

PHY TO- REMEDIATION

A NATURE-BASED SOLUTION AGAINST POOR AIR QUALITY

With an increasing number of wildfire events occurring year after year in California, one of the challenges many cities face today is the exposure to smoke produced by fires that spread faster and burn more intensely. This heavy smoke comprises gaseous pollutants, water vapor, and particle pollution, or particulate matter (PM). Particles generally 2.5 μm in diameter or smaller represent the primary pollutant in wildfire smoke and the leading health threat. People at greater risk include those with cardiovascular or respiratory disease, older adults, children 18 years and younger, pregnant women, outdoor workers, and those of lower socio-economic status. According to the California Air Resources Board (CARB), PM2.5 contributes to 5,400 premature deaths due to cardiopulmonary causes per year, in addition to 2,800 hospitalizations for cardiovascular and respiratory diseases and 6,700 emergency room visits for asthma each year.

The most common advice during a wildfire smoke event is to remain indoors. For this to be effective, buildings should have a tightly closed, air-conditioned space in which the air conditioner recirculates indoor air. According to the 2021 American housing survey released by the U.S. Census, San Francisco has become the least air-conditioned metro area in the U.S. The survey states that about 45% of the 1.8 million housing units have a primary air conditioning source, compared to a national average of 92%. Of those 45%, only about 34% of homes are equipped with central air, while 11% use room air conditioning.

This research aims to provide an alternative nature-based solution to today's conventional HVAC systems. This research will integrate the benefits of phytoremediation, a plant's ability to remediate soil, water, and air, with a building HVAC system to combat poor air quality in the urban environment.



NORTH ELEVATION : 1/32" = 1'-0"



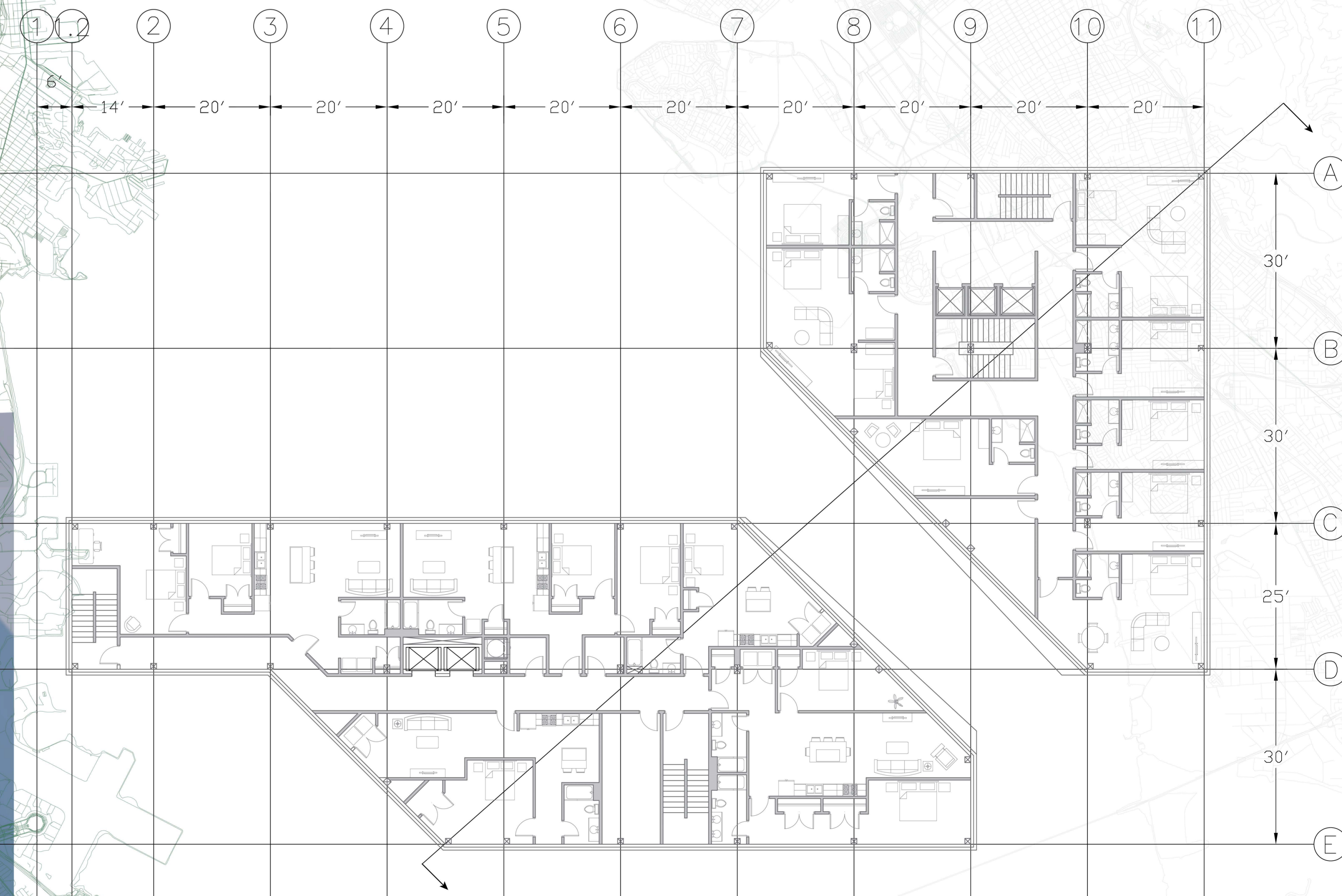
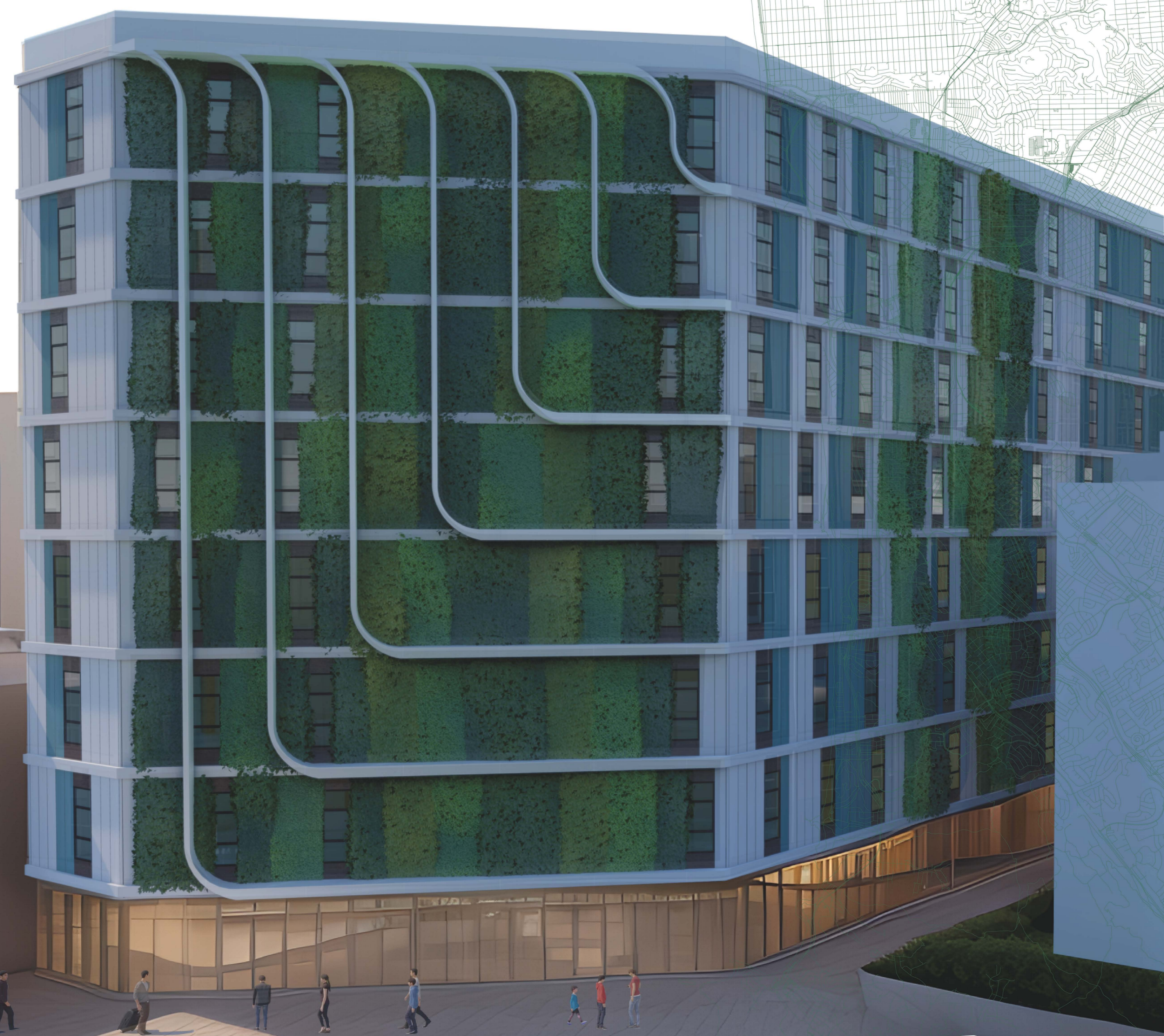
EAST ELEVATION : 1/32" = 1'-0"



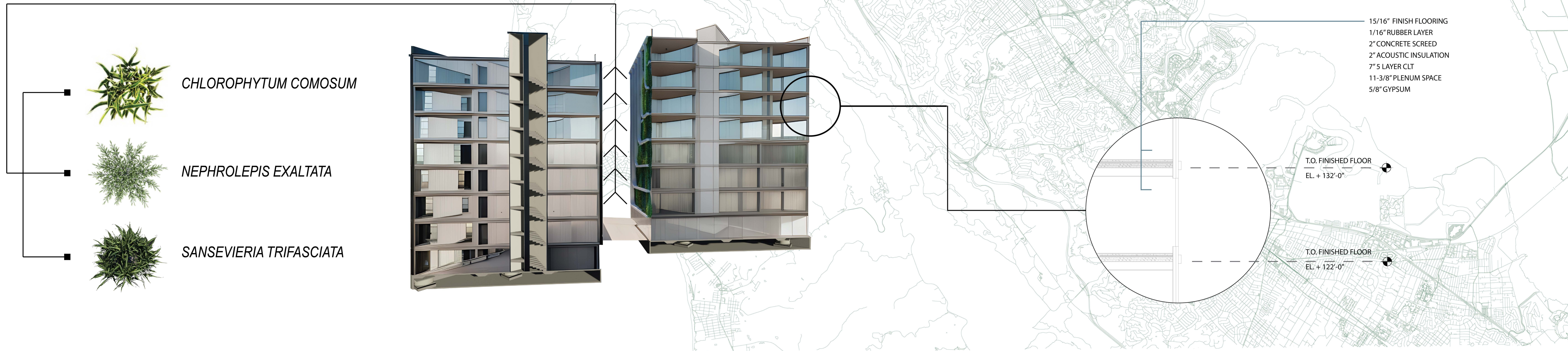
SOUTH ELEVATION : 1/32" = 1'-0"



WEST ELEVATION : 1/32" = 1'-0"



TYPICAL FLOOR PLAN : 3/32" = 1'-0"



SIZING OF BIOFILTER

A metric used to indicate the effectiveness of the biofilter in an in-situ application is the air cleaner effectiveness. Iriga, P. J. (2017) This tells us the capacity of the biofilter to serve as a standalone ventilation system for the main spaces of a hotel. Four air changes per hour will be used to size the biofilter to serve as a standalone ventilation system for all scenarios. Based on the calculation of Iriga, P. J. 2017 the biofilter in its most effective operational setting would require 0.1872 modules per m3 to supply a ventilation equivalent of 4 air changes per hour. Assuming all this for each scenario, throughout this study, the volume of spaces in a hotel and apartment was used to estimate the biofilter size required to replace mechanical ventilation fully.



TYPICAL SQUARE FOOTAGE FLOOR PLAN WITH BIOFILTER
1/16" = 1'-0"

TOTAL CUBIC FEET : 259,758 CUBIC FEET = 7355.5 CUBIC METERS
(7355.5 CUBIC METERS)(0.1872) = 1376.95 / 4 = 344.24 SQ METERS
344.24 SQ METERS = 3,705.34 SQ FEET OF BIOFILTER

