

Via Email: RPantel@Princeton-Engineering.com

May 20, 2016

Princeton Engineering
35091 Paxson Road
Round Hill, VA 20141

Re: Johnson Controls, Inc. (JCI)
Structural Evaluation for the Proposed PV Carport Project at Laguna Woods Village

Dear Mr. Pantel:

On your behalf, NS Structural Engineering, Inc. (NSSE) performed a site visit with Mr. Howard of JCI on March 29, 2016 to the Laguna Woods Village apartment complex located in Laguna Woods, California. During our visit, we understood Johnson Controls Inc. (JCI) desires to install a new solar panel racking system positively mounted to the structural roof framing elements to generate and provide additional electricity to the community. The purpose of our site visit was to perform a limited review of the roof framing capacity of the existing carport structure(s) located throughout the Laguna Woods apartment complex sites. Following is a brief description of the existing carport structures along with a summary of our findings. Figures referenced in the text of this report follow at the end.

Background and Observations

The existing carport structures located at the Laguna Woods Village apartment complex may be an option to install a new solar rack system to aid in energy reduction and independence with minimized expenses. NSSE was asked to visit and assess the existing condition of the typical carport structure for the new solar racking system installation and provide recommendations for cost estimation purposes.

The existing carport is a single-story structure(s) approximately 8 feet in height. The plan dimensions are approximately 60'-8" feet long x 20'-0" feet wide. The roof structure is comprised of a 20 GA metal deck roof spanning to existing 10" x 3.5" x 12 GA Z purlins. The Z purlins are simply supported with a span of 20'-0" feet which are supported by 3.5" diameter steel pipe columns. The steel pipe columns are typically spaced at 11'-6" feet in the transverse direction and 20 feet in longitudinal direction. The lateral resisting framing system (LRFS) are the cantilevered steel pipe columns supported by a concrete caisson foundation system.

Findings and Recommendations

At this time, NSSE does not have an overlay drawing of the final solar rack layout on top of the existing carport structure roof framing plan. To address any structural issues and report our findings, we have made the following professional assumptions based on information in the (15 sets) as-built drawings prepared by FE MacDonald dated circa mid-1960s:

1. Dead load (DL) of solar modules including racking = 2.5 pounds per square feet (psf)
2. Structural analysis based on the latest building code.
3. Strength level wind speed = 110 mph and wind exposure C.
4. Seismic Design Category D
5. Wind and seismic importance factor = 1.0
6. Uniform loading (psf) based on dead, live and wind loads

Based on current design code, our findings indicate the overall structure will perform satisfactory under vertical downward and lateral loads with the exception of the existing Z purlins. Under current wind design level uplift forces, the existing long span purlins appear to fail in flexural buckling. We recommend the existing Z purlins shall be strengthened by installing an additional track to span between these purlins. A detailed analysis of the Z purlins can be found in the attached calculation. During this phase of work, the study of the existing foundation is beyond the scope of this report and analysis of substructure will be excluded. The next phase will include hand sketch details for the strengthening of the Z purlins.

If you have any questions regarding this letter, please do not hesitate to call us.

Sincerely,
NS STRUCTURAL ENGINEERING, INC.



Neal Shah, PE, SE
Principal Structural Engineer



Figure 1. Site observation photos.



Figure 2. Site observation photos.



Figure 3. Site observation photos.