## Alice Shaw

## SFO International Terminal , Boarding Area G, Gate 95

No Other Lands Their Glory Know

## SFO // Shaw// No Other Lands Their Glory Know

- Printed photographic mural
- Gesso is applied to the $3 / 4$ " apple ply (specialty plywood)
- Image is printed on top
- Panels it is then coated with a uv protecting matte varnish to cut down on the reflection
- Gold leaf is hand applied by the artist
- 20' x 26' plywood panels
- Plywood panel supported by an aluminum frame
- 6 z-clip cleats per panel



## Structural Narrative and Design Criteria

 Alice Shaw SFO Installation

San Francisco International Airport

May 23, 2017
Tallulah Terryll
Magnolia Editions
2527 Magnolia St.
Oakland, CA 94607

| 17124.10 | Alice Shaw SFO Mural Installation |
| :--- | :--- |
| San Francisco International Airport, San Francisco, CA |  |

Tallulah,

We have examined the structural issues related to the permanent installation of the mural by the artist Alice Shaw at Gate G95 in the International Terminal of the San Francisco International Airport (SFO). Please see below for a summary of our review and recommendations.

## Scope of Review

Our review has been limited to the following scope:

- Structural consultation with the Artist and Fabricator for the sculpture including 2 design meetings and 1 site visits including a design coordination meeting and structural observation of the sculpture.
- Perform structural calculations to determine the gravity, wind, and seismic demands on the sculptures and base.
- Coordinate with the Artist and Fabricator to determine structural element sizes and geometry.
- Coordinate with the Artist and Fabricator to determine structural element connections.
- Prepare structural narrative summarizing our findings.
- Coordinate with SFO's Building Inspection and Code Enforcement (BICE) Department during Agency Review and responds to questions (assumed one round of questions/comments)

Please note, that we have not included an evaluation of the existing light gauge metal stud wall supporting the mural in our scope of services. We have provided the anchorage reactions in this report for use by the buildings' Structural Engineer of Record (SEOR).

## Structural Criteria

Seismic Design Criteria (2016 San Francisco Building Code)
Ss $=2.03 \mathrm{~g}$
S1 = 0.96 g
Sds $=1.35 \mathrm{~g}$
Sd1 $=0.96 \mathrm{~g}$
$\mathrm{lp}=1.0$
ap $=2.5$ ("Appendages and Ornamentations" per Table 13.5-1 of ASCE 7-10)
Rp $=2.5$ ("Appendages and Ornamentations" per Table 13.5-1 of ASCE 7-10)
$z / h=0.5$ (Conservatively assumed halfway up the height of building)
Fp $=1.08 \mathrm{~g} \times \mathrm{Wp}$ [per EQ 13.3-1 of ASCE 7-10]

Wind Design Criteria (2016 San Francisco Building Code)
Interior Wind Pressure: 5 psf

## Structure Description:

The proposed project is a permanent installation of a printed photographic mural by Alice Shaw (Artist) at San Francisco International Airport (SFO). The photograph will be printed on plywood panels and assembled into a 20'-0" x $26^{\prime}-0$ " mural to be installed at Gate G95 in the International Terminal at SFO. The plywood panels will be supported on an aluminum frame using (6) z-clip cleats per panel. All of the vertical load bearing will occur through the upper three z-clips/cleats. The clips will bear on continuous aluminium channels that are screwed to horizontal aluminium tubes. The horizontal tubes are supported with angle brackets that are screwed to vertical aluminium tubes. The aluminium tubes are finally supported by (4) continuous aluminium channels that are anchored to the existing light-gauge metal stud wall with sheet metal screws.

Refer to Appendix A for drawings used as the basis of our design. Evaluation and design of the existing structure for the imposed loads as presented in this narrative are the responsibility of the building SEOR. See below for the calculated support reactions based on the criteria outlined above.

## Support Reactions of Mural:

The following loads (unfactored LRFD) can be used to evaluate the existing supporting structure:

## Total Dead Load

$\mathrm{P}=2,340 \mathrm{lbf}$. (Vertical Force)
Live Load
$\mathrm{P}=0 \mathrm{lbf}$. (Vertical Force)

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## Wind Load

*Seismic Governs, see below
Seismic Load (V and T do not occur simultaneously)
$\mathrm{V}=2,530 \mathrm{lbf}$. (Shear force in-plane of wall/mural)
$\mathrm{T}=2,530 \mathrm{lbf}$. (Tension force out-of-plane of wall/mural)
Omega $=2.5$ (Over strength Factor)

## Design Assumptions:

Our recommendations are based on the following assumptions:

- The mural will be a permanent installation, and will be required to meet the structural criteria of the 2016 San Francisco Building Code.
- The mural will not be used to support people; The Artist shall work with the Owner to develop a climbing deterrence plan.

We also take this opportunity to make the following additional recommendations concerning the installation:

- The condition of all connecting hardware (bolts etc.) should be reviewed by the artist and confirmed to be in good condition prior to installation, or replaced.
- Capacity of the existing building based on the imposed loads presented above in this narrative, are to be verified and approved by the building SEOR.

This design is based on the typical conditions and assumptions outlined above. Any future installation's site conditions that do not meet the above criteria will require re-evaluation by an engineer licensed in the local jurisdiction.

## Conclusions

Based on the above criteria and assumptions, we have concluded that the mural and its anchorage outlined in Appendix A meets the strength and stability structural design requirements of the San Francisco Building Code. Refer to Appendix B for detailed structural calculations.
We appreciate the opportunity to be of service. Please contact us if have any questions or require additional information.

Thank you,


Erik Kneer, SE, LEED AP BD+C
ASSOCIATE PRINCIPAL

Project:
17124.10

## Appendix A:

## Basis of Design and Structural Sketches






## Appendix B:

## Structural Calculations

Project:
Alice Shaw SFO Installation

| $\mathrm{No}:$ | 17124.1 |
| ---: | :---: |
| By: $\frac{\mathrm{EK}}{} \quad$ |  |
| Date: $\quad 5 / 23 / 17$ | Page: |

WEIGH UP

Dead Loads

|  | Gravity |  | Area |  | Total Weight |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: |
| 1" Ply Art Panel | 3.0 | psf | 520.0 | sf | 1560.0 | lb |
| Aluminum Z-bar and Clips | 0.3 | psf | 520.0 | sf | 130.0 | lb |
| Aluminum Vertical Tubes | 0.3 | psf | 520.0 | sf | 130.0 | lb |
| Aluminum Horizontal Tubes | 0.5 | psf | 520.0 | sf | 260.0 | lb |
| Aluminum Channels | 0.3 | psf | 520.0 | sf | 130.0 | lb |
| Misc. Brackets/Fasteners | 0.3 | psf | 520.0 | sf | 130.0 | lb |
|  |  |  |  |  | 0.0 |  |
|  | Total | 4.5 | psf |  | 2340.0 | lb |

## No Live Loads

Project:
Alice Shaw SFO Installation
No: $\qquad$
By: $\qquad$

SEISMIC PARAMETERS

USGS Design Maps Summary
http://earthquake.usgs.gov/designmaps/us/application.php

## ※USGS Design Maps Summary Report

User-Specified Input

| $\qquad$ Report Title | Alice Shaw SFO Installation |
| ---: | :--- |
| Building Code Reference Document | ASCE 7-10 Standard <br> (which utilizes USGS hazard data available in 2008) |
| Site Coordinates | $37.62081^{\circ} \mathrm{N}, 122.37874^{\circ} \mathrm{W}$ |
| Site Soil Classification | Site Class D - "Stiff Soil" |
| Risk Category | I/II/III |



USGS-Provided Output

| $\mathbf{S}_{\mathrm{s}}=2.029 \mathrm{~g}$ | $\mathbf{S}_{\mathrm{MS}}=2.029 \mathrm{~g}$ | $\mathbf{S}_{\mathrm{DS}}=1.352 \mathrm{~g}$ |
| :--- | :--- | :--- |
| $\mathbf{S}_{1}=0.956 \mathrm{~g}$ | $\mathbf{S}_{\mathrm{M} 1}=1.435 \mathrm{~g}$ | $\mathbf{S}_{\mathrm{D} 1}=0.956 \mathrm{~g}$ |

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the " 2009 NEHRP" building code reference document.



For $P_{G A}, T_{L}, C_{R 5}$, and $C_{R 1}$ values, please view the detailed report.

[^0] the data contained therein. This tool is not a substitute for technical subject-matter knowledge.

| Project $:$ | Alice Shaw SFO Installation |
| ---: | :---: |
| No: | 17124.1 |
| By: | EK |
| Date: | $5 / 23 / 17$ |

NONSTRUCTURAL COMPONENT FORCE FOR: enter component description here
Per Chapter 13, ASCE 7-10

## Input Parameters

Type: APPENDAGES AND ORNAMENTATIONS
Description:

| $\mathrm{S}_{\mathrm{DS}}=$ | 1.35 g |  |
| ---: | :--- | :--- |
| $\mathrm{I}_{\mathrm{p}}$ | $=1.0$ |  |
| $\mathrm{a}_{\mathrm{p}}$ | $=2.5$ |  |
| $\mathrm{R}_{\mathrm{p}}=$ | 2.5 |  |
| $\mathrm{~h}=$ | 1 | floor/ft |
| $\mathrm{z}=$ | 0.5 | (See Section 13.1.3) |
| $\mathrm{z} / \mathrm{h}$ | $=0.50$ | (Average roof height of structure with respect to the base) |$\quad$| (Height in structure of point of attachment of component) |
| :--- |

## Seismic Design Force

| $\mathrm{F}_{\mathrm{p}}$ | $=\frac{0.4 \mathrm{a}_{\mathrm{p}} \mathrm{S}_{\mathrm{DS}} \mathrm{W}_{\mathrm{p}}}{\left(\mathrm{R}_{\mathrm{p}} / \mathrm{I}_{\mathrm{p}}\right)}\left(1+2 \frac{\mathrm{z}}{\mathrm{h}}\right)$ | $=1.08 \mathrm{Wp}$ | (Eqn 13.3-1) |  |
| ---: | :--- | ---: | :--- | :--- |
| $\left(\mathrm{F}_{\mathrm{p}}\right)_{\max }$ | $=1.6 \mathrm{~S}_{\mathrm{DS}} \mathrm{I}_{\mathrm{p}} \mathrm{W}_{\mathrm{p}}$ | $=$ | 2.16 Wp | (Eqn 13.3-2) |
| $\left(\mathrm{F}_{\mathrm{p}}\right)_{\min }$ | $=0.3 \mathrm{~S}_{\mathrm{DS}} \mathrm{I}_{\mathrm{p}} \mathrm{W}_{\mathrm{p}}$ | $=$ | 0.41 | Wp |

## Anchorage Design

תo 2.5 (overstrength factor, from Chp 13 of ASCE 7-10, Supplement)

## Image of Component



Printed on: 5/24/2017 at 4:00 PM

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| ---: | :--- |
| No: | 17124.1 |
| By: | EK |
| Date: | $5 / 23 / 17$ |

## Channel Connection Calculations

| Wtotal | $=$ | 2340 | lb |
| ---: | :---: | :---: | :--- |
| Fp | $=$ | 1.08 | g |
| V, eq, total | $=$ | 2531 | lb |$\quad$ (Total Base Shear due to Seismic)

[Provide 2 - \#10 SMS per Stud, Min. 26 per channel distributed evenly across 13 studs min.]

Check Shear and Tension on Spacer Tube and Brackets
\# Spacer Brackets 24
Wcleat 98 lb
V/T cleat 75 lb
\# screws / spacer = 2
W, bolt $=48.8 \quad \mathrm{lb}$
$\mathrm{V} / \mathrm{T}$, bolt $=37.7 \quad \mathrm{lb}$

D/C, combined = 0.69
[Provide Min. 2 - \#10 SMS from Vert Tube to Spacer]
[All other connections are OK By Inspection]






[^0]:    Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of

