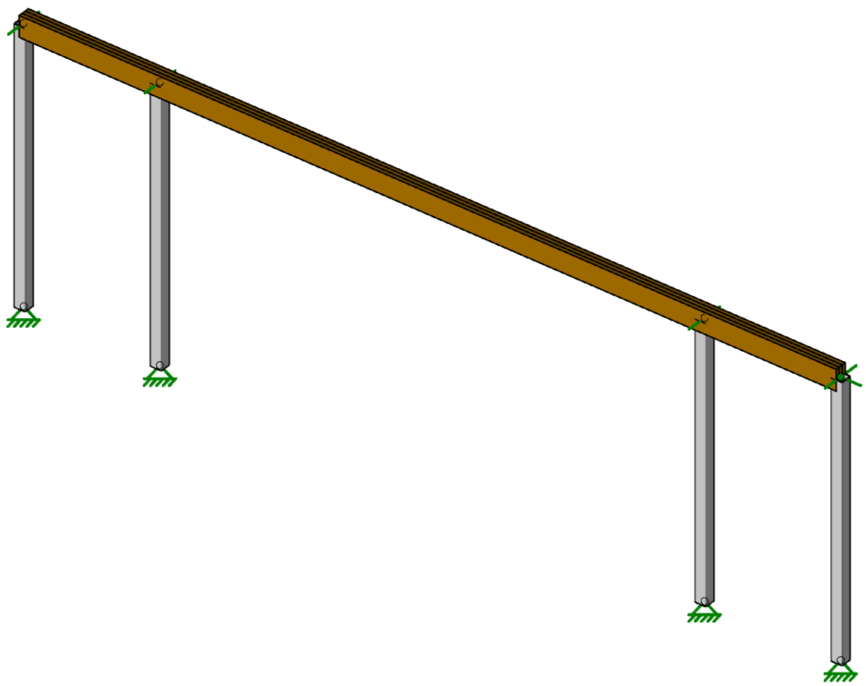
LIC# : KW-06017302, Build:20.23.09.30 Bob D. Campbell and Co., Inc. (c) ENERCALC INC 1983-2023

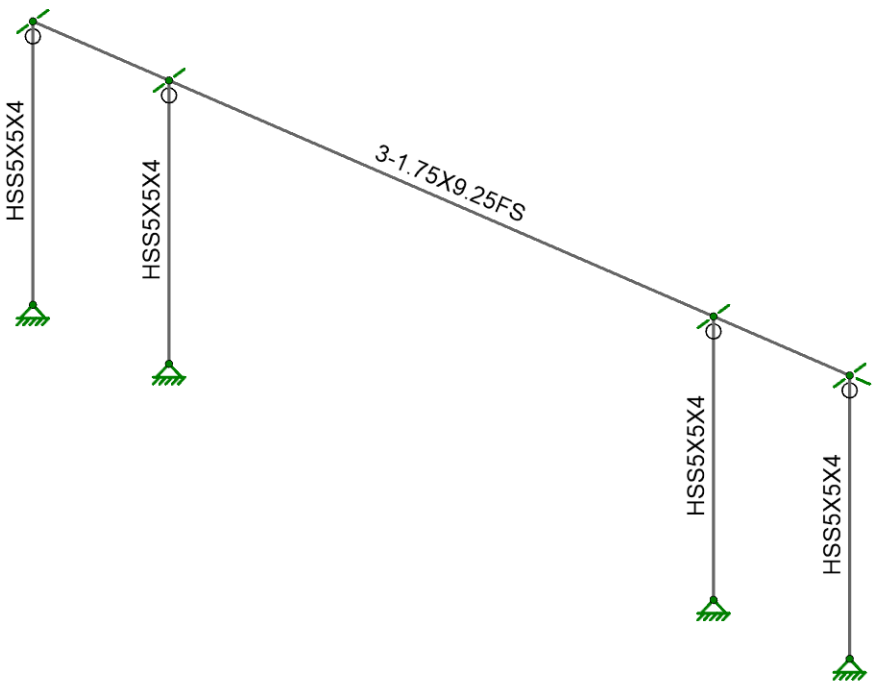
DESCRIPTION: Breezeway Floor Joists



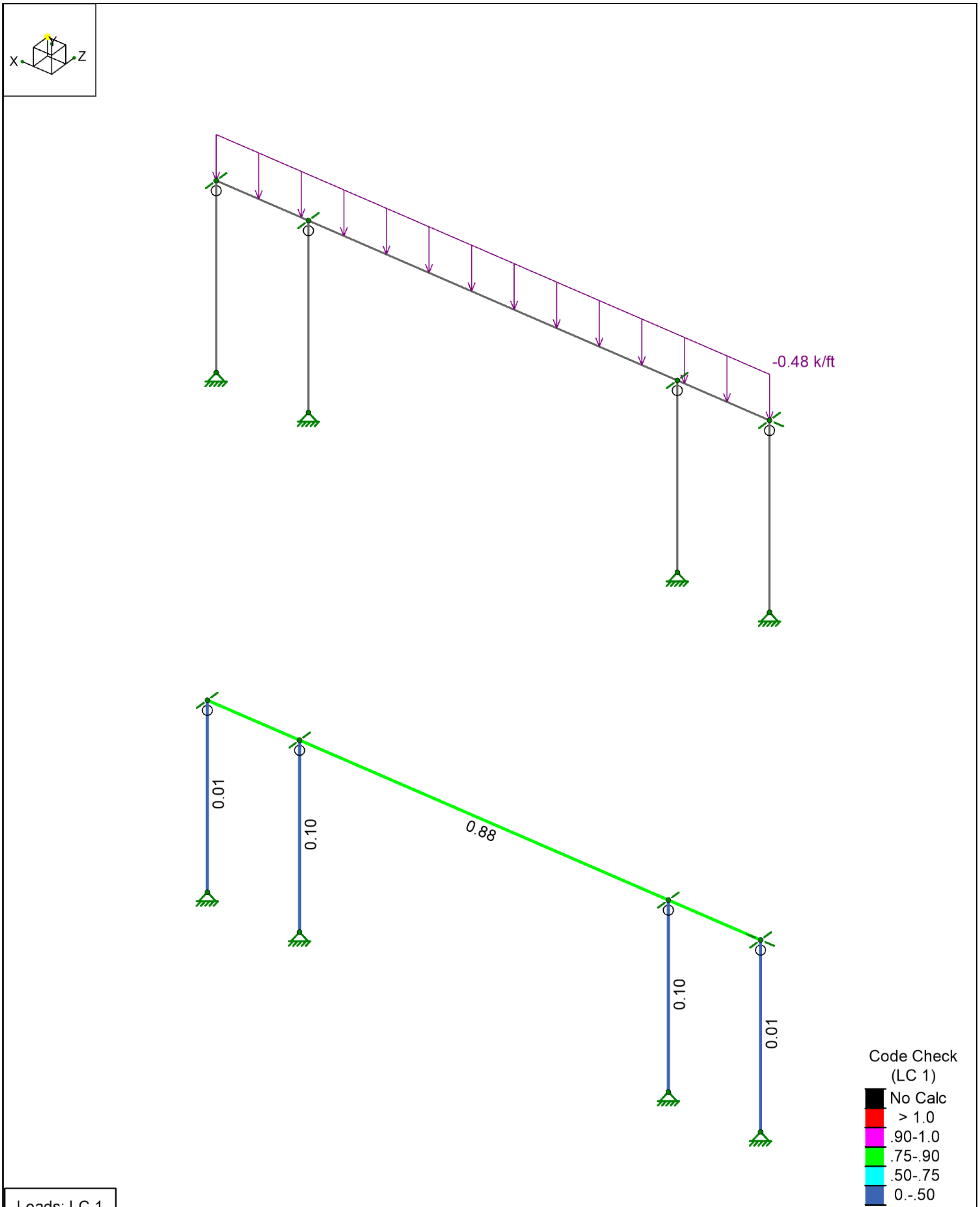








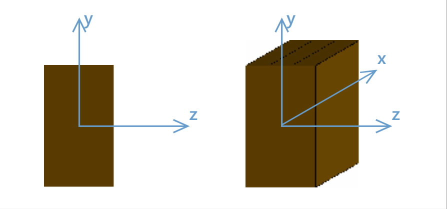
<Licensed Company>	CLUBHOUSE FRAME	SK-2
RMH		Nov 02, 2023
		Clubhouse Frame.r3d



Loads: LC 1,

<Licensed Company>	CLUBHOUSE FRAME	SK-4
RMH		Nov 02, 2023
		Clubhouse Frame.r3d

Detail Report: M5 **Unity Check:** 0.882 (axial/bending) **Load Combination:** LC 1:



Input Data:

Shape:	3-1.75X9.25FS (nominal)	I Node:	N6
Member Type:	Beam	J Node:	N5
Length (ft):	30	I Release:	Fixed
Material Type:	Wood	J Release:	Fixed
Design Rule:	Typical	I Offset (in):	N/A
Number of Internal Sections:	97	J Offset (in):	N/A

Material Properties:

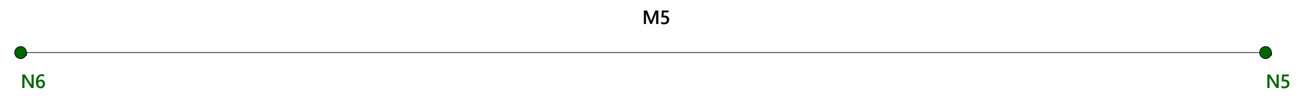
Material:	LVL_Microlam_1.9E_2600F	Grade:	na	Nu:	0.3
Type:	Custom	Cm:	No	Therm. Coeff. ($1e^{5}$°F^{-1}):	0.3
Database:	N/A	Ci:	No	Density (k/ft^3):	0.035
Species:	LVL_Microllam_1.9E_2600F	Emod:	1		

Shape Properties:

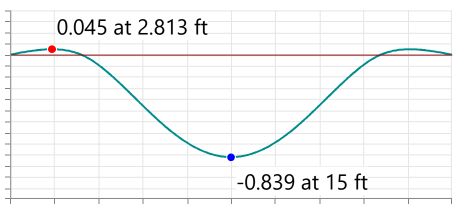
F_b (ksi):	2.6	E (ksi):	1900	b (actual) (in):	5.25
F_t (ksi):	1.555	Emod:	1	d (actual) (in):	9.25
F_v (ksi):	0.285	COV_E (Table F1):	0.1	# of Plies:	3
F_c (ksi):	2.51	E_{min} (ksi):	1004.11	K_f:	N/A

Design Properties:

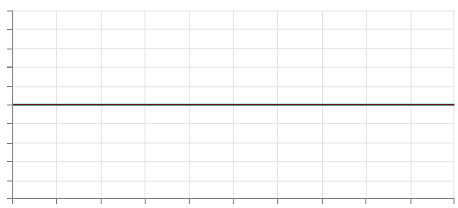
le2 (ft) :	2	C_D:	1	Max Defl Ratio:	L/289
le1 (ft) :	N/A	R_B:	8.975	Max Defl Location:	15
le-bend top (ft) :	Lbyy	C_L:	0.99	Span:	2
le-bend bot (ft) :	20	C_r:	1		
K_{y-y}:	1	C_{fu}:	1		
K_{z-z}:	1	C_P:	0.211		
y sway:	No	K_f:	0.6		
z sway:	No				



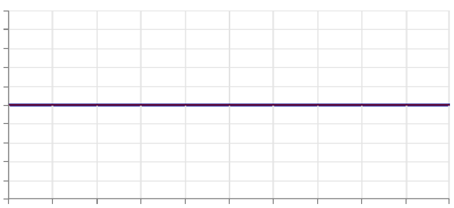
Diagrams:



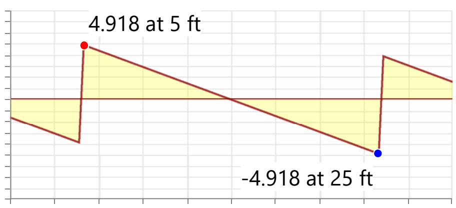
y Deflection (in)



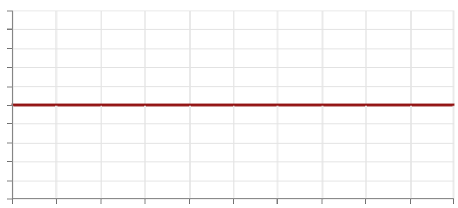
z Deflection (in)



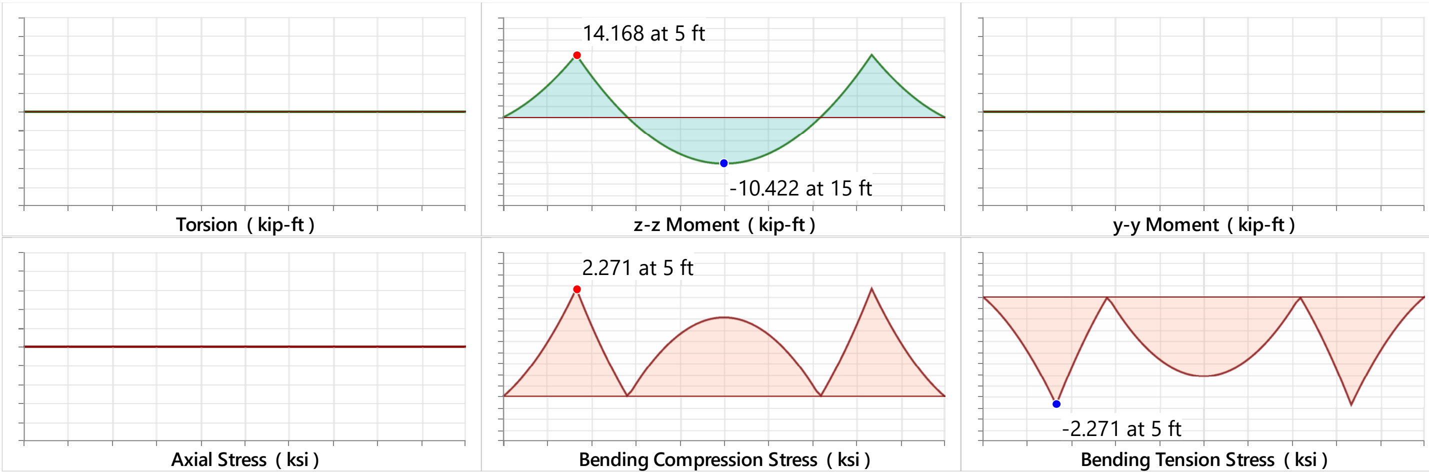
Axial Force (kips)



y Shear Force (kips)



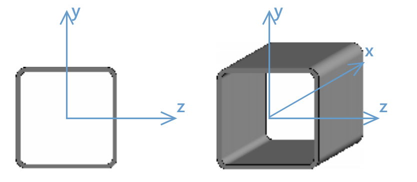
z Shear Force (kips)



AWC NDS-18: ASD Code Check

Limit State	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial	-	-	-	-
Applied Loading - Shear + Torsion	-	-	-	-
Axial Compression Analysis	0.000 ksi	0.531 ksi	-	-
Axial Tension Analysis	0.000 ksi	1.555 ksi	-	-
Flexural Analysis, Fb1'	2.271 ksi	2.573 ksi	-	-
Flexural Analysis, Fb2'	0.000 ksi	2.6 ksi	-	-
Bending & Axial Compression Analysis	-	-	0.882	Pass
Bending & Axial Tension Analysis	-	-	0.882	Pass
Shear Analysis	0.152 ksi	0.285 ksi	0.533	Pass

Detail Report: M3 **Unity Check:** 0.1 (axial/bending) **Load Combination:** LC 1:



Input Data:

Shape:	HSS5X5X4	**I Node:**	N3
Member Type:	Column	**J Node:**	N8
Length (ft):	10	**I Release:**	Fixed
Material Type:	Hot Rolled Steel	**J Release:**	BenPIN
Design Rule:	Typical	**I Offset (in):**	N/A
Number of Internal Sections:	97	**J Offset (in):**	N/A

Material Properties:

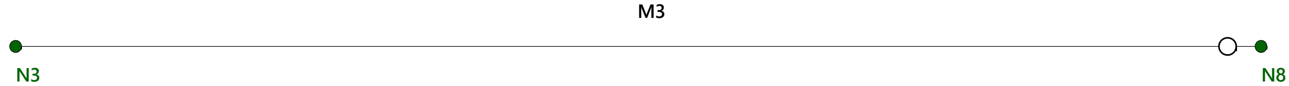
Material:	A500 Gr.B RECT	**Therm. Coeff. ($1e^5 °F^{-1}$):**	0.65	**R_y:**	1.4
E (ksi):	29000	**Density (k/ft^3):**	0.527	**F_u (ksi):**	58
G (ksi):	11154	**F_y (ksi):**	46	**R_t:**	1.3
Nu:	0.3				

Shape Properties:

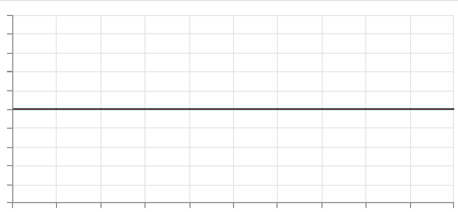
d (in):	5	**I_{yy} (in^4):**	16	**Area (in^2):**	4.3
b_f (in):	5	**I_{zz} (in^4):**	16	**J (in^4):**	25.8
t (in):	0.233				

Design Properties:

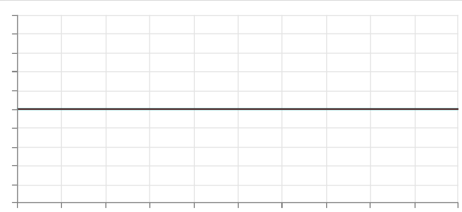
$L_{b\ y\text{-}y}$ (ft):	N/A	**$K_{y\text{-}y}$:**	1	**Max Defl Ratio:**	L/10000
$L_{b\ z\text{-}z}$ (ft):	N/A	**$K_{z\text{-}z}$:**	1	**Max Defl Location:**	0
$L_{comp\ top}$ (ft):	Lbyy	**y sway:**	No	**Span:**	N/A
$L_{comp\ bot}$ (ft):	N/A	**z sway:**	No		
L_{torque} (ft):	N/A	**Function:**	Gravity		
		Seismic DR:	None		



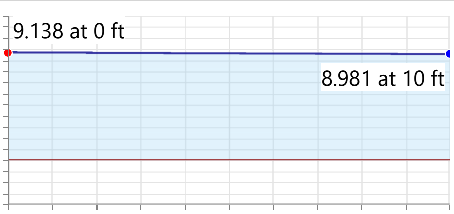
Diagrams:



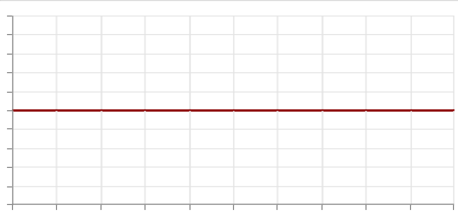
y Deflection (in)



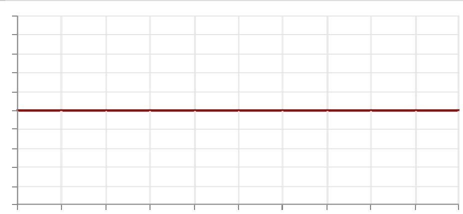
z Deflection (in)



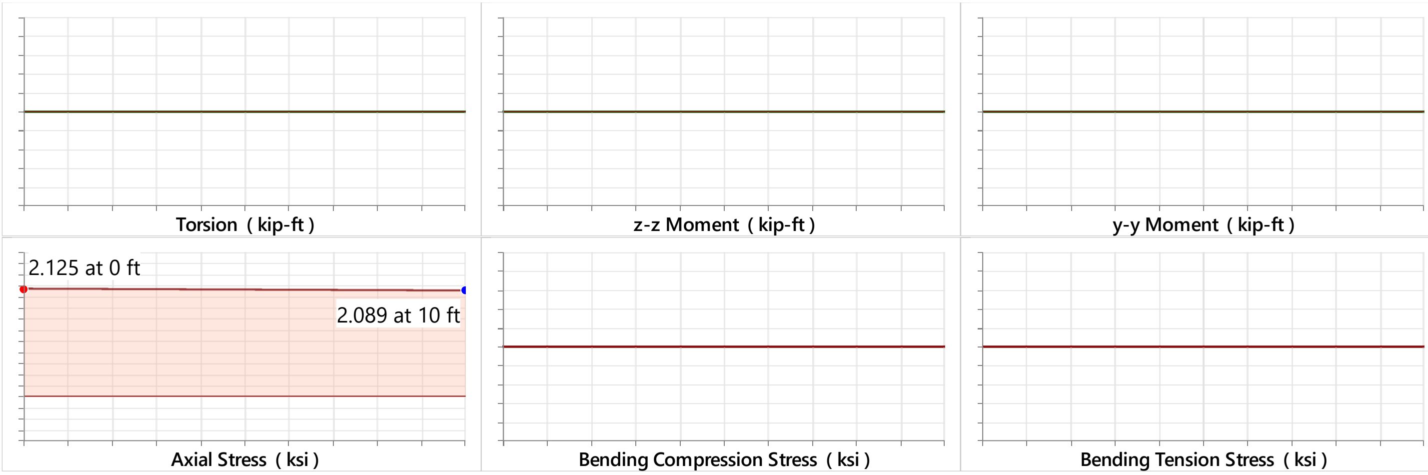
Axial Force (kips)



y Shear Force (kips)



z Shear Force (kips)



AISC 15th (360-16): ASD Code Check

Limit State	Required	Available	Unity Check	Result
Applied Loading - Bending/Axial				
Applied Loading - Shear + Torsion	-	-	-	-
Axial Tension Analysis	0.000 k	118.443 k	-	-
Axial Compression Analysis	9.138 k	91.296 k	-	-
Flexural Analysis (Strong Axis)	0.000 k-ft	17.468 k-ft	-	-
Flexural Analysis (Weak Axis)	0.000 k-ft	17.468 k-ft	-	-
Shear Analysis (Major Axis y)	0.000 k	33.124 k	0.000	Pass
Shear Analysis (Minor Axis z)	0.000 k	33.124 k	0.000	Pass
Bending & Axial Interaction Check (UC Bending Max)	-	-	0.1	Pass
Torsional Analysis	0.000 k-ft	14.517 k-ft	0.000	Pass

STRUCTURAL ENGINEERING CALCULATIONS

Supplemental Calculations: ZIP R-12 Shear Wall Sheathing

FOR

THE RESERVES AT EAGLE POINT
NEW APARTMENT COMPLEX
AURORA, COLORAD

PREPARED BY

JEFFREY L. WRIGHT, P.E.
&
MICHAEL J. FALBE, P.E.
&
RYAN M. HAGEDORN, P.E.

OF

BOB D. CAMPBELL & COMPANY, INC.
STRUCTURAL ENGINEERS
4338 BELLEVIEW AVENUE
KANSAS CITY, MISSOURI 64111
(816) 531-4144

Structural plan review is limited to a general survey for code compliance. No review is implied nor was undertaken to verify structural adequacy.

FOR

JonesGillamRenz ARCHITECTS
1881 MAIN STREET, SUITE 301
KANSAS CITY, MO 64108
785.827.0386

COLORADO LICENSED
JEFFREY LYLE WRIGHT
0053159
PROFESSIONAL ENGINEER
12-22-23

DECEMBER 22, 2023

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Structural Engineers Since 1957
4338 Belleview Ave. 816.531.4144
Kansas City, MO 64111 www.bdc-engrs.com

Project EAGLE POINT - AURORA, CO

Date 12-22-23 Page ___ of ___

ZIP SHEATHING CHECK

(FROM PREVIOUS CALCULATIONS PACKAGE)

MAX LOAD TO SHEAR WALL < 200 PLF

EXTERIOR SHEARWALL SHEATHING: ZIP R-12 SHEATHING

FASTENED w/ 0.131" SHANK NAILS @ 3/12 SPACING (1.5" PEN. INTO FRAMING) = 215 PLF ALLOW. > 200 PLF ✓

∴ ZIP R-12 SHEATHING OK

* REFER TO ATTACHED ZIP ESR REPORT *

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ICC-ES Evaluation Report
ESR-3373

Reissued June 2023
This report is subject to renewal June 2025.

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 12 00—Structural Panels
Section: 06 16 00—Sheathing

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 21 00—Thermal Insulation
Section: 07 25 00—Water-Resistive Barriers/Weather Barriers
Section: 07 27 00—Air Barriers

REPORT HOLDER:

HUBER ENGINEERED WOODS, LLC

EVALUATION SUBJECT:

ZIP SYSTEM® R-SHEATHING (INSULATING SHEATHING)

1.0 EVALUATION SCOPE

1.1 Compliance with the following codes:

- 2021, 2018, 2015, 2012 and 2009 *International Building Code®* (IBC)
- 2021, 2018, 2015, 2012 and 2009 *International Residential Code®* (IRC)
- 2021, 2018, 2015, 2012 and 2009 *International Energy Conservation Code®* (IECC)

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-3373 LABC and LARC Supplement.

Properties evaluated:

- Structural
- Thermal resistance
- Air leakage
- Weather resistance

1.2 Evaluation to the following green code(s) and/or standards:

- 2022 and 2019 California Green Building Standards Code (CALGreen), Title 24, Part 11
- 2021, 2018, 2015 and 2012 *International Green Construction Code®*
- 2020, 2017, 2014 and 2011 ANSI/ASHRAE/USGBC/IES Standard 189.1-Standard for the Design of High-Performance Green Buildings, Except Low-Rise Residential Buildings
- 2020, 2015, 2012 and 2008 ICC 700 National Green Building Standard™ (ICC 700-2020, ICC 700-2015, ICC 700-2012 and ICC 700-2008)

2.0 USES

ZIP System® R-Sheathing panels are used as combination wall sheathing and continuous insulation in conventional light wood-framed walls of Type V construction (IBC) and dwellings constructed in accordance with the IRC. R-Sheathing is used to resist transverse loads in accordance with the PS-2 span rating shown on the panels. The panels are used to satisfy the continuous insulation and insulated sheathing allowances of 2021 IRC Table N1102.1.3 (2018 and 2015 IRC Table N1102.1.2, 2012 IRC Table N1102.1.1 or 2009 IRC Table N1102.1.2) and 2021 IECC Tables R402.1.3 and C402.1.3 [2018 and 2015 IECC Tables R402.1.2 and C402.1.3, 2012 IECC Tables R402.1.1 and C402.2, or 2009 IECC Tables 402.1.1 and 502.2(1)], as applicable. When installed with ZIP System™ Flexible Flashing seam tape, R-Sheathing may be used as an alternative to the water-resistive barrier required by 2021 and 2018 IBC Section 1403.2 (2015, 2012 and 2009 IBC Section 1404.2) and IRC Section R703, and to address air leakage in the building envelope as required by Sections R402.4 and C402.5 of the 2021, 2018 and 2015 IECC, Sections R402.4 and C402.4 of the 2012 IECC or Sections 402.4.1 and 502.4.3 of the 2009 IECC.

ZIP System R-Sheathing panels may be used as intermittent wall bracing panels within designated braced wall lines in accordance with Section 4.5, and as shear wall panels in accordance with Section 4.6, of this report.

The attributes of the ZIP System® R-Sheathing have been verified as conforming to the provisions of (i) 2022 and 2019 CALGreen Section 5.407.1 for water-resistive barriers; (ii) ICC 700 2020 Sections 602.1.8, 11.602.1.8, 1202.6 and 13.104.1.4; (vi) ICC 700 2015 Sections 602.1.8, 11.602.1.8 and 12.6.602.1.8 (iii) ICC 700-2012 Sections 602.1.8, 11.602.1.8 and 12.5.602.1.8; ICC 700-2008 Section 602.9 for water-resistive barriers.

The attributes of the ZIP System® R-Sheathing have been verified as conforming to the provisions of (i) 2021 IgCC Section 701.3.1.2, 2018 IgCC Section 701.3.1.1 and 2015 and 2012 IgCC Section 605.1.2.1 for air barriers; and (ii)

2020 ASHRAE 189.1 Section 7.3.1.2, 2017, 2014 ASHRAE 189.1 Section 7.3.1.1 and 2011 ASHRAE 189.1 Section 7.4.2.9 for air barriers. Note that decisions on compliance for those areas rest with the user of this report.

3.0 DESCRIPTION

ZIP System® R-Sheathing is an insulated sheathing made by combining $^{7}/_{16}$-inch-thick ZIP System® Wall Sheathing recognized in ESR-1474 with a layer of maximum 2-inch-thick (25.4 mm) rigid foam plastic insulation laminated to its interior face using polyvinyl alcohol (PVA) adhesive. The ZIP System® Wall Sheathing is OSB complying with U.S. DOC PS 2 for wood structural panels as Exposure 1 with a 24/0, 24/16, or Wall 24 span rating, and is overlaid on the exterior side with a Grade D water-resistive barrier. The rigid foam plastic insulation is EnergyShield® CGF recognized in ESR-1375 which complies with the ICC-ES Acceptance Criteria for Foam Plastic Insulation (AC12). The foam plastic insulation boards have a nominal density of 2.0 pcf, compressive strength of 20 psi (138 kPa), vapor permeance of less than 1.0 perm, a flame-spread index of 75 or less and a smoke-developed index of 450 or less. The ZIP System® R-Sheathing panels are nominally 4 feet wide by 8, 9, 10, 11 or 12 feet long and have a square-finished-edge or machined-edge profile.

4.0 INSTALLATION

4.1 General:

ZIP System® R-Sheathing panels must be installed over wood-framed walls with minimum nominally "2-by" framing spaced at a maximum of 24 inches (406 mm) on center. In accordance with the manufacturer's published installation instructions, it is recommended that the square edges of the panels be installed with a gap between adjacent panels, and that the panels be separated from dissimilar materials. ZIP System® R-Sheathing panels may be installed vertically or horizontally. When use is in the construction of braced wall panels in accordance with Section 4.5, or as wood shear walls in accordance with Section 4.6, all joints and panel edges must be backed by framing.

When the panels are used as wall bracing panels or shearwall panels, fastening must be as described in Tables 1 or Table 2. ZIP System® R-Sheathing panels that are not used for structural bracing or shearwalls must be installed with minimum 8d common nails (or equivalent) at a maximum spacing of 6 inches on center on panel edges and 12 inches on center in the field. Nails must have a minimum 1-inch embedment into framing.

4.2 Water-resistive Barrier:

To qualify as a water-resistive barrier, ZIP System® R-Sheathing panels must be installed with the polymer-modified sheet overlay facing the exterior and all panel seams must be sufficiently sealed with ZIP System™ Flexible Flashing Tape in accordance with ESR-1474. All overlay surfaces must be dry and free of sawdust and dirt prior to application of the ZIP System™ seam tape. The seam tape must extend a minimum of 1 inch (25.4 mm) past the panel edge T-joint intersections and must be centered, within $^{1}/_{2}$ inch (12.7 mm), over the middle of panel seams. The tape must be pressed firmly to adhere to the surfaces and seal the seams. Wrinkles in the ZIP System™ seam tape are acceptable unless they create a leak path to the panel seam.

Flashing complying with the applicable code must be installed at the perimeter of door and window assemblies, penetrations and terminations of exterior wall assemblies, exterior wall intersections with roofs, chimneys, porches, decks, balconies, and similar projections, and at built-in gutters and similar locations where moisture could enter the wall. An adhesive-backed flashing tape that complies with the ICC-ES Acceptance Criteria for Flashing Materials (AC148) must be installed to seal all ZIP System® R-Sheathing flashing joints. Penetration items must be sealed to the panels. The adhesive-backed flashing tape must be installed in accordance with the manufacturer's published installation instructions.

4.3 Air Barrier:

ZIP System® R-Sheathing fastened to maximum 24-inch-on-center (610 mm) wood wall framing, using 8d nails spaced at 6 inches (152 mm) around panel edges and at 12 inches (305 mm) in the field, leaving a $^{1}/_{8}$-inch (3.18 mm) gap between panels, forms an air barrier assembly when the gaps between panels and the perimeter of penetrations are sealed with ZIP System™ seam tape recognized in ESR-2227. The assembly has demonstrated a maximum air leakage of 0.0072 cfm/ft^2 [0.037 L/(s•m^2)] infiltration and 0.0023 cfm/ft^2 [0.012 L/(s•m^2)] exfiltration at a pressure differential of 1.57 psf (75 Pa).

4.4 Thermal Resistance:

ZIP System® R-Sheathing panels have nominal thermal resistance in accordance with the R-Sheathing Type shown in Tables 1 or 2.

4.5 Braced Wall Panels in Accordance with the 2021, 2018, 2015, 2012, and 2009 IRC:

ZIP System® R-Sheathing panels are recognized for use in intermittent braced wall panel construction in accordance with IRC Section R602.10.2 when installed in accordance with Table 1. The panels are recognized as equivalent to wood structural panels used in Bracing Method WSP and may be used with amounts of bracing (lengths) specified in 2021, 2018, 2015 and 2012 IRC Table R602.10.3(1) and 2009 IRC Table R602.10.1.2(1), entitled "Bracing Requirements Based on Wind Speed." The minimum effective braced wall panel length must be 48 inches (1219 mm) for wall heights up to 10 feet (3048 mm), 4 feet 5 inches (1346 mm) for walls not exceeding 11 feet (3352 mm) in height, and 4 feet 10 inches (1473 mm) for walls not exceeding 12 feet (3658 mm) in height. For prescriptive wall bracing under this section (Section 4.5), 2021, 2018, 2015 and 2012 IRC, use is limited to areas where wind design is not required per IRC Section R301.2.1.1 and in Seismic Design Categories (SDC) A, B, and C (excluding townhouses in SDC C); use of sheathing in other conditions is outside the scope of this report. For prescriptive wall bracing under this section (Section 4.5), 2009 IRC recognition is limited to use in areas where the design wind speed is less than 110 mph and in Seismic Design Categories A, B, and C (excluding townhouses in SDC C); use of the sheathing in other conditions is outside the scope of this report. Holes and notches in wood framing are permitted in accordance with IRC Section R602.6.

4.6 Wood Framed Shear Walls in accordance with the 2021, 2018, 2015, 2012, and 2009 IBC and IRC:

ZIP System® R-Sheathing panels may be used in the construction of wood shear walls when the design is in accordance with Table 2 and 2021, 2018, 2015, 2012, or 2009 IBC Sections 2305 and 2306, as applicable. The Allowable Shear Capacity values in Table 2 must be used in lieu of the values shown in the code. Under this section (Section 4.6), recognition is limited to resisting in-plane wind loads and to use in Seismic Design Categories (SDC) A, B, and C, with earthquake load resistance determined using the maximum values of R = 2.0, Ωo = 2.5, and

Cd = 2.0. Holes and notches in the framing are permitted in accordance with the applicable code, code-referenced documents, and engineered design.

Shearwalls using ZIP System® R-Sheathing panels installed in accordance with this report may be used under the 2021, 2018, 2015, 2012, and 2009 IRC when an engineered design is submitted in accordance with 2021, 2018, 2015, 2012, and 2009 IRC Section R301.1.3, as applicable.

5.0 CONDITIONS OF USE

The ZIP System® R-Sheathing panels described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The ZIP System® R-Sheathing panels must be manufactured, identified and installed in accordance with this report and the manufacturer's published installation instructions. In the event of a conflict between the instructions and this report, this report governs.

5.2 When required by the code official, this evaluation report and the manufacturer's published installation instructions must be submitted at the time of permit application.

5.3 Walls sheathed with the panels must not be used to resist in-plane horizontal loads from concrete or masonry walls.

5.4 The ZIP System® R-Sheathing panels must be covered with a code-complying exterior wall covering or one that is recognized in a current ICC-ES evaluation report.

5.5 Siding installed over R-Sheathing must be installed in accordance with the code, and with the siding manufacturer's recommendations. Siding installers must account for any extra fastener length required to attach siding through the foam backed panel and into framing.

5.6 Where foam plastic is used in areas where the probability of termite infestation is "very heavy," safeguards must be followed in accordance with the protection against subterranean termite provisions in Chapter 26 of the IBC or Chapter 3 of the IRC, as applicable.

5.7 Fire-resistance-rated construction is outside the scope of this report.

5.8 Under the 2021 IBC, special inspection must be provided in accordance with 2021 IBC Sections 1704.3 and 1705.12 for sheathing installed in shear walls on buildings in Exposure B locations where *V* is 150 mph (67 m/s) or greater and in Exposures C or D where *V* is 140 mph (62.5 m/s) or greater. Under the 2018 or 2015 IBC, special inspection must be provided in accordance with IBC Sections 1704.3 and 1705.11 for sheathing installed in shear walls on buildings in Exposure B locations where V_{ASD} is 120 mph (53.6 m/s) or greater and in Exposures C and D locations where V_{ASD} is 110 mph (49.2 m/s) or greater. Under the 2012 IBC, special inspection must be provided in accordance with IBC Sections 1704.3 and 1705.10 for sheathing installed in shear walls on buildings in Exposure B locations where V_{ASD} is 120 mph (53.6 m/s) or greater and in Exposures C and D locations where V_{ASD} is 110 mph (49.2 m/s) or greater. Under the 2009 IBC, special inspection must be provided in accordance with IBC Sections 1705.1, 1705.2 and 1705.4 for sheathing installed in shear walls on buildings in Exposure B locations where the basic wind speed is 120 mph (53.6 m/s) or greater and in Exposures C and D locations where the basic wind speed is 110 mph (49.2 m/s) or greater. A statement of special inspections complying with 2021, 2018, 2015 or 2012 IBC Section 1704.3 or 2009 IBC Section 1705 (as applicable) must be provided to the code official (this includes addressing requirements in 2021, 2018 and 2015 IBC Sections 1704.3.3 and 1705.11 or 2012 IBC Sections 1704.3.3 and 1705.10 or 2009 IBC Sections 1705.4.1 and 1705.4.2, as applicable).

5.9 Cutting openings and penetrations in designated braced wall panels is not permitted.

5.10 Gypsum wallboard is required to be installed on the side of the wall opposite the proprietary sheathing in accordance with 2021, 2018, 2015 and 2012 IRC Section R602.10.4.3 and 2009 IRC Section R602.10.2.1.

5.11 Use of ZIP System® R-Sheathing panels to resist combined wind uplift and shear must be approved by the code official.

5.12 ZIP System® R-Sheathing panels are laminated at facilities located in Camp Hill, Pennsylvania, Diboll, Texas, East Moline, Illinois, and Northglenn, Colorado, under a quality-control program with inspections provided by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Water-resistive Membranes Factory-bonded to Wood-based Structural Sheathing, Used as Water-resistive Barriers (AC310), dated May 2008 (editorially revised, June 2019).

6.2 Under the 2021, 2018, 2015, 2012 and 2009 IBC and IRC for use in shear walls, data in accordance with the ICC-ES Acceptance Criteria for Proprietary Sheathing Jobsite-attached to Wood Light-frame Wall Construction Used as Shear Walls (AC269.2), dated October 2013 (editorially revised October 2021).

6.3 Under the 2021 2018, 2015, 2012, and 2009 IRC for use as an alternative to prescriptive intermittent braced wall panels, data in accordance with the ICC-ES Acceptance Criteria for Proprietary Sheathing Attached to Wood Light-frame Wall Construction Used as Braced Wall Panels under the IRC (AC269.1), dated February 2017 (editorially October 2021).

6.4 Air leakage data in accordance with ASTM E2357.

7.0 IDENTIFICATION

7.1 Each ZIP System® R-Sheathing panel described in this report must bear a label that includes the manufacturer's name (Huber Engineered Woods, LLC) and address, the product name, the R-Sheathing type, the date of manufacture or a tracking number, the manufacturing plant identifier, and the evaluation report number (ESR-3373).

7.2 The report holder's contact information is the following:

HUBER ENGINEERED WOODS, LLC
ONE RESOURCE SQUARE
10925 DAVID TAYLOR DRIVE, SUITE 300
CHARLOTTE, NORTH CAROLINA 28262
(800) 933-9220
www.huberwood.com

PRESCRIPTIVE METHOD (INTERMITTENT WALL BRACING)

TABLE 1—FASTENING REQUIREMENTS FOR ZIP SYSTEM® R-SHEATHING WITH FRAMING OF DOUGLAS FIR-LARCH FOR WIND OR SEISMIC LOADING UNDER THE 2021, 2018, 2015, 2012, AND 2009 IRC (WSP METHOD)

R-SHEATHING TYPE[3] (*R*-Value of foam)	FRAMING[4]		FASTENING REQUIREMENT		
	Nominal Stud Size (min.)	Maximum Stud Spacing (inches)	Fastener Specifications[2]	Edge/Field Spacing (inches)	Minimum Penetration into Framing (inches)
R-3	2-by-4	24	0.131-inch shank nails	$^{4}/_{12}$	1.5
R-3	2-by-4	16	16ga staples, $^{7}/_{16}$-inch crown, 2-inch length	$^{3}/_{6}$	1.0
R-6	2-by-4	24	0.131-inch shank nails	$^{4}/_{12}$	1.5
			15ga staples, $^{7}/_{16}$-inch crown, 2.5-inch length	$^{3}/_{6}$	1.0
R-9	2-by-4	24	0.131-inch shank nails	$^{3}/_{12}$	1.5
R-12	2-by-4	24	0.131-inch shank nails	$^{3}/_{12}$	1.5

For **SI:** 1 inch = 25.4 mm

[1]All fasteners must be located a minimum of $^{3}/_{8}$ inch from panel edges.
[2]Fasteners must be common nails or equivalent, or staples, of a type generally used to attach wood sheathing.
[3]Type R-12 R-Sheathing panels have a foam plastic insulation thickness of 2.0 inch. Type R-9 R-Sheathing panels have a foam plastic insulation thickness of 1.5 inch. Type R-6 R-Sheathing panels have a foam plastic insulation thickness of 1.0 inch. Type R-3 R-Sheathing panels have a foam plastic insulation thickness of 0.5 inch.
[4]All panel edges must be backed by framing.

ENGINEERED METHOD (SHEARWALL PANELS)

TABLE 2—FASTENING REQUIREMENTS AND ALLOWABLE SHEAR CAPACITY FOR ZIP SYSTEM® R-SHEATHING WITH FRAMING OF DOUGLAS FIR-LARCH[2] FOR WIND OR SEISMIC LOADING UNDER THE 2021 2018, 2015, 2012 AND 2009 IBC

R-SHEATHING TYPE[4] (*R*-Value of foam)	FRAMING		FASTENING REQUIREMENT			ALLOWABLE SHEAR CAPACITY[5,6,7] (plf)
	Nominal Stud Size (min.)	Maximum Stud Spacing (inches)	Fastener Specifications[3]	Edge/Field Spacing (inches)	Minimum Penetration into Framing (inches)	
R-3	2-by-4	24	0.131-inch shank nails	$^{4}/_{12}$	1.5	245
R-3	2-by-4	24	0.131-inch shank nails	$^{3}/_{12}$	1.5	280
R-3	2-by-4	16	16ga staples, $^{7}/_{16}$-inch crown, 2-inch length	$^{3}/_{6}$	1.0	210
R-6	2-by-4	24	0.131-inch shank nails	$^{4}/_{12}$	1.5	230
R-6	2-by-4	24	0.131-inch shank nails	$^{3}/_{12}$	1.5	255
R-9	2-by-4	24	0.131-inch shank nails	$^{3}/_{12}$	1.5	240
R-12	2-by-4	24	0.131-inch shank nails	$^{3}/_{12}$	1.5	215

For **SI:** 1 inch = 25.4 mm, 1 plf = 14.6 N/m.

[1]All fasteners must be located a minimum of $^{3}/_{8}$ inch from panel edges.
[2]For framing of other species, the shear value above must be multiplied by the Specific Gravity Adjustment Factor = [1- (0.50 – SG)], where SG is the specific gravity of the framing lumber in accordance with the AWC NDS. This adjustment factor must not be greater than 1.
[3]Fasteners must be common nails or equivalent, or staples, of a type generally used to attach wood sheathing.
[4]Type R-6 R-Sheathing panels have a foam plastic insulation thickness of 1.0 inch. Type R-3 R-Sheathing panels have a foam plastic insulation thickness of 0.5 inch.
[5]The maximum height-to-width aspect ratio of shear walls is 2:1.
[6]The allowable shear capacity may be increased by 40% for wind in Allowable Stress Design in accordance with Section 2306.3 of the 2021, 2018, 2015, 2012 and 2009 IBC.
[7]All panel edges must be backed by framing.

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ICC-ES Evaluation Report

ESR-3373 LABC and LARC Supplement

Reissued June 2023

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Section: 06 12 00—Structural Panels
Section: 06 16 00—Sheathing

DIVISION: 07 00 00—THERMAL AND MOISTURE PROTECTION
Section: 07 21 00—Thermal Insulation
Section: 07 25 00—Water-Resistive Barriers/Weather Barriers
Section: 07 27 00—Air Barriers

REPORT HOLDER:

HUBER ENGINEERED WOODS, LLC

EVALUATION SUBJECT:

ZIP SYSTEM® R-SHEATHING (INSULATING SHEATHING)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that ZIP System® R-Sheathing, described in ICC-ES evaluation report ESR-3373, has also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2023 *City of Los Angeles Building Code* (LABC)
- 2023 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The ZIP System® R-Sheathing, described in Sections 2.0 through 7.0 of the evaluation report ESR-3373, complies with the LABC Chapters 14 and 23, and the LARC, and is subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The ZIP System® R-Sheathing described in this evaluation report supplement must comply with all of the following conditions:

- All applicable sections in the evaluation report ESR-3373.
- The design, installation, conditions of use and identification of the ZIP System® R-Sheathing panels are in accordance with the 2021 *International Building Code®* (IBC) provisions noted in the evaluation report ESR-3373.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.

This supplement expires concurrently with the evaluation report ESR-3373, reissued June 2023.

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ICC-ES Evaluation Report

ESR-3373 CBC and CRC Supplement

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REPORT HOLDER:

HUBER ENGINEERED WOODS, LLC

EVALUATION SUBJECT:

ZIP SYSTEM® R-SHEATHING (INSULATING SHEATHING)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that ZIP System® R-Sheathing, described in ICC-ES evaluation report ESR-3373, has also been evaluated for compliance with the code*(s)* noted below.

Applicable code editions:

- 2022 *California Building Code®* (CBC)

For evaluation of applicable chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) AKA: California Department of Health Care Access and Information (HCAI) and the Division of State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

- 2022 *California Residential Code®* (CRC)

2.0 CONCLUSIONS

2.1 CBC:

The ZIP System® R-Sheathing, described in Sections 2.0 through 7.0 of the evaluation report ESR-3373, complies with CBC Chapters 14 and 23, provided the design and installation are in accordance with the 2021 *International Building Code®* (IBC) provisions noted in the evaluation report and the additional requirements of CBC Chapters 16 and 17, as applicable.

2.1.1 OSHPD: The applicable OSHPD Sections and Chapters of the CBC are beyond the scope of this supplement.

2.1.2 DSA: The applicable DSA Sections and Chapters of the CBC are beyond the scope of this supplement.

2.2 CRC:

The ZIP System® R-Sheathing, described in Sections 2.0 through 7.0 of the evaluation report ESR-3373, complies with CRC Chapters 3 and 6, provided the design and installation are in accordance with the 2021 *International Residential Code®* (IRC) provisions noted in the evaluation report and the additional requirements of CRC Chapters 3 and 6 as applicable.

This supplement expires concurrently with the evaluation report, reissued June 2023.

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ICC-ES Evaluation Report

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REPORT HOLDER:

HUBER ENGINEERED WOODS, LLC

EVALUATION SUBJECT:

ZIP SYSTEM® R-SHEATHING (INSULATING SHEATHING)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that ZIP System® R-Sheathing, described in ICC-ES evaluation report ESR-3373, has also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2020 *Florida Building Code—Building*
- 2020 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The ZIP System® R-Sheathing, described in Sections 2.0 through 7.0 of ICC-ES evaluation report ESR-3373, complies with the *Florida Building Code—*

Building and *Florida Building Code—Residential*, provided the design requirements are determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable. The installation requirements noted in ICC-ES evaluation report ESR-3373 for the 2018 *International Building Code®* meet the requirements of the *Florida Building Code-Building* or the *Florida Building Code-Residential,* as applicable.

Use of the ZIP System® R-Sheathing for compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* or the *Florida Building Code—Residential* has not been evaluated and is outside the scope of this supplemental report.

For products falling under Florida Rule 61G20-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued June 2023.