

AICHI STEEL

Vertical Greening Cylinders (Vertical Forest®) Using Stainless Steel at Aichi International Convention & Exhibition Center

Member company	Aichi Steel
Category	original application concept for stainless steels

The Challenge

We would like to inherit the environmental efforts of Aichi Prefecture that were seen at the "EXPO 2005 AICHI JAPAN" and create a symbolic space that provides visitors with a variety of flowers throughout the four seasons. To realize the concept, we planned to hang 45 vertical greening cylinders (Vertical Forest®) with a length of 9 m from the large approach eaves with a length of 200 m and a height of 11.5 m, which constitutes the main gate of the International Convention & Exhibition Center.

Why?

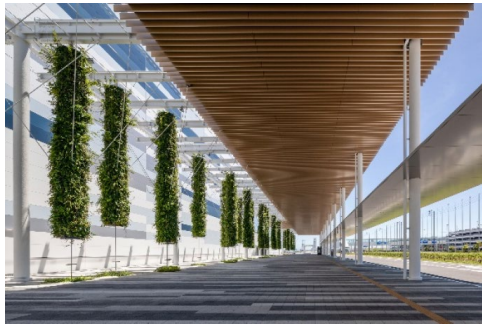
The construction site of the International Convention & Exhibition Center is located on an airport island, making high wind pressure resistance and salt damage resistance mandatory. The vertical greening cylinders are designed to be always in a humid environment due to irrigation, making it mandatory to select materials with particularly high weather resistance.



Picture courtesy of Aichi Steel Corporation

Needed Action

To reduce the amount of water that the steel material is exposed to, the green cylinder is hollowed out to allow air to pass through. This structure is achieved by separating a ring that supports the greening panels from the mandrel. The mandrel is made of 350 φ stainless steel pipe (t = 9 mm) and supported by an anti-sway rod (M28) extended in four horizontal directions to withstand the lateral force brought by earthquake or strong wind. A ring-like support made of stainless steel channel is provided to support the ring. It is extended in three directions from the mandrel. The greening panels are bolted to the support. Applying such a structural system can minimize the area in contact with the



Pictures courtesy of Aichi Steel Corporation

moisture-rich greening panels and reduce the weight of the support frame.

The ring that supports the mandrel and the greening panels is difficult to maintain, so we planned to manufacture it from stainless steel, which has excellent weather resistance. The anti-sway rod and the hanging bracket, are made of general hot dip galvanized steel because they are exposed, but an insulating region was provided to prevent corrosion due to contact with dissimilar metals. The mandrel, the main structure, is made of a stainless steel pipe of SUS316A, which is a designated building material. The ring that supports the greening panels is made of angle stainless steel of SUS316. A total of about 70 tons of stainless steel is used.

Action Review

Specific: The verification was carried out as per the Building Standards Act.

Measurable: To verify the performance of the entire vertical greening structure, six vertical greening cylinders (Vertical Forest[®]) were erected in advance under the large approach eaves constituting a subgate, and the growing state of the plants was consistently observed for about one year under the same condition as

at the time of completion.

Achievable: The same as above.

Realistic: In 2018, the site was hit by a storm with a maximum instantaneous wind speed of 46 m/s due to the Typhoon Jebi, but had no structural problem. We confirmed that the structure had sufficient wind resistance.

Time-bound: The structure was designed and constructed by Takenaka Corporation, completed in June 2019 as planned, and opened on August 30, 2019.

Horizontal Expansion Capability

We were able to identify specific issues and solutions to the extent that we can horizontally expand the structure.

Under the conditions that require high wind pressure resistance and salt damage resistance, this structure has various elements that can be referred to, such as material selection and the provision of an insulating region to prevent corrosion due to contact with different metals.





Outcome

In selecting materials, we considered non-stainless steel, such as hot dip galvanized steel and coated steel, and the grade of stainless steel. We also examined what the quality assurance, maintenance costs and operating loss during the maintenance period would be if we had adopted non-stainless steel for difficult-to-maintain parts inside the greening cylinders. As a result of the examination, we finally adopted SUS316A and SUS316 stainless steel. For cost and inventory levels, we had a detailed discussion about processes for stable supply. This allowed us to proceed smoothly with factory production and site construction as planned.



Pictures courtesy of Aichi Steel Corporation