HORIZON LINES – the transparency of energy

Concept

The Santa Monica Pier has a rich and diverse history, evolving greatly over time as the city around it has shifted into the present. HORIZON LINES takes a part of this history and turns it upside down. In its original form, the pier was built to cover a sewage pipe that emptied into the ocean, working to hide the effects of humanity on the environment. The HORIZON LINES project presents a dichotomy to this piece of history by creating a transparent energy source, taking the image of the pylons of the pier and the form of a wave and placing it on the horizon line for all to see. The project is composed of BIPV (Building Integrated Photovoltaic) glass panels whose spacing is based on the environment surrounding it, the crest and trough of a wave. The panels are spaced tighter near the end of the pier to create the intensity in the crest of the wave, reflecting and refraction water and sky. The middle portion represents the trough of the wave, where the ocean becomes calm and glass like. This pattern culminated again with a tightening of the panels to signify the next peak of the wave as it heads toward shore. Walking along the beach or pier, a visitor experiences different perceptions of the sculpture, like the glint of a wave in morning sun or a crystal clear view through the panels to the true horizon behind. HORIZON LINES pays homage to the history of the pier, while showing visitors glimpses of the beautiful breakwaters of the ocean through a new, transparent take on sustainable energy.

Structure + Materials

HORIZON LINES is created from a series of 30 panels and base modules that can easily be scaled to fit the site. The base platform of each panel is made from reinforced concrete measuring 41m long by 1m wide and up to 5m deep. These platforms are connected to a structural concrete beam (5m deep by 3m wide) embedded in the existing breakwater. At each platform connection point are pylons that anchor the beam. The total dimensions of the project are 503.5m long and 44m wide. Each BIPV panel is attached to its platform with a structural frame. This frame holds the electrical conduit to the battery storage and converter stored in the platform base, as well as the BIPV glass panels in a smaller framing system. The panels are 40m long and 20m tall, creating a presence on the horizon without obstructing views. The platforms allow maintenance accessibility on an individual basis. Each panel is also illuminated with an LED light strip. When connected to each panel’s individual meter, the light will illuminate up to the point of the energy produced. Visitors will be able to see how much energy each panel has produced for that month. All electrical equipment will be run from the platforms to the structural beam in a conduit, then transferred back to the grid.

Technology + Energy Produced

The main material in the HORIZON LINES project is the energy generator itself. This is BIPV glass, also known as Building Integrated Photovoltaic glass. It is a thin film system between two layers of glass and acts as a transparent solar panel to harvest the energy of the sun. Even though Santa Monica’s climate allows for a large amount of sun exposure, the thin film BIPV panels work in as low as 10% light and various temperature swings. They are mainly used in building applications in place of windows, curtain walls, and skylights and as such, they work even at non-optimal tilt angles. The modules estimated for this project are manufactured by Onyx Solar® and are specified as thin film photovoltaic panels with a 30% transparency. Based on their 86Wp module, the annual average energy production at standard test conditions would be 454,779kWh per year for all 30 panels. The projects annual average energy production with shading estimations could be roughly 256,192kWh per year. These estimations are based on the module specified by this company and could vary with other manufacturers.

Environmental Impact

HORIZON LINES works to minimize and negate certain effects a structure can create on its surrounding environment. Because the HORIZON LINES project utilizes BIPV technology, there is less embodied energy in the manufacturing process. The thin film technology is applied as the glass panel is created, minimizing the energy required to adapt the panels later with solar technology. This helps with the entire construction and manufacturing process for the project. HORIZON LINES also works to stabilize the existing breakwater to protect against shore erosion and provide a stable habitat for underwater sea life that may have found its home on the existing breakwater. The concrete beam and platforms connected to the breakwater completely encase any metal reinforcement, eliminating any oxidation that could harm the underwater life around the break. Specific concrete mixtures may also be specified to limit exposure to harmful chemicals. By utilizing the existing breakwater and setting the panels behind it, HORIZON LINES also minimizes the degradation of views visitors have of the ocean and break. Instead, the transparent panels work to enhance views by giving visitors a unique perspective to look through, letting them see the surrounding ocean environment through a sustainable technology. With an example panel integrated into the pier, visitors are able to learn about BIPV systems and experience them up close. The goal is to introduce this technology to visitors so that they can better understand how sustainable energy systems such as BIPV can be used in regular built projects. HORIZON LINES inspires visitors and leaves them wondering if they can integrate BIPV technology into their own built environment, or even how a technology like this can be bettered for the future.