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April 29, 2022

Ms. Donna Ruark
Development Services
City of Portland
ATTN: Appeals
1900 SW 4th Avenue, Suite 5000 (5th floor)
Portland, OR 97201

Greenbrier Gunderson
Existing Building Repair - Building Code Appeal
WJE No. 2021.1080.1

Dear Ms. Ruark:

Wiss, Janney, Elstner Associates, Inc. (WJE) is writing this letter on behalf of the Greenbrier Companies to request approval for use of an alternative way to meet the intent of the adopted building code through a formal Building Code Appeal. This letter serves to provide background for the existing building repair project of "Ways 2", at the Greenbrier Gunderson industrial complex located at 4350 NW Front Avenue in Portland, Oregon, and to supplement a letter dated April 13, 2022, by Atlas Geotechnical which explains the geotechnical merit of our appeal.

Specifically, we are requesting exemption from the following:

1. ASCE 7-16 Table 12.13-2 which provides an upper bound limit on the horizontal ground displacement from lateral spreading for shallow foundations beyond which deep foundations are required, and
2. Design and detailing in accordance with Section 12.13.9.2.1.

BACKGROUND

The Greenbrier Gunderson industrial complex comprises many buildings on NW Front Avenue on the south side of the Willamette River in northwest Portland, Oregon. Ways 2 is rectangular in plan and approximately 300 feet long north-south by 95 feet wide east-west, abutting an adjacent industrial building to the south and terminating at the north end within the sloping bank of the Willamette River. A site plan, WJE Sheet G003, is attached as part of this submittal. The subject building was originally constructed in the late 1950s to cover Shipways No. 2, a sloping railway used to deliver manufactured products from inside the Shipways No. 2 building into the Willamette River. In the 1970s the interior sloping railway of the building was filled and regraded to support the present-day level concrete slab on ground floor. Subsequently, the north end of the building was closed in with a steel framed gable end wall.

The building is steel framed, unconditioned, and its current use for manufacturing steel rail cars is categorized in the Oregon Structural Specialty Code (OSSC) as occupancy class Group F-1. As designed and constructed, the longitudinal walls included steel buttress columns (a buttress column is a vertical member that is braced in the east-west direction by a diagonal member that intersects the column about

35 feet above the foundation and is connected to the column with smaller members such that the column and brace form a truss) spaced 35 feet on-center (Figure 3). Each buttress column included a section (pedestal) extending above the connection to its diagonal brace so that the roof trusses would be supported above the column/brace connection. Including the pedestals, the buttress columns were approximately 47 feet high. At the points where columns and their associated braces intersected, the buttress columns along each wall supported and were interconnected by a north-south line of plate girders that extended the entire length of the building. North-south bracing included "x" and chevron bracing as shown in Figure 4, and pedestals are braced by "x" cable bracing. The building facade consisted of 2x6 wood or cold form steel metal girts that supported a combination of corrugated metal and translucent corrugated fiberglass panel siding. Each steel buttress column and associated diagonal brace were supported on its own concrete pier that extended down between 7 and 17 feet to concrete spread footings. The heights of the concrete piers varied to accommodate the original sloping Shipways No. 2 railway. The brace piers along each north-south wall were connected by concrete walls. Several buttress column pier and associated diagonal brace pier were connected by transverse walls, but this is not a typical condition. WJE was provided an aerial photograph of the Ways 2 building from 1970 before the Shipways No. 2 railway was filled in, which is consistent with the above description of the foundation (Figure 1 and Figure 2). The roof consisted of heavy timber bowstring trusses, timber purlins, and timber decking.

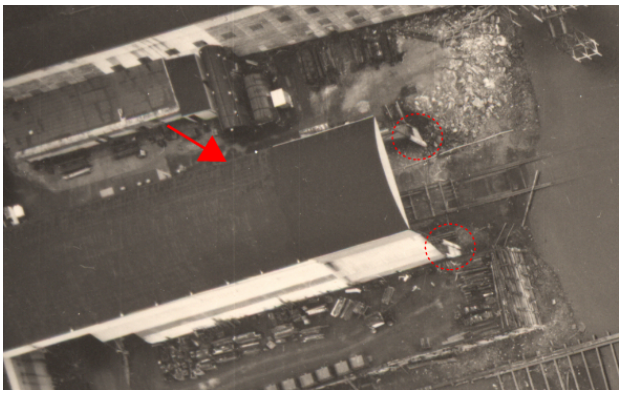


Figure 1. Aerial photograph of Ways 2 (red arrow) circa 1970. The exposed buttress column footings at the north end of the building are circled with red dash.

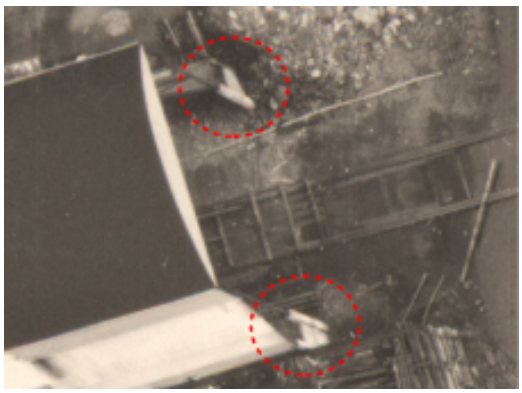


Figure 2. Closeup of Figure 1 showing the exposed concrete piers with tie walls.

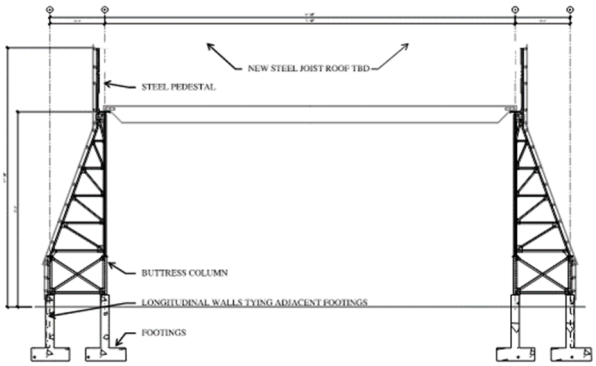


Figure 3. Typical east-west section of the building.

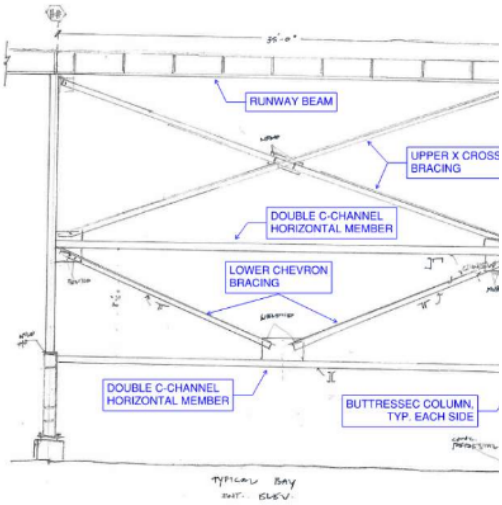


Figure 4. Typical 35-foot north-south braced bay drawn by WJE. Note pedestals are not shown.

On February 15, 2021, the Ways 2 building roof collapsed from snow accumulation. The collapse also severely damaged the extensions of the buttress columns (pedestals) which were subsequently removed. Damage to other elements of the structure was very limited. WJE has been retained by the owner, The Greenbrier Corporation, to develop repair documents and provide permitting services to restore functionality of the building.

Cleanup of collapsed debris began shortly after the collapse and was completed in June 2021. Subsequently, WJE confirmed that the remaining portions of the building were suitable for continued use without the roof. Since that time, the building has been used for storage and various manufacturing processes.

On January 4, 2022, WJE, Greenbrier representatives, and others met with the City of Portland (City) for a preapplication meeting to discuss the scope of work needed to construct a roof for the building. Based on the amount of damaged suffered by the lateral force resisting system from the roof collapse, primarily in the form of damage to the buttress column pedestals, the City interpreted Portland City Code (PCC) Section 24.85.055 to require that the lateral force resisting components of the building be able to meet the OSSC requirements for new construction.

This interpretation of the PCC requires the Ways 2 building be evaluated for compliance with various criteria applicable to new construction, which is a more stringent requirement than that which is required by OSSC Chapter 34, which adopts and amends the 2018 International Existing Building Code (IEBC) for repair of existing buildings. The OSSC explicitly allows reconstruction of a building, provided the repair meets the structural requirements of IEBC Section 405 and there were no dangerous conditions present, as determined by the building official. In general, undamaged elements are allowed to remain and new elements, including existing components that receive load from new elements, must be shown to meet requirements for new construction, except that seismic forces are permitted to be reduced by 25 percent from those that would be required for new construction.

The City also expressed concerns regarding potential for liquefaction and lateral spreading at the site during a seismic event and requested that geotechnical analyses be performed. WJE retained Atlas

Geotechnical (Atlas) to perform geotechnical analysis for the site. Atlas's preliminary findings are that the soil supporting the existing building foundations is not likely to satisfy the Building Code's seismic lateral displacement requirements as described in ASCE 7-16 Table 12.13-2. Refer to Atlas's letter dated April 15, 2022, included with this submittal, for more information.

DISCUSSION

Our case for appeal is based on the expected performance of the building according to the performance goals stated in Section 1.1 of The National Earthquake Hazards Reduction Program (NEHRP) Recommended Seismic Provisions for New Buildings and Other Structures. NEHRP works cooperatively with national building codes and organizations like the International Code Council (ICC), to integrate the most up-to-date earthquake engineering technology into the model building codes. There are two applicable objectives for seismic performance for the Ways 2 building from Section 1.1 of NEHRP which include 1) reasonable assurance of seismic performance that will avoid serious injury and life loss due to structure collapse, and 2) preserve means of egress.

Reasonable assurance of seismic performance that will avoid serious injury and life loss due to structure collapse

Atlas assumed that the area would be subjected to design level ground motions used for the design of new construction. Under these conditions, Atlas concluded that the seismic-induced differential vertical displacement between 35-foot-spaced columns would be approximately half of the 6.3 inch limit for differential settlement in ASCE Table 12.13-3, and thus within the acceptable differential settlement threshold for single-story steel buildings. However, Atlas also found that seismic-induced liquefaction and lateral spreading are also likely to occur given the assumed demands.

Lateral spreading is expected to cause the soils on site to move northward towards the Willamette River, with more significant effects occurring near the north end of the building nearest the river. Since the building is supported on shallow foundations that do not extend through the liquifiable soil layer, the building foundations may move with the soil on the order of several feet during a design level earthquake. Fortunately, based on review of historical aerial photographs like the one shown in Figure 1 and building alteration drawings from the 1970s, it appears that concrete walls connect the concrete piers and footings that support the buttress column brace members in the north-south direction. The buildings floor slab also provides constraints against relative movements among the columns. Each of these elements would mitigate the effects of lateral spreading on the steel superstructure. If these walls and the floor slab remain intact and cause columns and column braces to move collectively as a rigid body during a lateral spreading event, associated damage to the superstructure would be minimal. If the foundation walls and floor slab are damaged to the extent that significant relative displacement can occur between columns, damage to bracing elements (e.g., bucking, fracture, connection failure) connecting the columns and/or damage to the columns (e.g., substantial bending or kinking in the north-south direction) between the ground and the column/brace connections would be expected.

Once ground movement has ceased, any damaged framing needs to be able to support the roof. In order to characterize the sensitivity of the buttress columns to potential damage due to relative north-south movements between columns, we considered the following issues:

1) Proposed modifications to the north-south bracing system for the buttress columns

2) Roof dead loads consistent with proposed roof replacement
3) The capacity of a column to support roof loads with no bracing between the ground and the column/brace connection point (i.e., north-south lateral support exists only at the ground and the column/brace connection point)
4) The amount of north-south bracing that would be needed at the column/brace connection point to provide the restraint assumed in Item 1

Based on the measured column properties, the axial capacity of a typical buttress column with no north-south lateral bracing between the ground and the column/brace connection point is several times the dead load. Consequently, loss of intermediate bracing during a seismic even would not be expected to cause a column to fail. In order to evaluate Item 4, we first assumed that, after ground movement ceases, every column will have a permanent lean of 1 foot between the ground and the column/brace connection. Furthermore, we made the conservative assumption that all leans would be in the same direction. Given these assumptions, the post-event bracing in each north-south column line would need to provide a total lateral restraining force of about 18 kips at the top of buttress column/roof level, or about 2 kips at each column. This is significantly less than the capacity of a single diagonal tension brace, which means substantial bracing damage could be sustained without compromising effective lateral support for the assumed post-event gravity load conditions. Based on this analysis, we believe that the north-south framing would be able to sustain severe damage without compromising stability under post-event gravity loads.

Given that the new roof structure for the building will be much lighter in comparison to the collapsed timber bowstring roof, greatly reducing overall seismic and gravity demands; and given that the superstructure will be greatly enhanced to meet building code requirements for new construction in accordance with the PCC, we believe that the building will be able to tolerate design level lateral spreading and differential displacements without catastrophic collapse.

Means of egress

The Ways 2 building is classified as a Risk Category II building. This Risk Category includes seismic performance objectives for some multi-story apartment buildings and low-rise office buildings with permanent occupants, complex floor plans with multitudes of obstacles obstructing egress like partitions, miscellaneous clutter, stairs, and doorways. We are not suggesting the Ways 2 building be considered a Risk Category I building, but clearly this building represents a very low hazard compared to other buildings in a very generalized category. The open floor plan of the building is uniquely suited to allow unobstructed egress from the building during or after a seismic event through four large unobstructed permanent wall openings (Figure 5). Provided that the large wall openings are not closed with rigid doors but rather with roll up flexible covers, the openings are more likely to remain open if deformed or racked, compared to rigid doorways in other Risk Category II buildings. As shown on a floor plan of the building on Sheet G004, attached to this submittal, maximum exit access travel distance is less than half of that required in the OSSC.

In addition, Greenbrier reports that only approximately 15 people work in the building at one time, which is 20 times fewer occupants, than is allowed per OSSC Table 1004.5. Low building occupancy combined with unobstructed egress from the building presents a “low hazard to human life in the event of a failure” which sets this building apart from other buildings in the same Risk and performance objective category.

Figure 5. Large wall opening at the southwest corner of the building.

CONCLUSION

Based on our preliminary structural analysis of the building, we believe that, when modified as proposed, the steel superstructure will be able to sustain applicable seismic demands and maintain an appropriately low risk of collapse. In addition, the few occupants that would be expected to be in the building during an earthquake will have unobstructed access to exits and, if required, additional exists can be provided. Consequently, it is our opinion that when modified as proposed, the building will have adequate seismic performance characteristics, including a level of safety and reliability much greater than existing before the recent roof collapse.

Sincerely,

WISS, JANNEY, ELSTNER ASSOCIATES, INC.

Trent Tinney, P.E.
Senior Associate and Project Manager

Enclosure:
Sheets G003 and G004

REGISTERED PROFESSIONAL ENGINEER
96173PE
OREGON
MAY 12, 2020
TRENT LEE TINNEY
2022.04.29 09:21:14-07'00'

0 25.5' 50' 100' 200'

SCALE: 1:50

KEY

- ROADWAY
- PROPERTY BOUNDARY
- WORK AREA
- BUILDINGS NOT IN SCOPE
- UNION PACIFIC RAILWAY

NOTES:

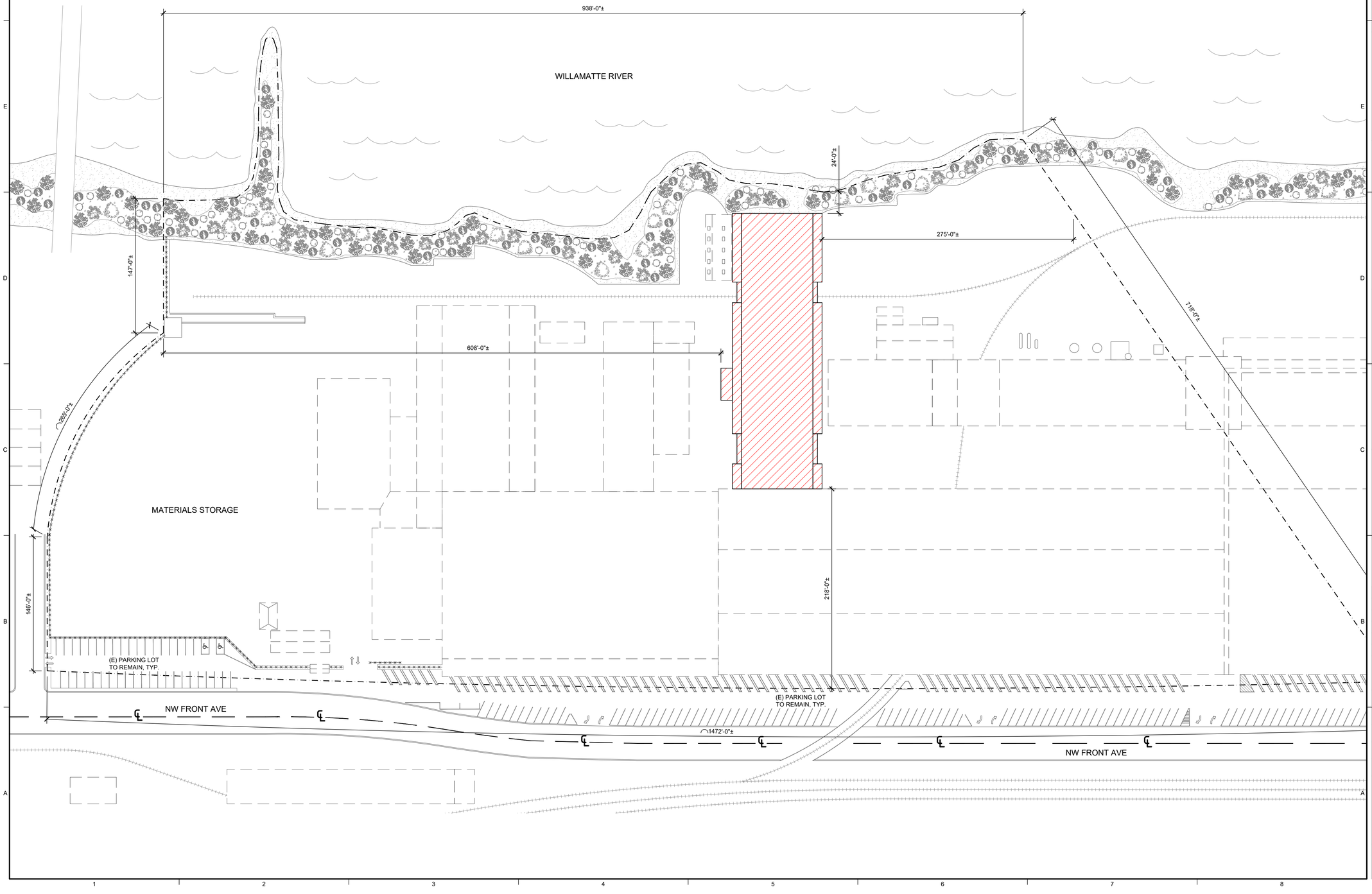
1. NO CHANGES TO EXISTING UNDERGROUND UTILITIES, OVERHEAD POWER LINES, SIDEWALKS, DRIVEWAY, OR STORM WATER DRAINAGE ARE PROPOSED IN THIS WORK.

INFORMATION SHOWN ON THIS DRAWING IS FROM ONE OR MORE OF THE FOLLOWING SOURCES AND IS NOT BASED ON BOUNDARY LINE OR TOPOGRAPHICAL SURVEY:

1. LIMITED VISUAL OBSERVATION BY WJE
2. GOOGLE EARTH IMAGERY
3. PROPERTY INFORMATION FROM MULTNOMAH COUNTY: https://www.portlandmaps.com/

GUNDERSON LLC

PROPERTY ID: P415743
SITE ADDRESS: 4350 NW FRONT AVE, PORTLAND, OR 97210
PROPERTY CLASS: PERSONAL PROPERTY INDUSTRIAL
LEGAL DESCRIPTION: TL 57 SEC 20 1N 1E
OWNER: GUNDERSON LLC.
4350 NW FRONT AVE, PORTLAND, OR 97210



WJE ENGINEERS ARCHITECTS MATERIALS SCIENTISTS

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Honolulu | Houston | Indianapolis | Los Angeles | Minneapolis | New Haven
New York | Philadelphia | Pittsburgh | Portland | Princeton | Raleigh
San Antonio | San Diego | San Francisco | Seattle | South Florida
Washington, D.C. | London, England

Consultants

Project

Greenbrier
Gunderson Ways 2
Building Repair
4350 NW Front Avenue
Portland, OR 97210

Client

The Greenbrier Companies
4350 NW Front Avenue
Portland, OR 97210

Mark	Date	Description

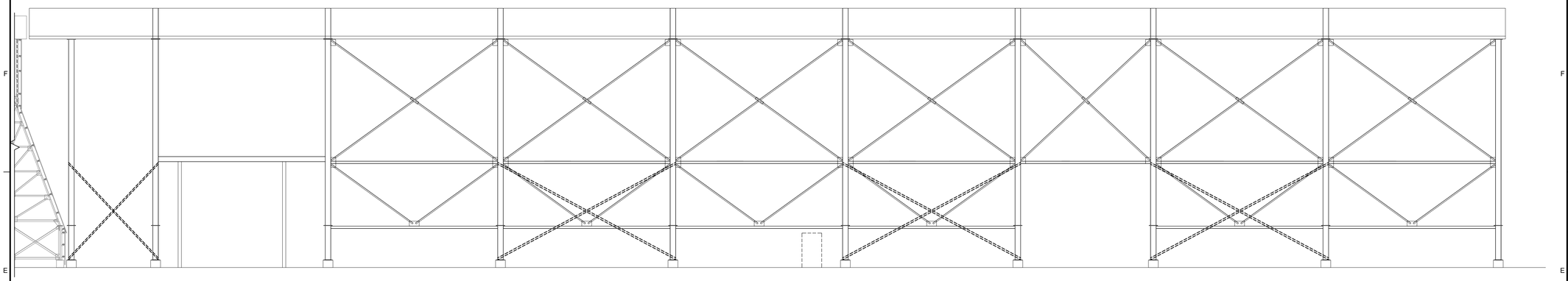
0 1/2" 1" 2"
THIS SHEET PLOTS FULL SIZE AT 24x36 (INCHES)

Project No.	2021.1080
Date	13 APRIL 2022
Drawn	BRS
Checked	TLT / ZTS / ZAM
Scale	AS NOTED

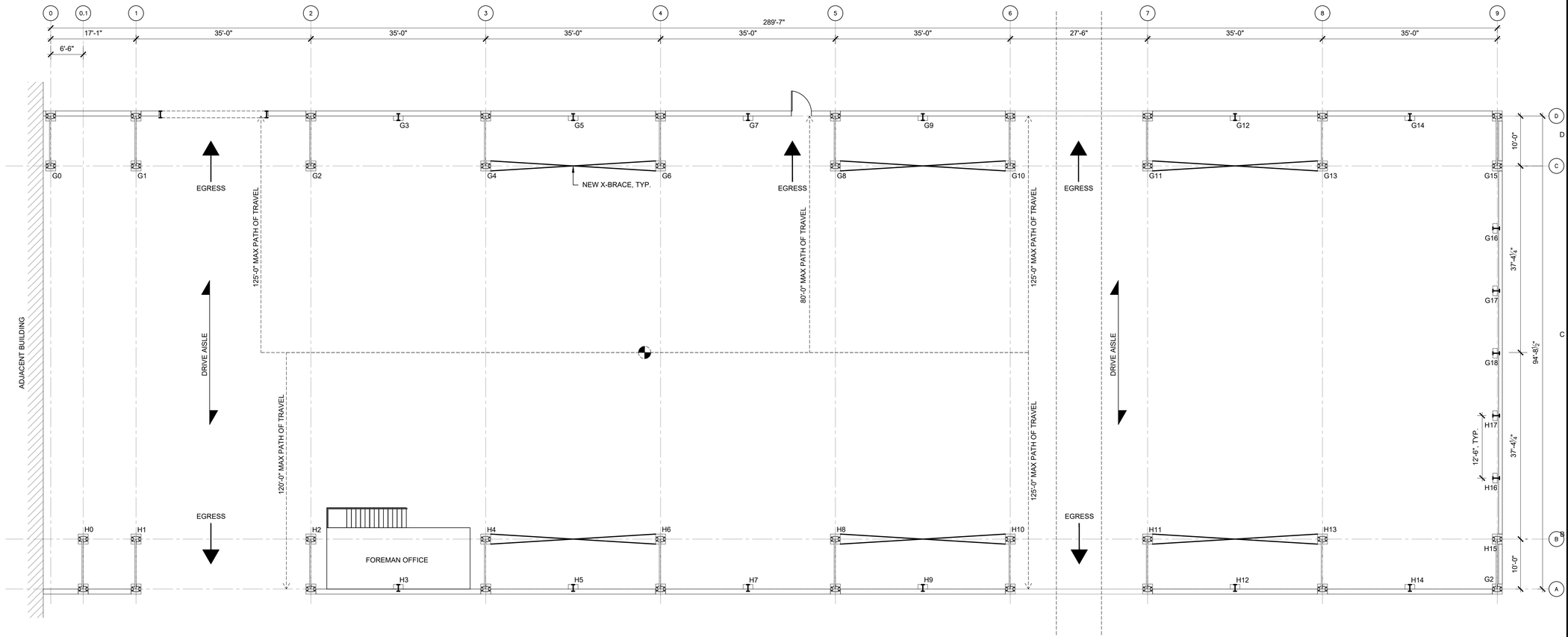
SITE PLAN

Sheet Title

Sheet No. **G003**



2 ELEVATION
SCALE: 3/32" = 1'-0"



1 EGRESS PLAN
SCALE: 3/32" = 1'-0"

N

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EGRESS PLAN
Sheet Title

Sheet No. **G004**