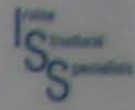


# Tilt-Up Concrete Building with Photovoltaic Cells



Irvine Structural Specialists: Royal Chu, David De Vera, Tu Hua, Sharon Rowe, Zayd Sharif, Wendy Wood  
 Advisors: Mohammad Hariri, SE and Dr. Farzin Zareian

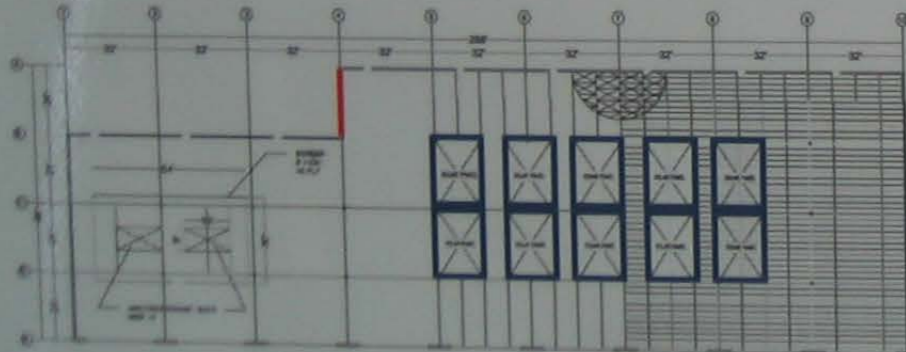
## Project Goals

The goal of this project is to design a one-story, 30 foot, tilt-up concrete building with photovoltaic cells on the roof to be used as a retail center with 9 potential sections. This building must be able to withstand the gravity and lateral loads it will experience in Irvine, CA.



## Design Approach

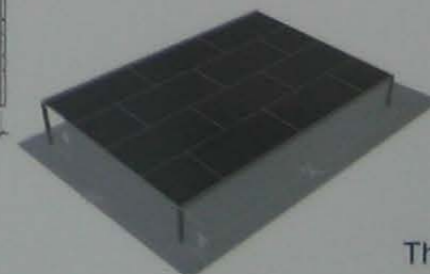
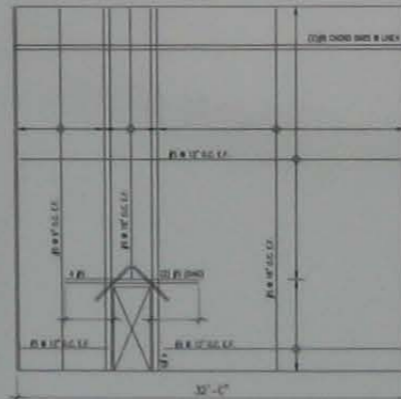
A critical part of designing this building is using the ASCE 7-05 code for minimal load designs. The seismic loads were determined according to this code book and using an address in Irvine, 6441 Irvine Boulevard, Irvine CA 92618. The wind loads were determined using Method 2 which required determination of several different factors. The gravity loads were determined using the code as a reference. Our client-consultant, Mohammad Hariri, has provided ample references that are extremely helpful as guides through various calculations. The general design of this building follows load path.



## Design Challenges and Results

Designing a building in Southern California requires ample design to withstand seismic loads. There are several important components of our building that were designed in response to earthquake loads. A key design alternative and result is along the panel in red on the figure below. This line only contains one panel to withstand all forces. Typical panels are 8 inches thick, this panel is 15 inches thick, almost double. The shear force on this panel were extremely high and required this wall to be heavier, require strong wall anchorage, and high steel reinforcement. The foundation below this wall is also much larger than the typical foundations at twice the thickness and extends beyond the panel length. Examples of the panel steel reinforcement is shown below.

A unique element to our design was including the solar panels, outlined in blue in the figure to the bottom left, which will alleviate the demand on the city power grid. However it also required investigation into the uplift force which creates a rare upwards vertical force on the roof.



## Design Contributions

- |                                                   |                                              |                                            |
|---------------------------------------------------|----------------------------------------------|--------------------------------------------|
| Royal Chu                                         | Tu Hua                                       | Zayd Sharif                                |
| <input type="checkbox"/> Wind Loads               | <input type="checkbox"/> Seismic Loads       | <input type="checkbox"/> Wind Loads        |
| <input type="checkbox"/> Wall Anchorage           | <input type="checkbox"/> Shear Wall Design   | <input type="checkbox"/> Foundation Design |
| <input type="checkbox"/> Diaphragm                | <input type="checkbox"/> Overturning Moments | <input type="checkbox"/> Diaphragm Design  |
| <input type="checkbox"/> Foundation Design        | <input type="checkbox"/> Foundation Design   | Wendy Wood                                 |
| David De Vera                                     | Sharon Rowe                                  | <input type="checkbox"/> AutoCAD Drafting  |
| <input type="checkbox"/> Wind Loads               | <input type="checkbox"/> Seismic Loads       | <input type="checkbox"/> Vertical Loads    |
| <input type="checkbox"/> Roof Structures Analysis | <input type="checkbox"/> Collector           | <input type="checkbox"/> Roof Members      |
| <input type="checkbox"/> Steel Columns            | <input type="checkbox"/> Ledger              | <input type="checkbox"/> Shear Wall Design |
| <input type="checkbox"/> Out of Plane Forces      | <input type="checkbox"/> Drag Strut          |                                            |
| <input type="checkbox"/> Diaphragm                |                                              |                                            |

## Project Cost

The estimated cost of this project is roughly \$4.3 million