Building Within Our Bounds

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Problem Statement:

What is it in the method of the architect's design process that produces waste?

Typology:

Mixed Used Building

Claim:

It isn't the construction process that creates waste, but the methodology that the architect uses through the process of design that produces unutilized material.

Premise:

It is the approach that the architect takes through the design process and decision making along the way that determines whether the building is going to be sustainable or not.

An understanding of the methodology that the architect uses through the entire design process is crucial in calculating how much unutilized material will be produced.

There is a finite amount of resources available within our environment and as stewards of the built environment it is our duty to reuse and preserve our scarce supply of building materials.

Building Use and Function

Parking Garage

Grocery Center

Residential

Commercial

Research

Algorithmic Analysis of a Design

Dimensional Space Planning

Sustainable Design Approaches

Algorithmic Analysis of a Design

Start:

Origin = (0,0)

OptimalMatUsage = Tot. Sq. Ft. of Floor Plan
12' (width of defined carpet)

Efficiency Check = { ((Tot. Ft. Run of Mat used)-OptimalMatUsage) }
{ OptimalMatUsage } * 100

Defined Material = 12' x R (roll length)

Aesthetic Check = Sum Ft Run of segments

1. Input Floor plan (data defined by as DXF or .dwg) Any data system based of coordinate positioning
    a. Find furthest point on x-axis
        i. Store in memory
    b. Find furthest point on y-axis
        i. Store in memory
2. Define Bounding Box
    a. Create a bounding box using the origin, furthest points on x and y axis, and their intersecting point
3. Define Segment Box
    a. Origin is defined as point 1
    b. From origin move greatest width of defined material on y axis
        i. Store as point 2
    c. Move to greatest value of bounding box in x value, remaining with y = 12
        i. Store as point 3
    d. Move, on same valued x-axis, down 12 on y axis
        i. Store as point 4 and return to origin
    e. Store rectangle formed as Wn
4. Continue process of segment box until the Bounding Box is fully divided
    a. Use point 2 from previous segment box as new location of origin
    b. Store as W(n+1)
5. Intersect Wn with floor plan
    a. Take the closest and furthest x value of newly formed shape
        i. Store that in memory as ft. run of material used
    b. Can material be placed without any obstructions?
        i. If yes then;

1. End function

ii. If no then;

1. Check database for stored material that can be used

a. If yes then;

i. Use it

b. If no then;

i. Store dimension of material in database.

c. Do the edge segments of the new shape share the same segments of the floor plan?

i. If yes then;

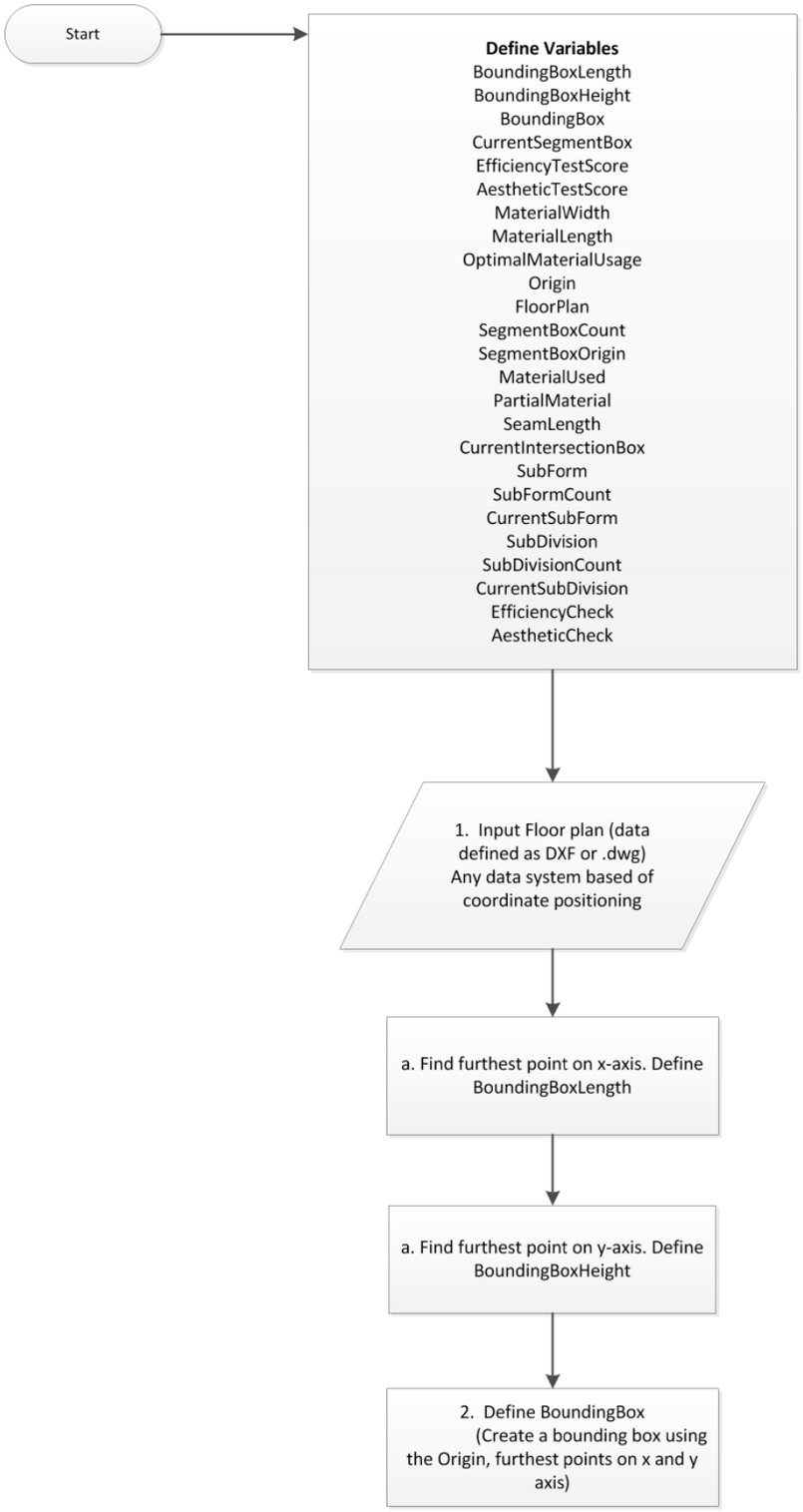
1. End function;

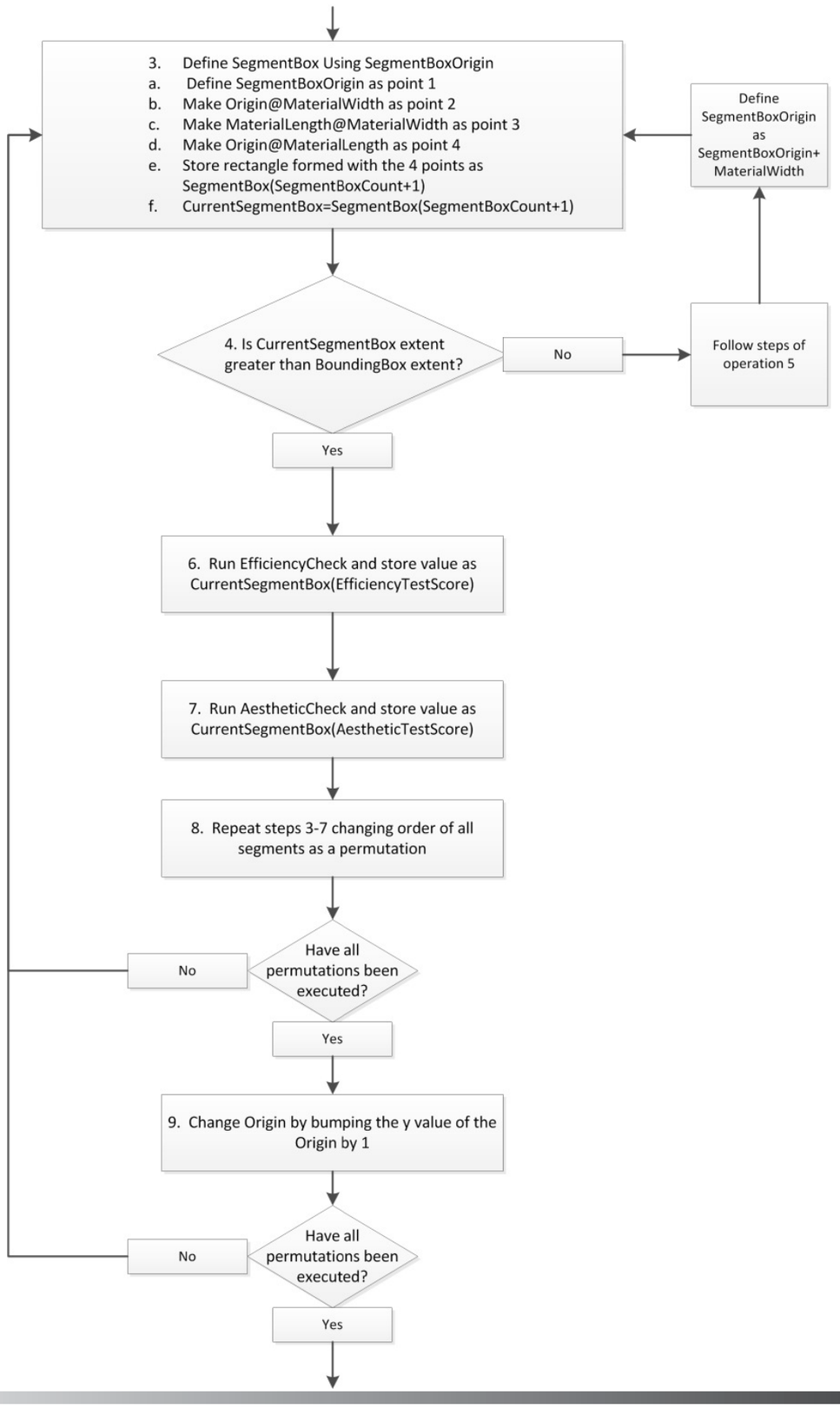
ii. If no then;

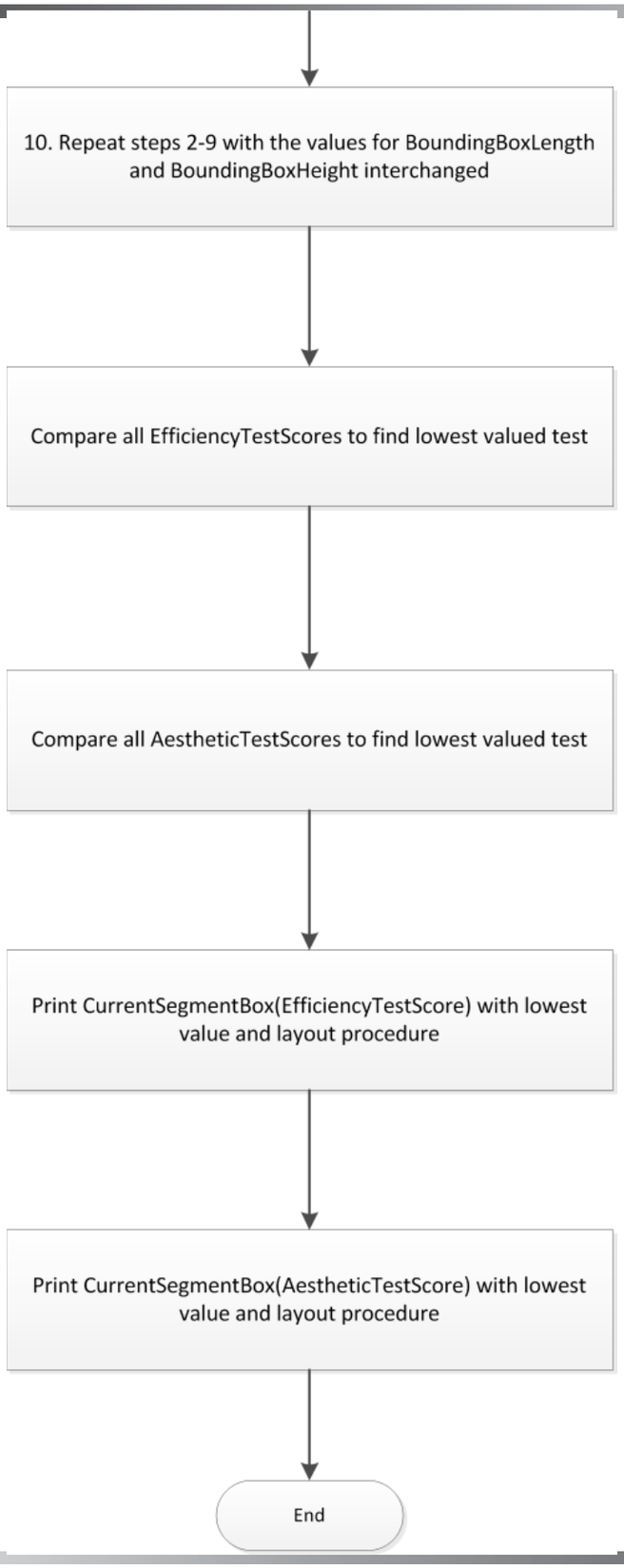
1. Store the length of that segment in memory.

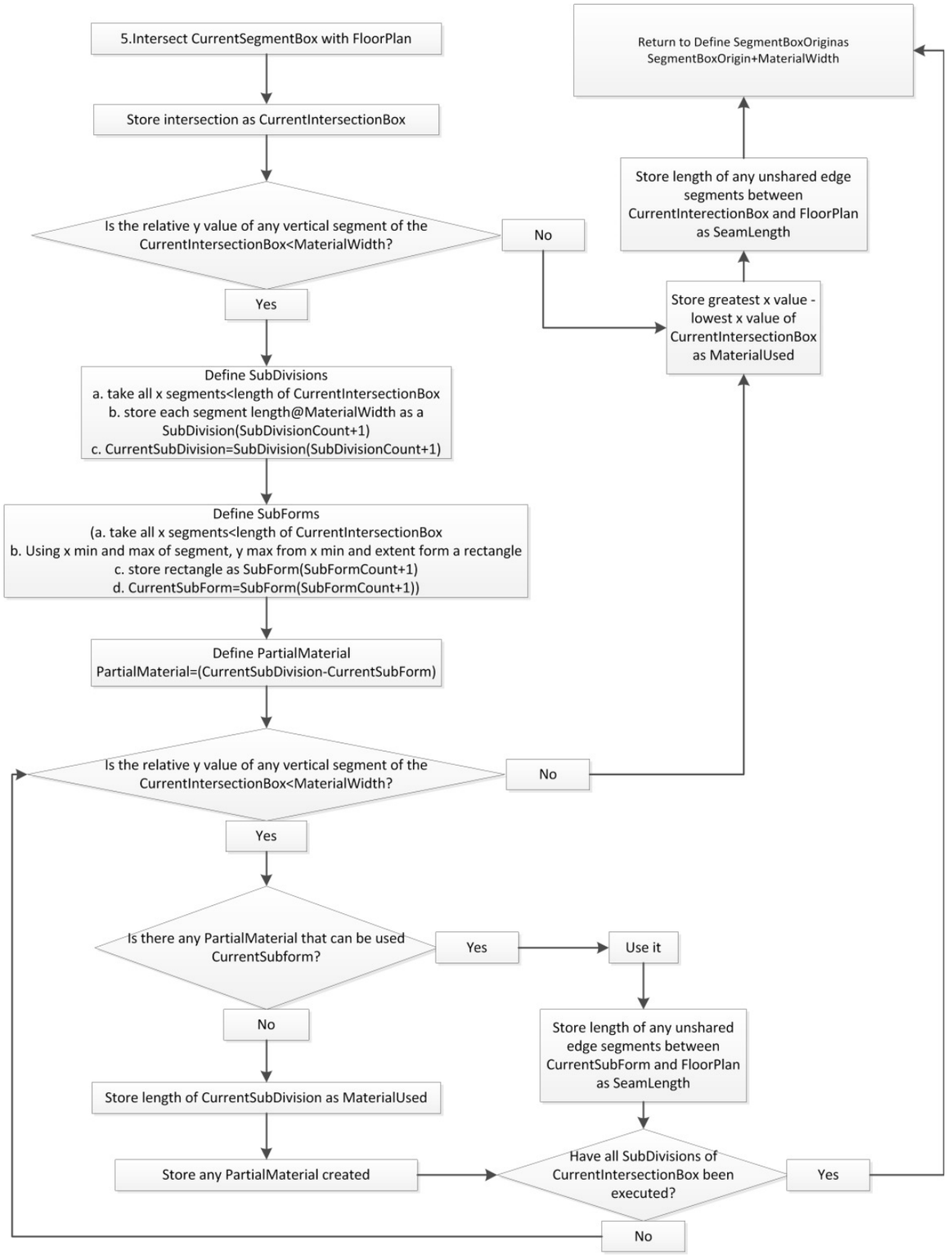
6. Repeat Process 5 with W(n+1) until all segments complete
7. Run Efficiency Check
   a. Store value in memory as Testn_1
8. Run Aesthetic Check
   a. Store value in memory as Testn_1
9. Repeat steps 5-8 changing order of all segments as a permutation
   a. Store value in memory as Test(n+1)
10. Change point of origin of W1 by bumping the y value by 1
    a. Repeat steps 3-8
    b. Store value in memory as Test(n+1)
11. Repeat steps 1-10 with the values for x and y interchanged
    a. Store value in memory as Test(n+1)
12. Compare all Efficiency Check Tests to find the lowest valued Testn
13. Compare all Aesthetic Check Tests to find the lowest valued Testn
14. Print Testn with lowest valued Efficiency Check and layout procedure
15. Print Testn with lowest valued Aesthetic Check and layout procedure

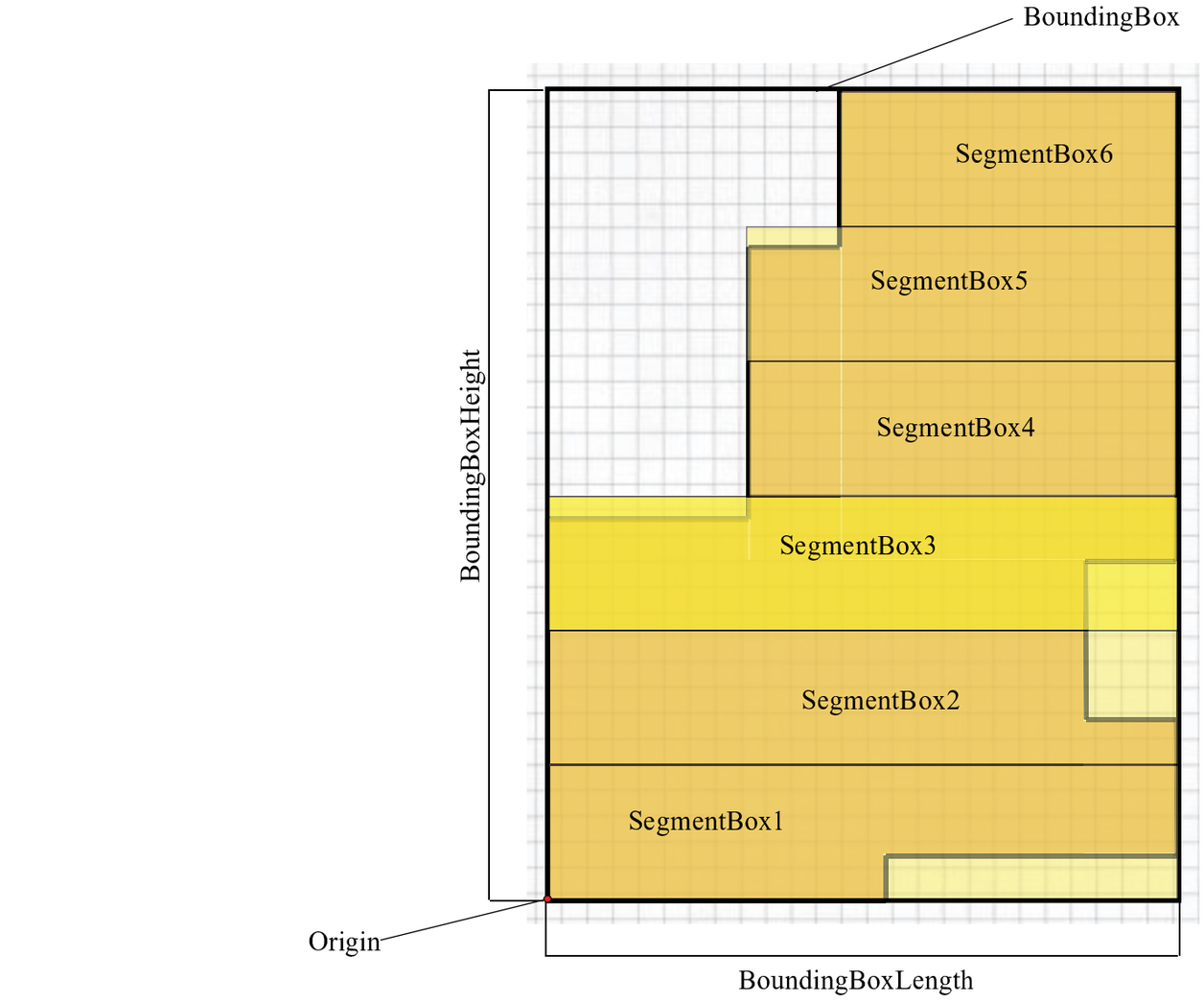
End

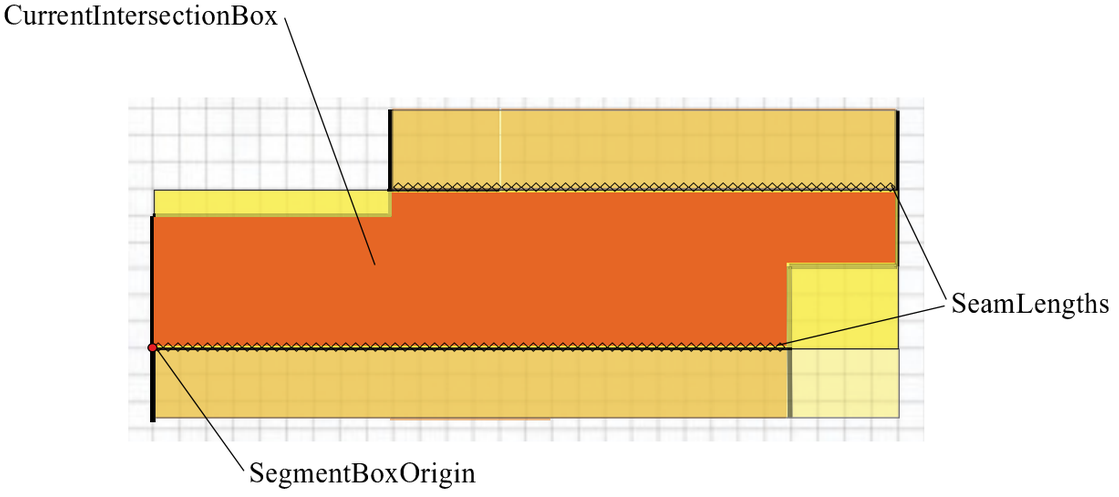

Start
Define Variables
BoundingBoxLength
BoundingBoxHeight
BoundingBox
CurrentSegmentBox
EfficiencyTestScore
AestheticTestScore
MaterialWidth
MaterialLength
OptimalMaterialUsage
Origin
FloorPlan
SegmentBoxCount
SegmentBoxOrigin
MaterialUsed
PartialMaterial
SeamLength
CurrentIntersectionBox
SubForm
SubFormCount
CurrentSubForm
SubDivision
SubDivisionCount
CurrentSubDivision
EfficiencyCheck
AestheticCheck
1. Input Floor plan (data defined as DXF or .dwg) Any data system based of coordinate positioning
a. Find furthest point on x-axis. Define BoundingBoxLength
a. Find furthest point on y-axis. Define BoundingBoxHeight
2. Define BoundingBox (Create a bounding box using the Origin, furthest points on x and y axis)

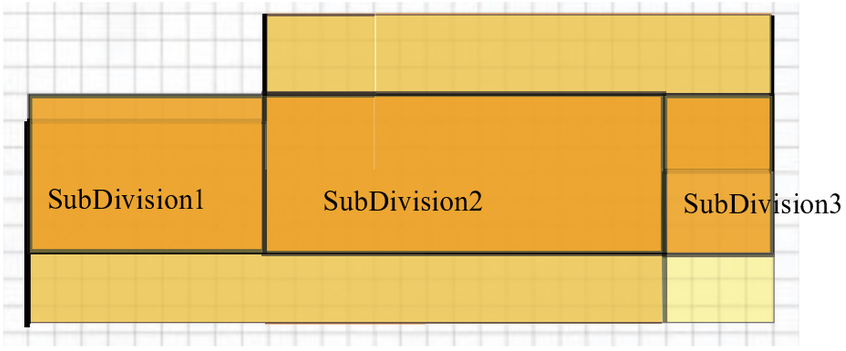

3. Define SegmentBox Using SegmentBoxOrigin
a. Define SegmentBoxOrigin as point 1
b. Make Origin@MaterialWidth as point 2
c. Make MaterialLength@MaterialWidth as point 3
d. Make Origin@MaterialLength as point 4
e. Store rectangle formed with the 4 points as SegmentBox(SegmentBoxCount+1)
f. CurrentSegmentBox=SegmentBox(SegmentBoxCount+1)
Define SegmentBoxOrigin as SegmentBoxOrigin+ MaterialWidth
4. Is CurrentSegmentBox extent greater than BoundingBox extent?
No
Follow steps of operation 5
Yes
6. Run EfficiencyCheck and store value as CurrentSegmentBox(EfficiencyTestScore)
7. Run AestheticCheck and store value as CurrentSegmentBox(AestheticTestScore)
8. Repeat steps 3-7 changing order of all segments as a permutation
Have all permutations been executed?
No
Yes
9. Change Origin by bumping the y value of the Origin by 1
Have all permutations been executed?
No
Yes

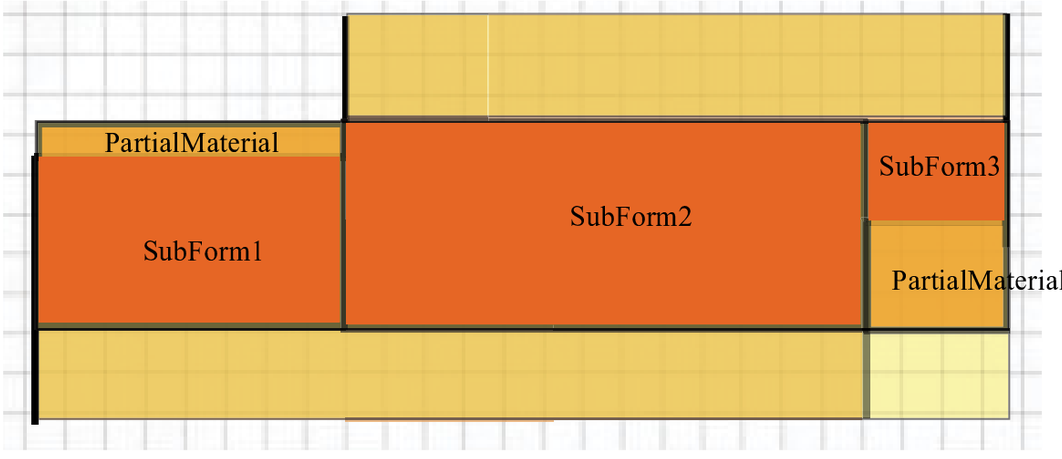

10. Repeat steps 2-9 with the values for BoundingBoxLength and BoundingBoxHeight interchanged
Compare all EfficiencyTestScores to find lowest valued test
Compare all AestheticTestScores to find lowest valued test
Print CurrentSegmentBox(EfficiencyTestScore) with lowest value and layout procedure
Print CurrentSegmentBox(AestheticTestScore) with lowest value and layout procedure
End

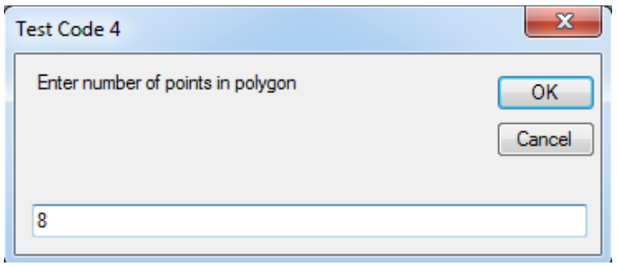

5.Intersect CurrentSegmentBox with FloorPlan
Store intersection as CurrentIntersectionBox
Is the relative y value of any vertical segment of the CurrentIntersectionBox<MaterialWidth?
No
Yes
Define SubDivisions
a. take all x segments<length of CurrentIntersectionBox
b. store each segment length@MaterialWidth as a SubDivision(SubDivisionCount+1)
c. CurrentSubDivision=SubDivision(SubDivisionCount+1)
Define SubForms
(a. take all x segments<length of CurrentIntersectionBox
b. Using x min and max of segment, y max from x min and extent form a rectangle
c. store rectangle as SubForm(SubFormCount+1)
d. CurrentSubForm=SubForm(SubFormCount+1))
Define PartialMaterial
PartialMaterial=(CurrentSubDivision-CurrentSubForm)
Is the relative y value of any vertical segment of the CurrentIntersectionBox<MaterialWidth?
No
Yes
Is there any PartialMaterial that can be used CurrentSubform?
Yes
Use it
No
Store length of CurrentSubDivision as MaterialUsed
Store length of any unshared edge segments between CurrentSubForm and FloorPlan as SeamLength
Store any PartialMaterial created
Have all SubDivisions of CurrentIntersectionBox been executed?
Yes
No
Store greatest x value - lowest x value of CurrentIntersectionBox as MaterialUsed
Store length of any unshared edge segments between CurrentInterectionBox and FloorPlan as SeamLength
Return to Define SegmentBoxOriginas SegmentBoxOrigin+MaterialWidth

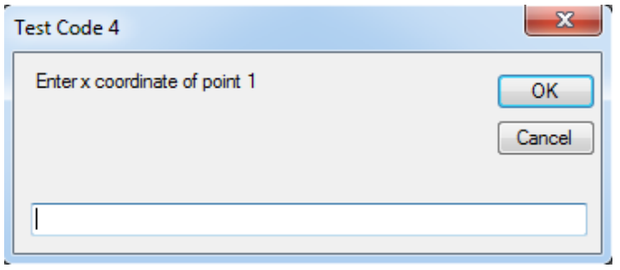

BoundingBox
SegmentBox6
SegmentBox5
SegmentBox4
SegmentBox3
SegmentBox2
SegmentBox1
BoundingBoxHeight
Origin
BoundingBoxLength

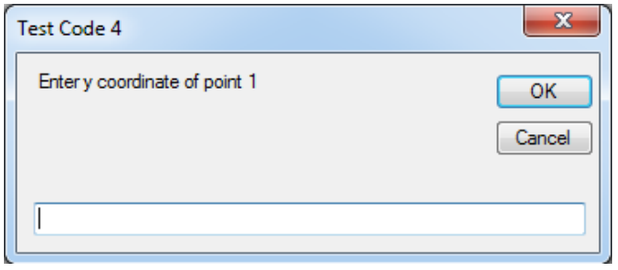

CurrentIntersectionBox
SeamLengths
SegmentBoxOrigin

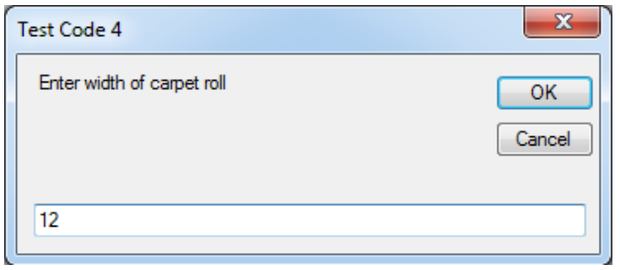

SubDivision1
SubDivision2
SubDivision3

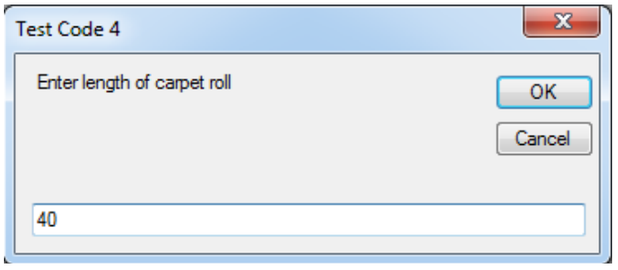

PartialMaterial
SubForm1
SubForm2
SubForm3
PartialMaterial

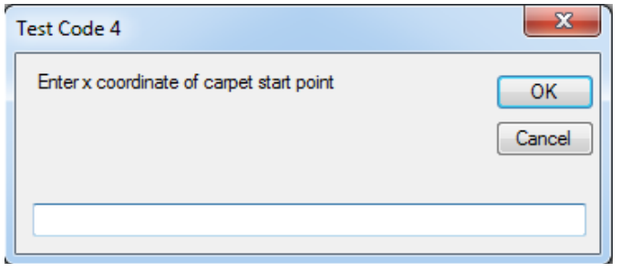

Test Code 4
Enter number of points in polygon
OK
Cancel
8

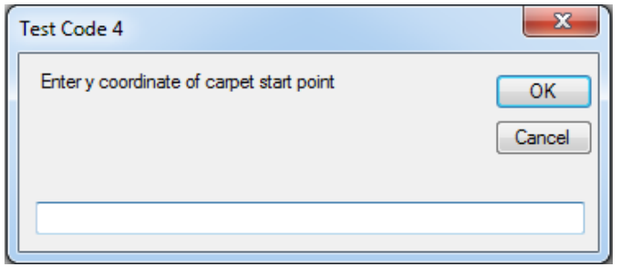

Test Code 4
Enter x coordinate of point 1
OK
Cancel

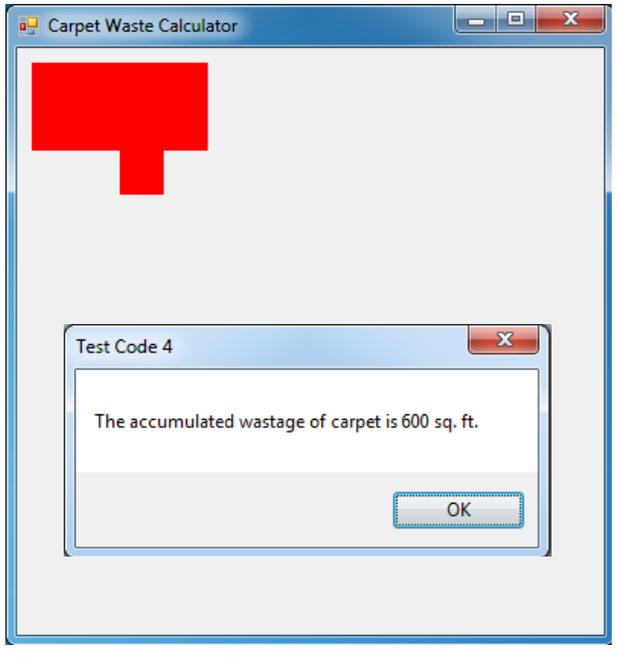

Test Code 4
Enter y coordinate of point 1
OK
Cancel


Test Code 4
Enter width of carpet roll
OK
Cancel
12


Test Code 4
Enter length of carpet roll
OK
Cancel
40


Test Code 4
Enter x coordinate of carpet start point
OK
Cancel


Test Code 4
Enter y coordinate of carpet start point
OK
Cancel


Carpet Waste Calculator
Test Code 4
The accumulated wastage of carpet is 600 sq. ft.
OK

Dimensional Space Planning

Modular forms and spaces

Material based dimensioning

Sustainable Design Approaches

PV Solar Panels

Solar Water Heater

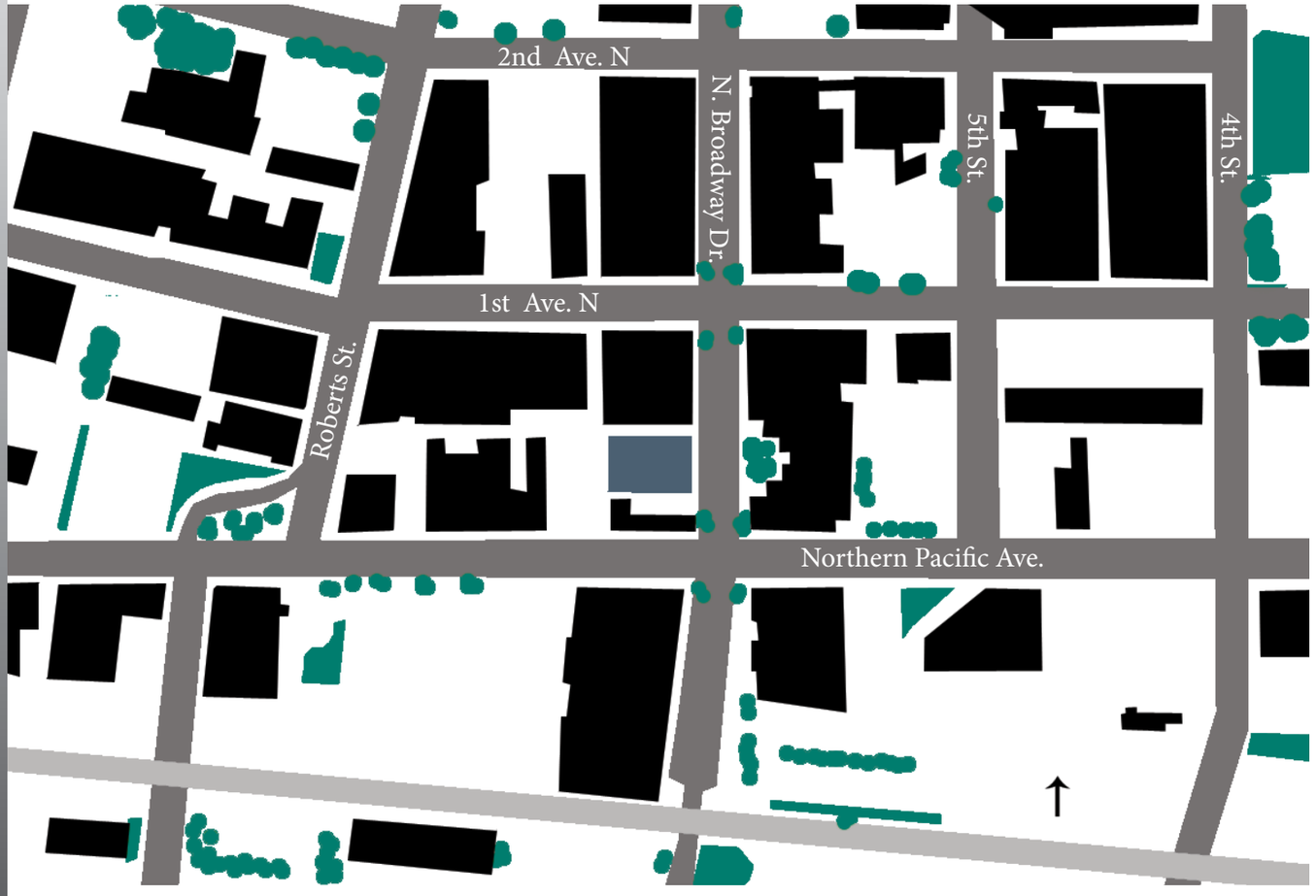
Heating/Cooling Tower

Green Roof

Natural Lighting and Ventilation

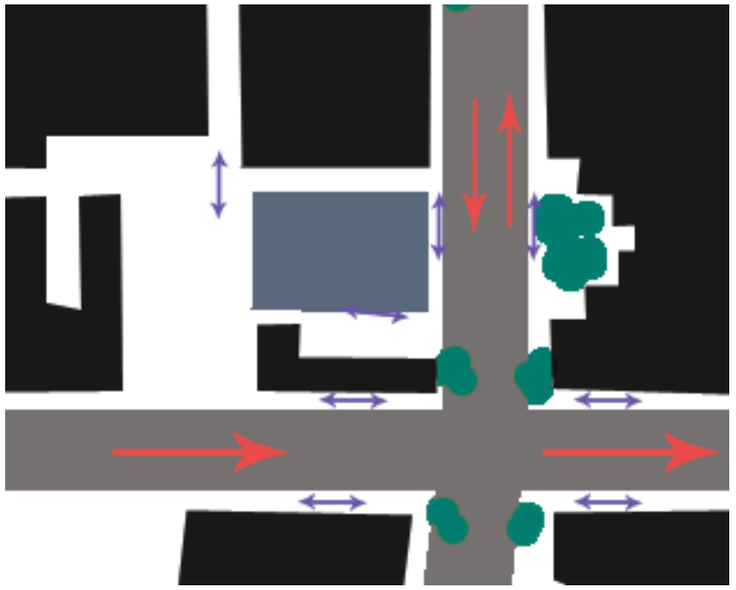
Site:

Fargo, ND

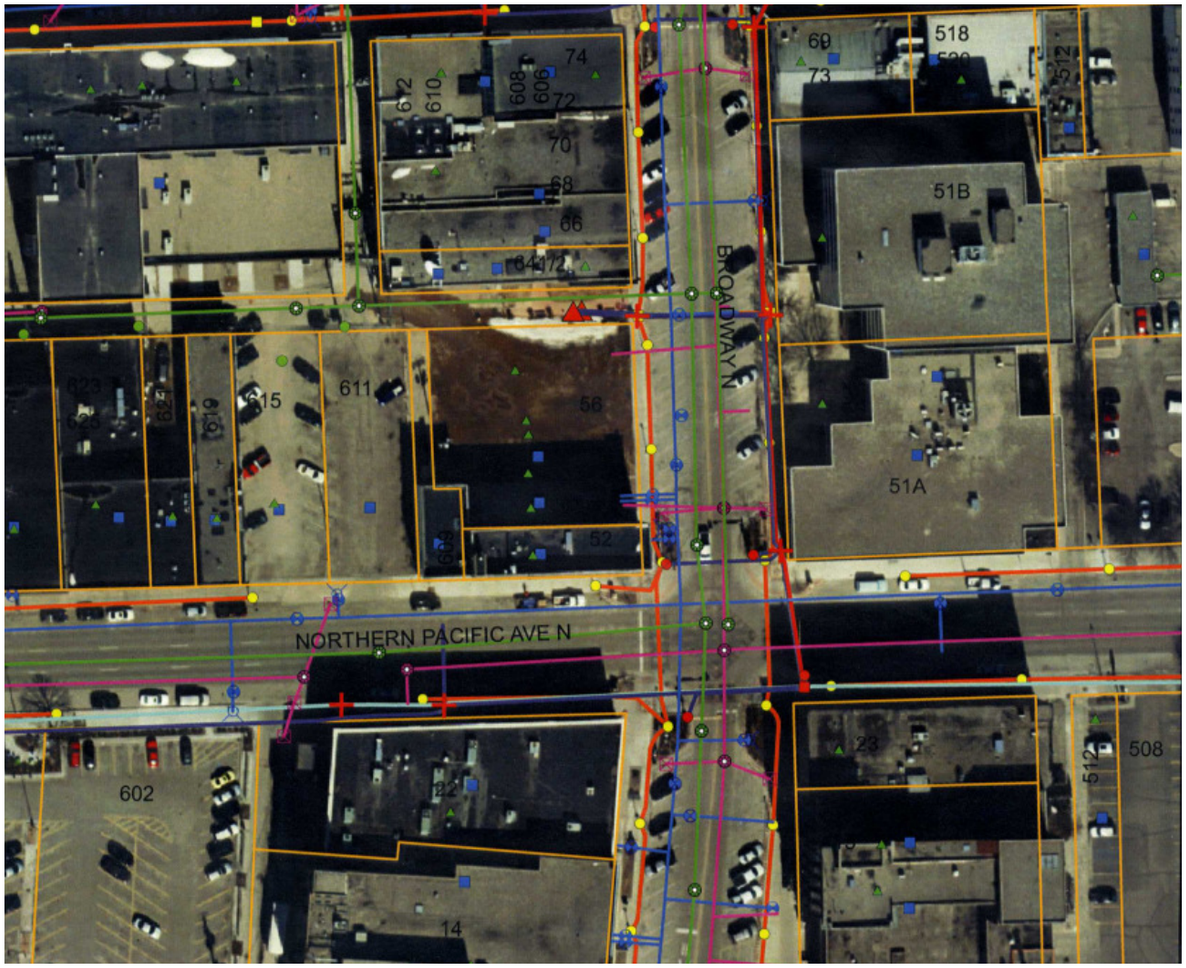


Wind and Solar Study

Pedestrian and Vehicular Traffic



Utilities Study



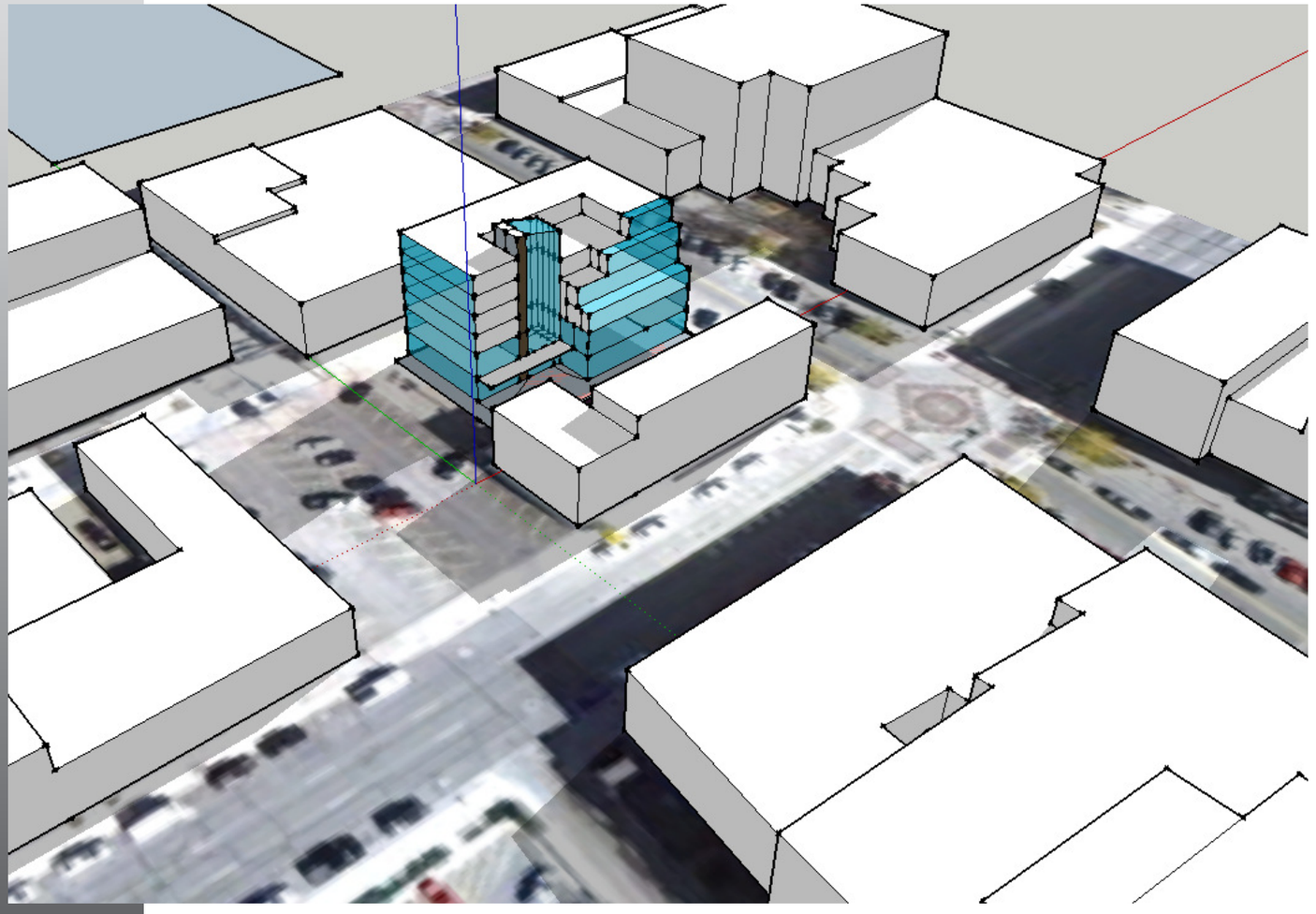
Blue:	Water Lines
Red-Orange:	Street Lights
Green:	Sanitory Waste Lines
Pink:	Storm Waster

South

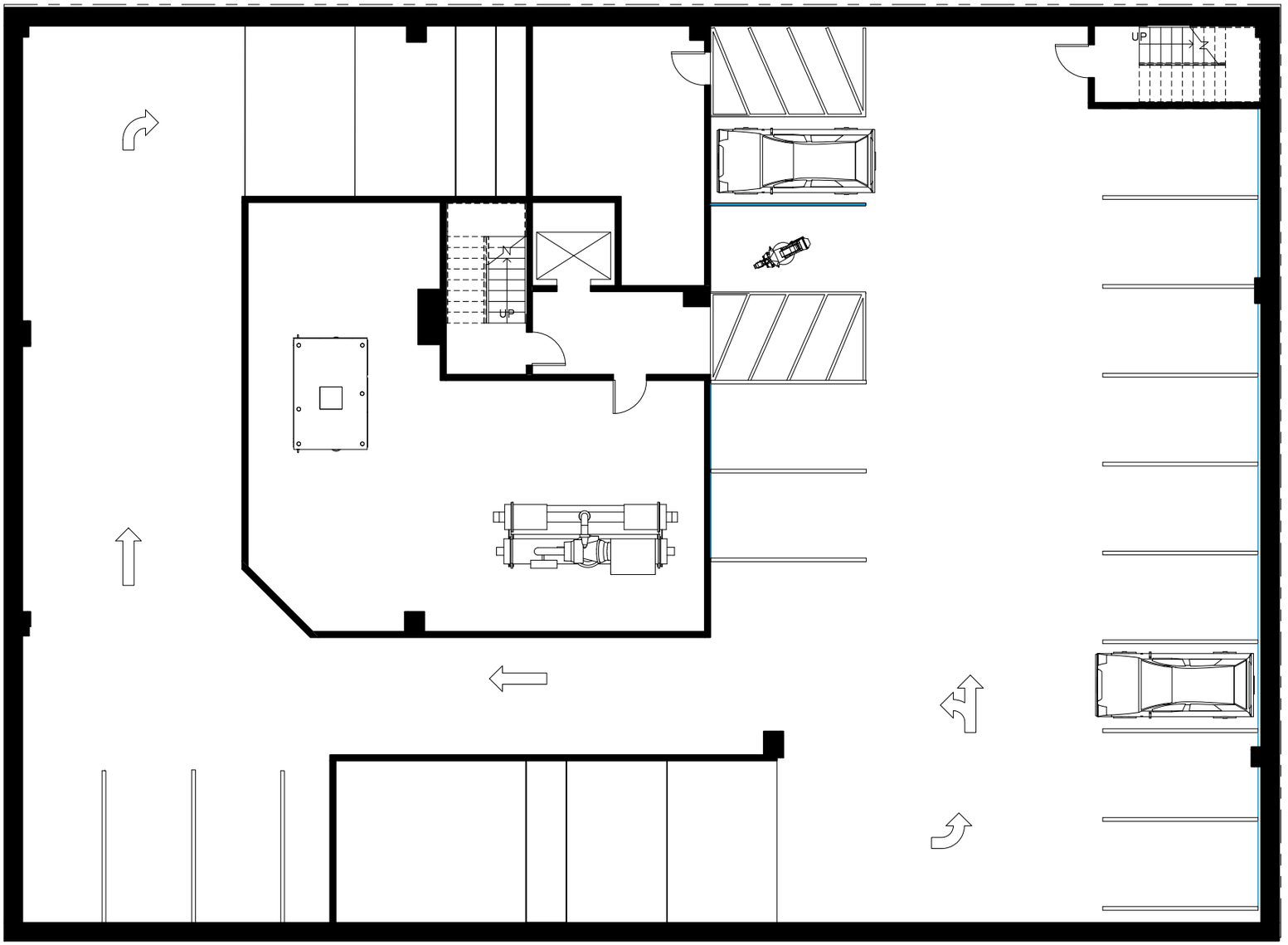
West

East

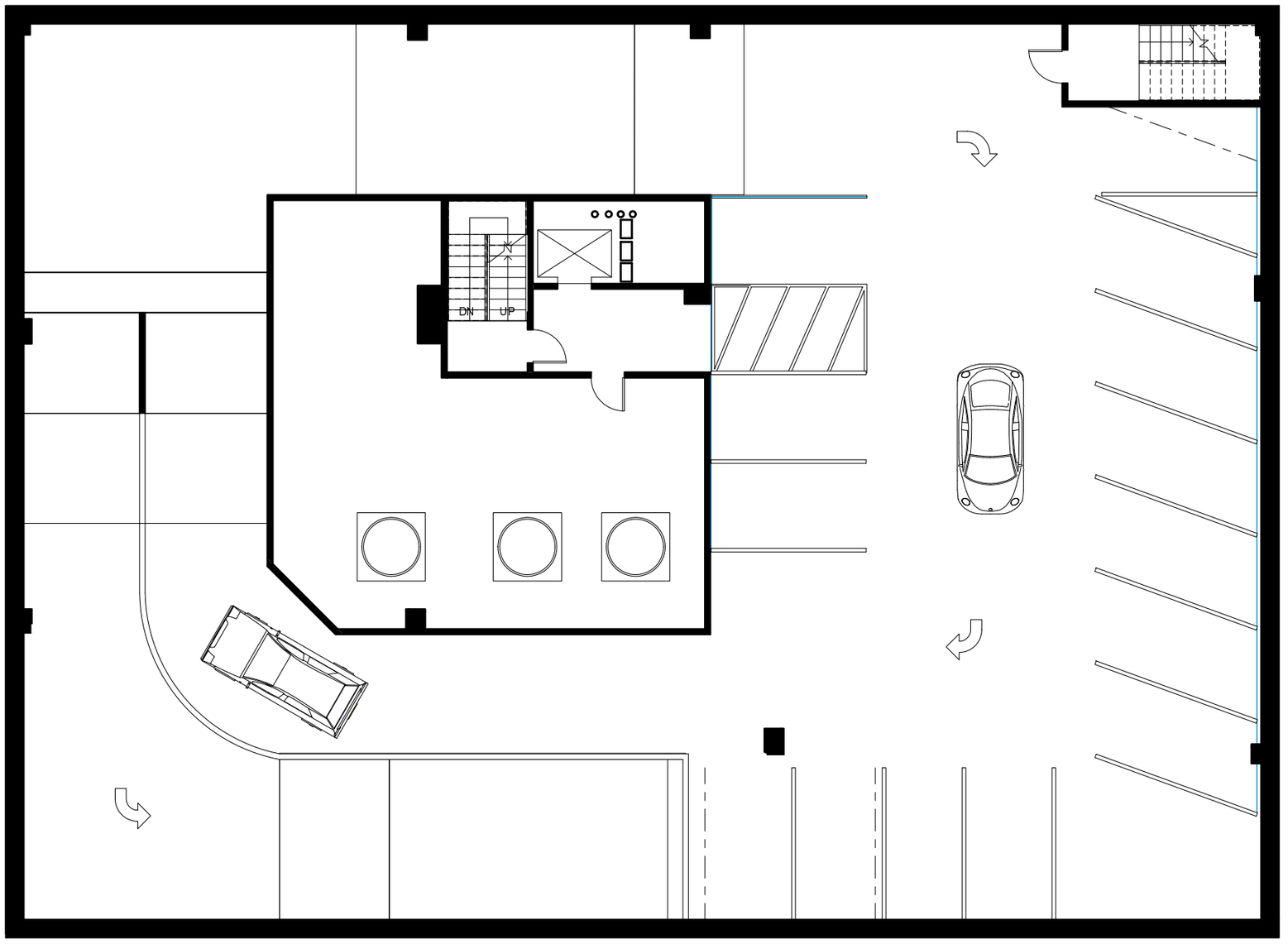
North



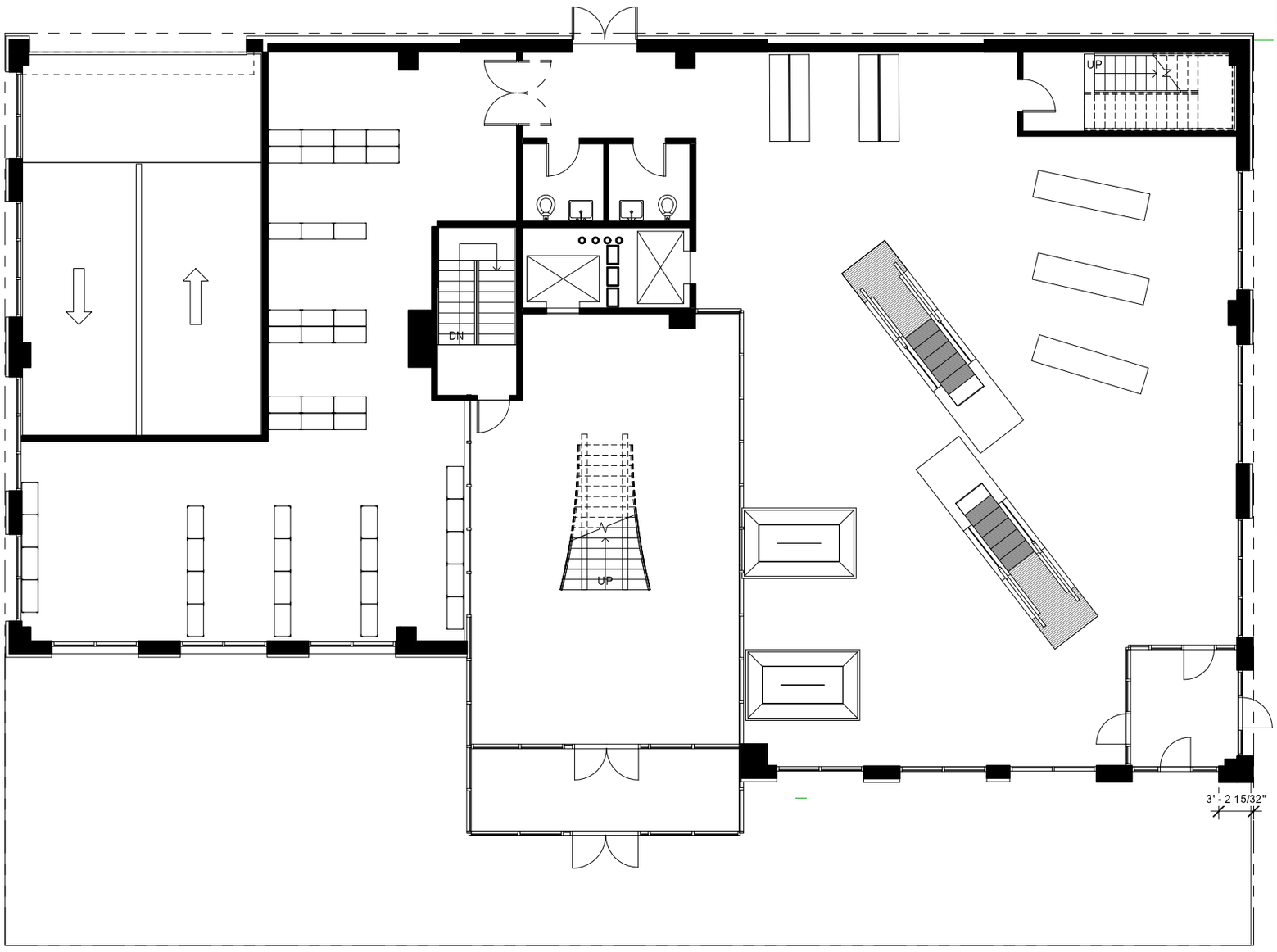
Level 1



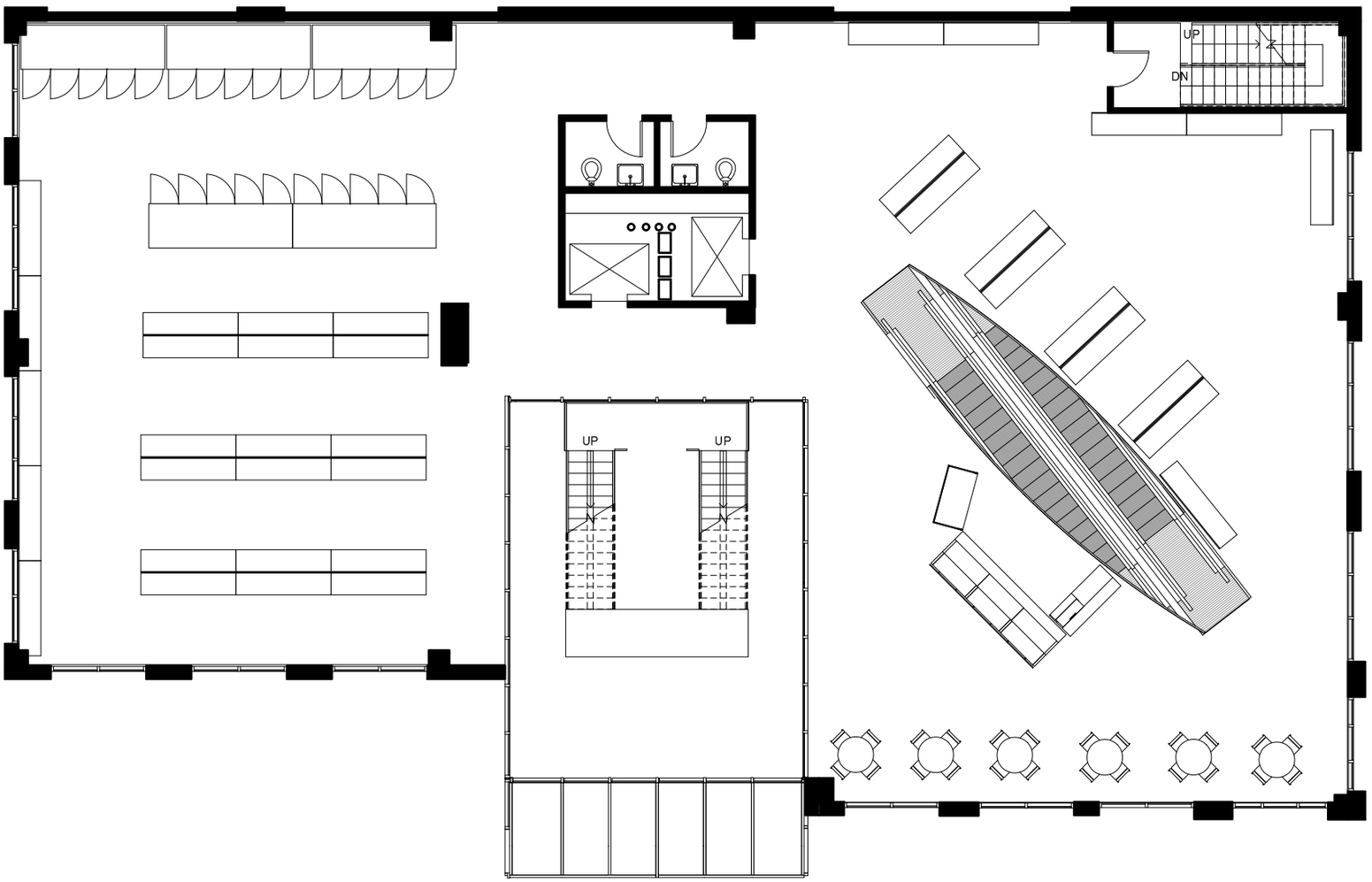
Level 2



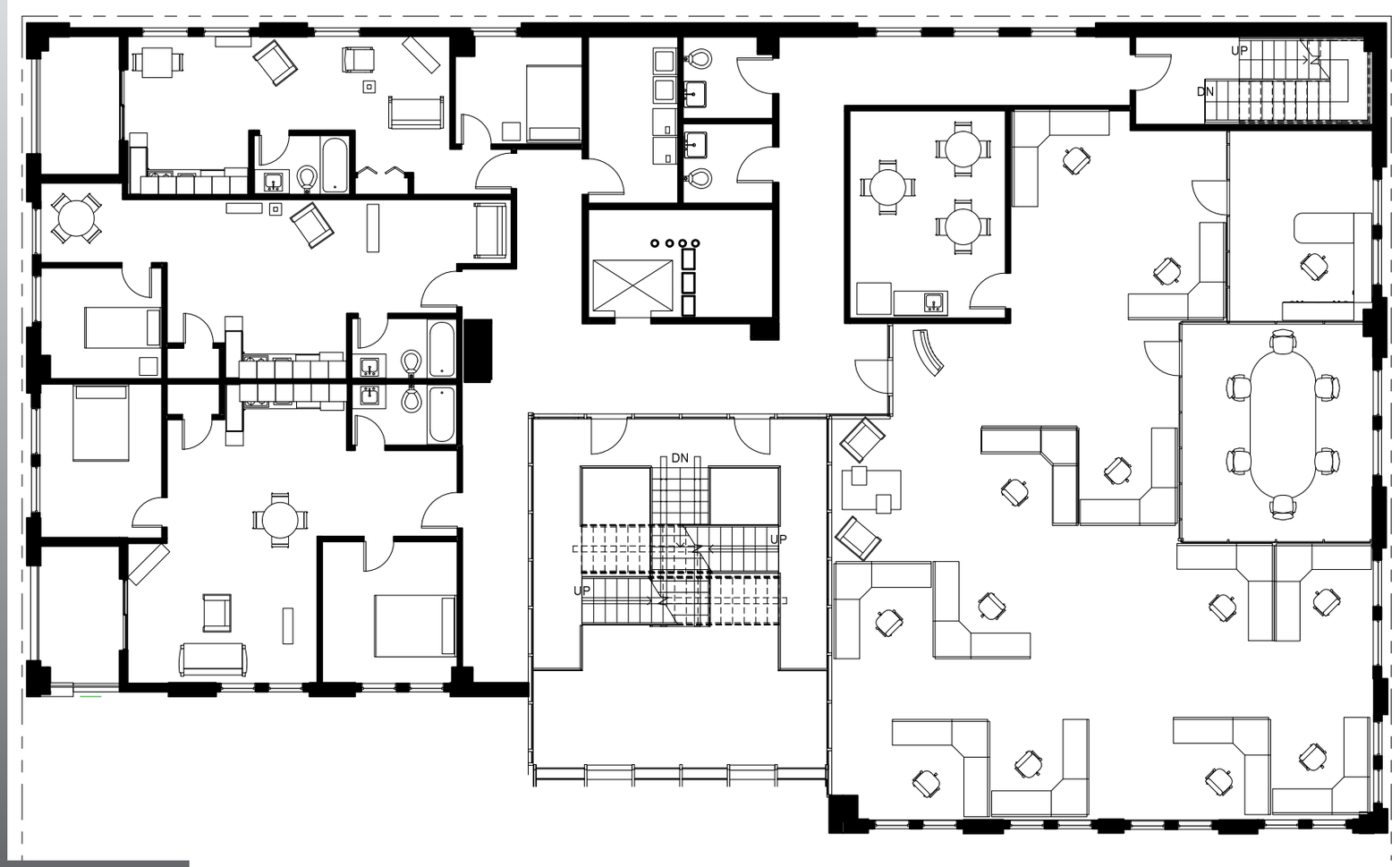
Level 3



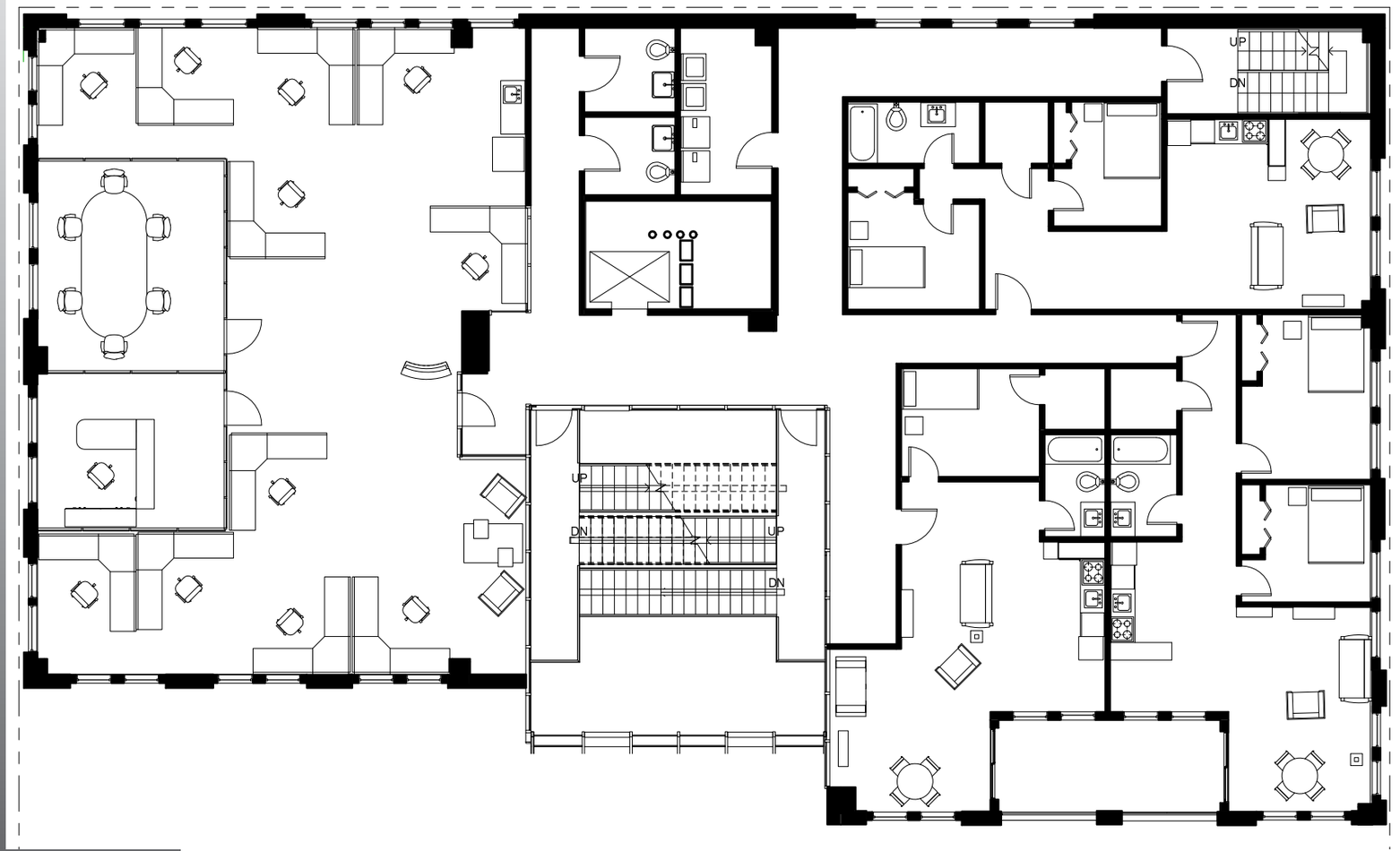
Level 4



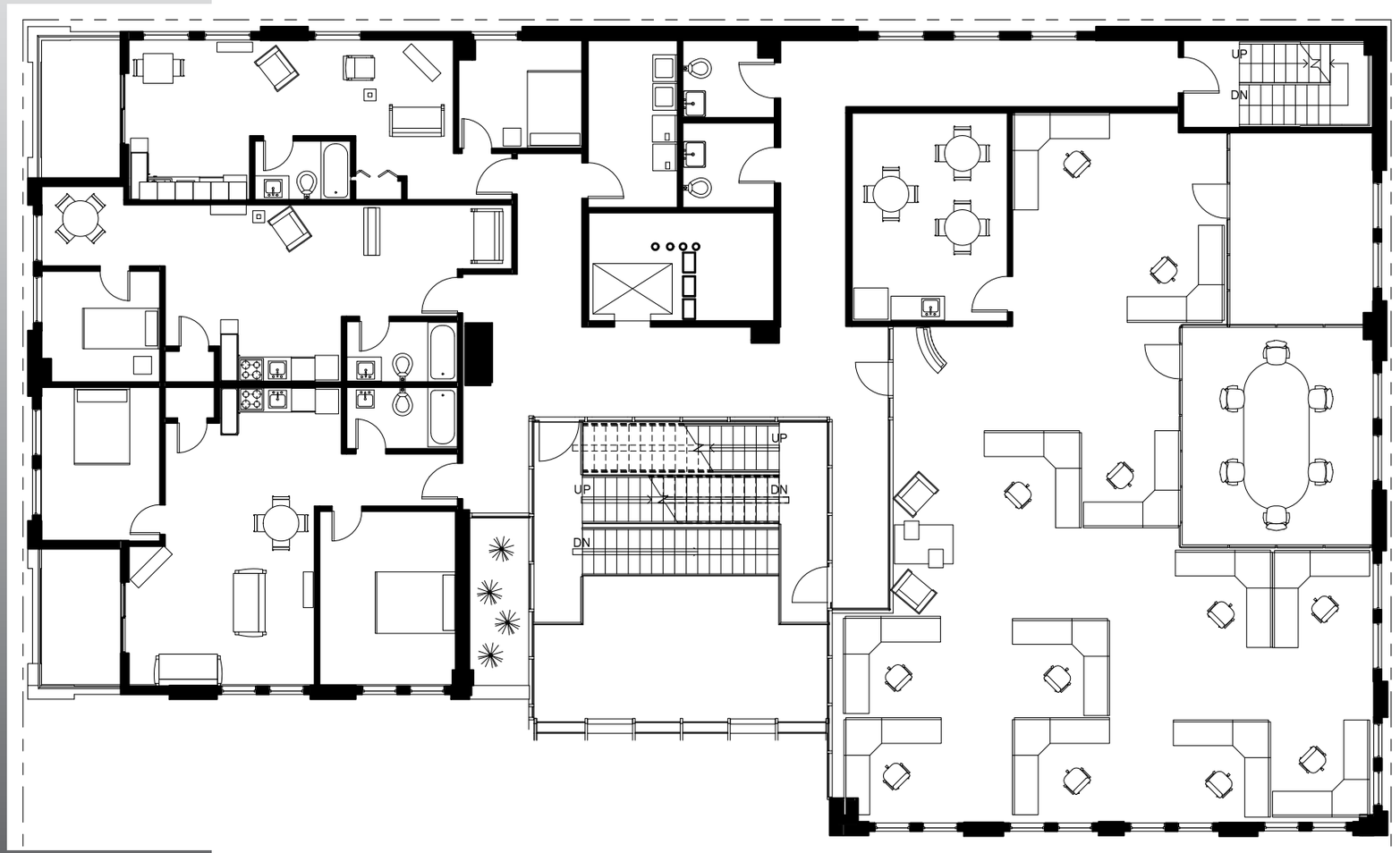
Level 5



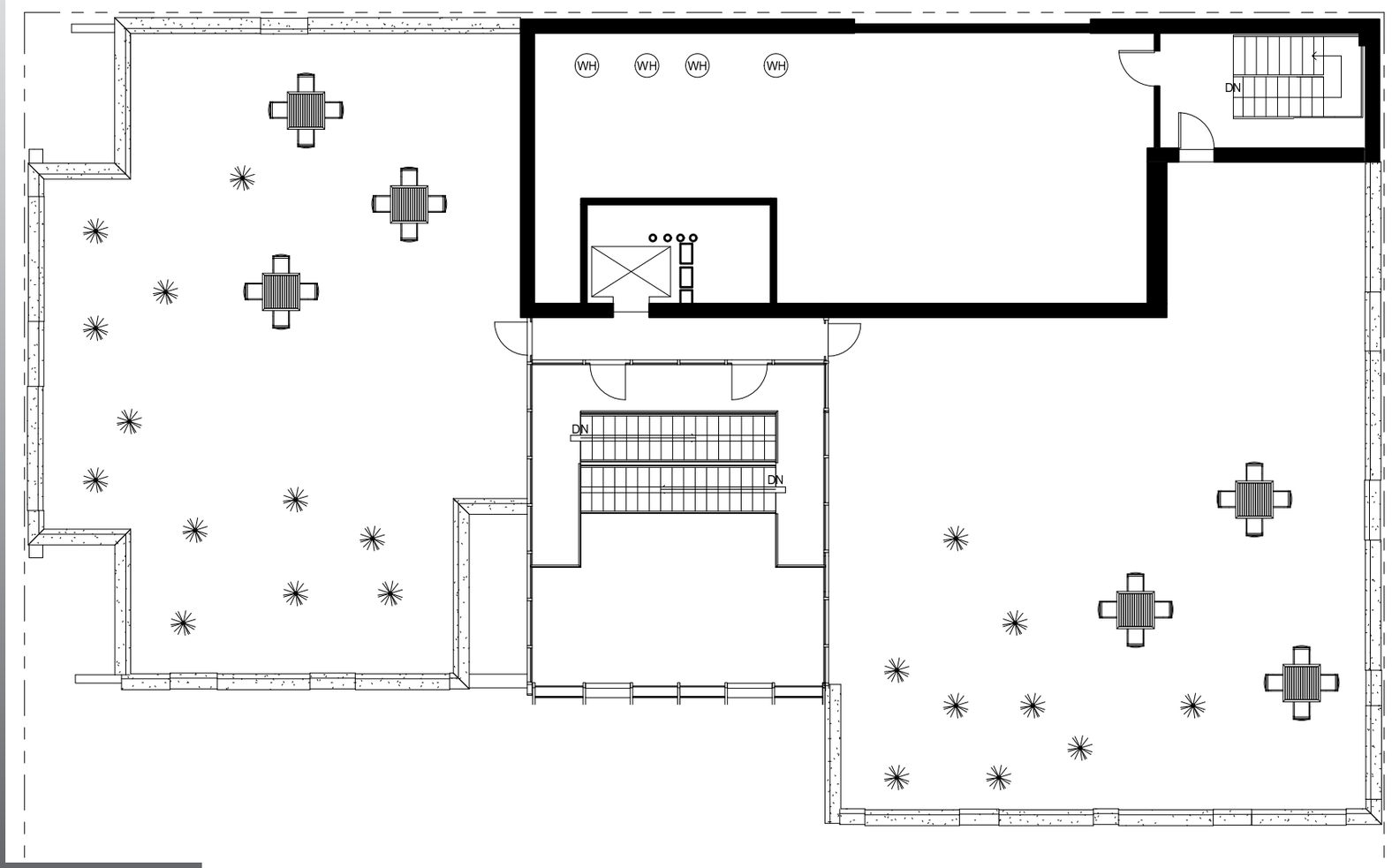
Level 6

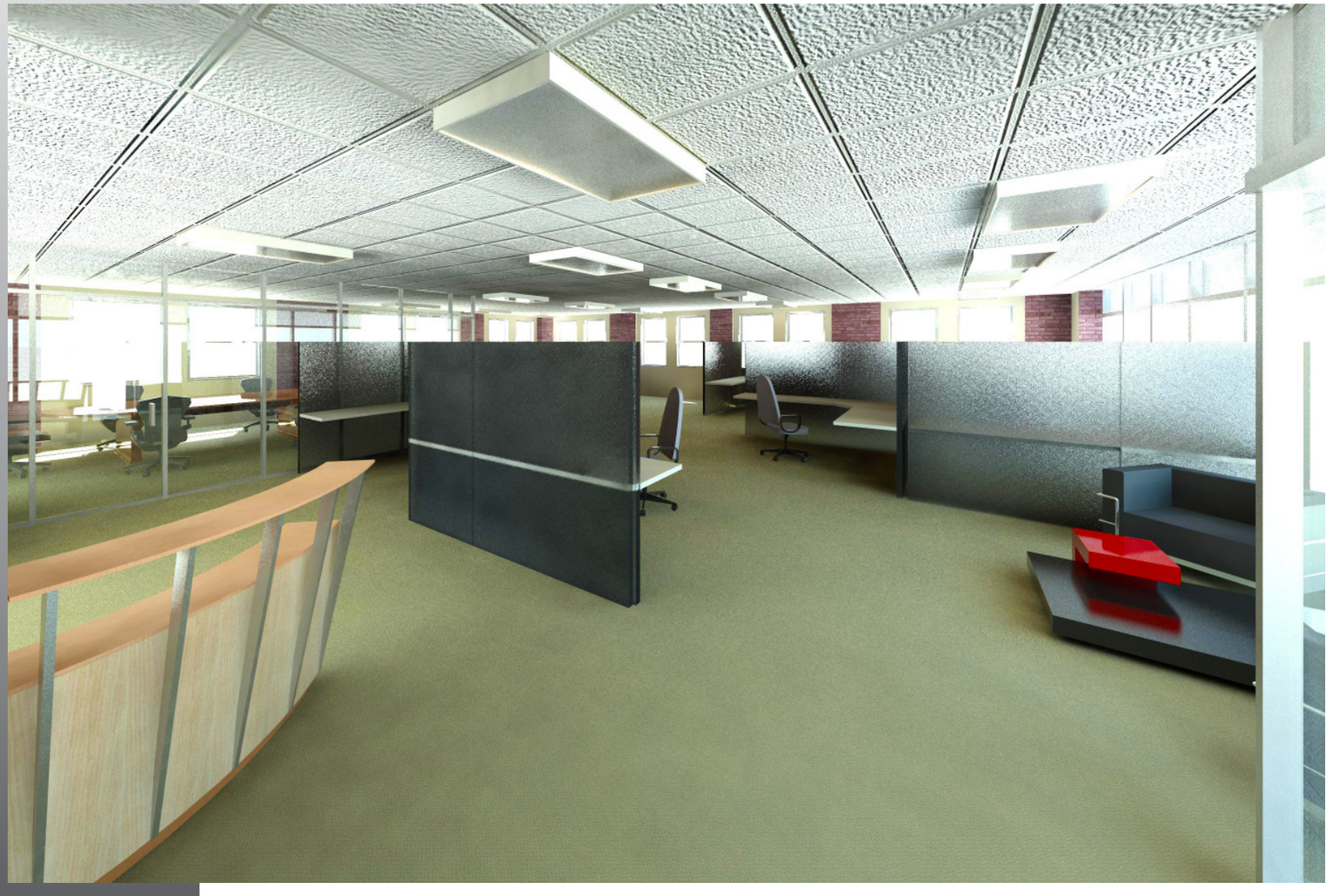


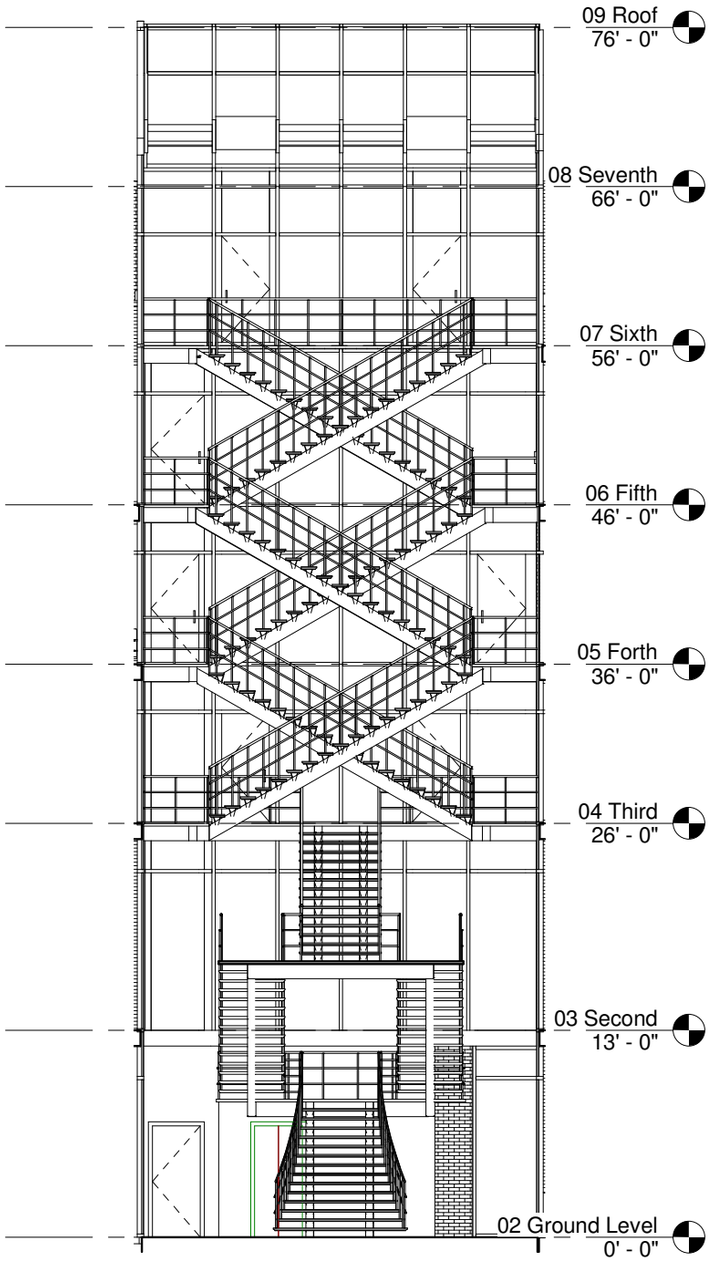
Level 7

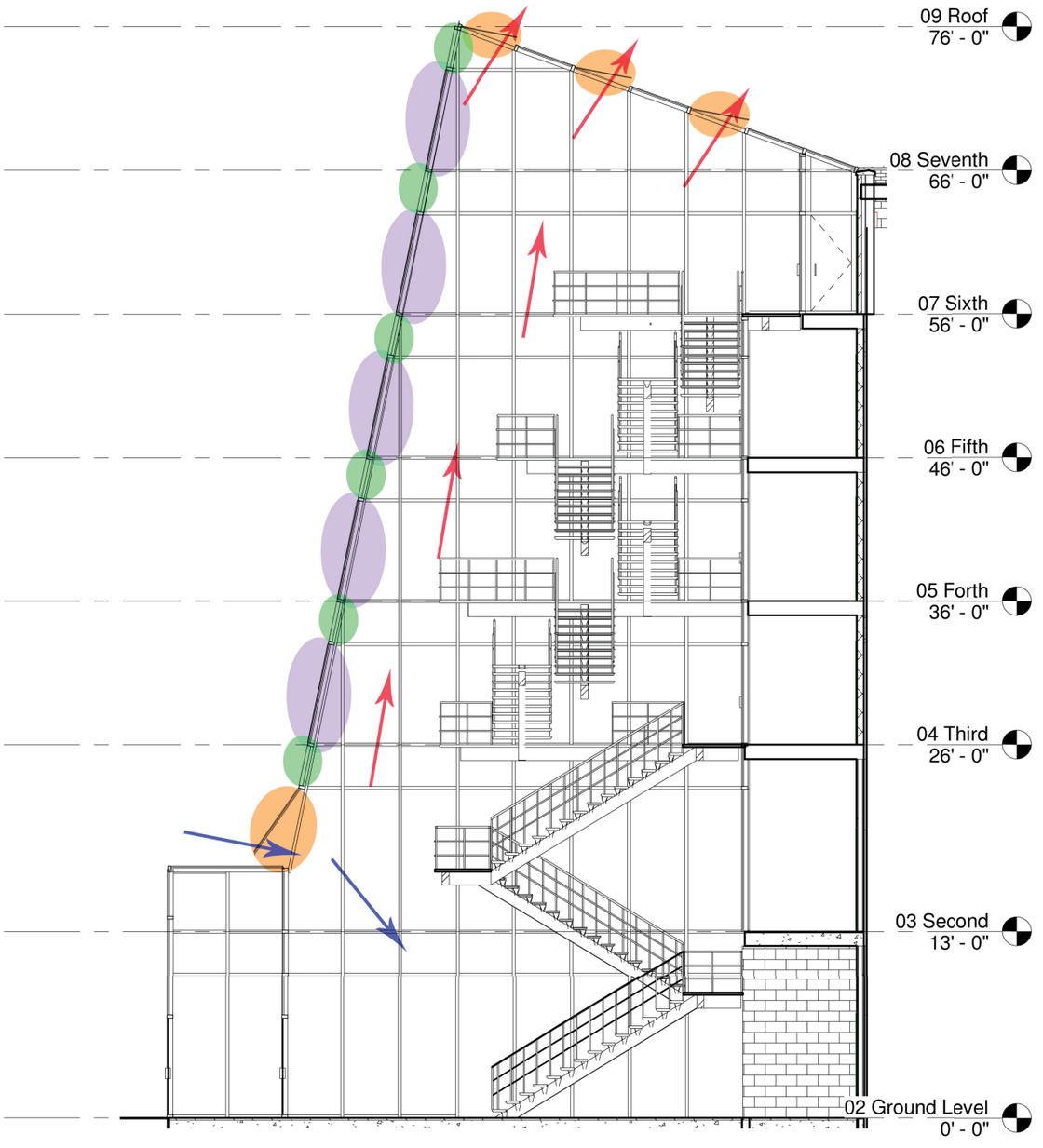


Level 8






09 Roof
76' - 0"
08 Seventh
66' - 0"
07 Sixth
56' - 0"
06 Fifth
46' - 0"
05 Forth
36' - 0"
04 Third
26' - 0"
03 Second
13' - 0"
02 Ground Level
0' - 0"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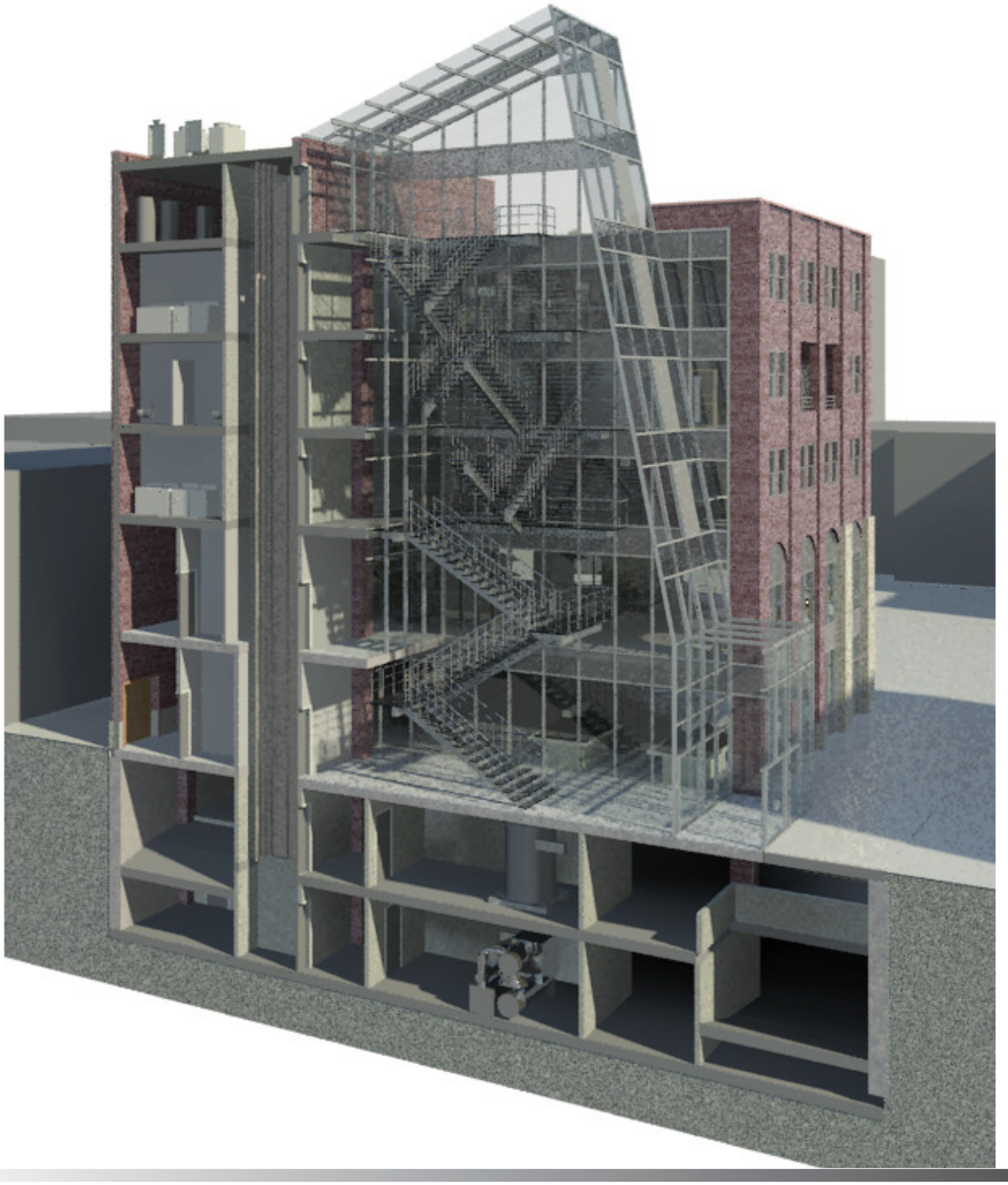

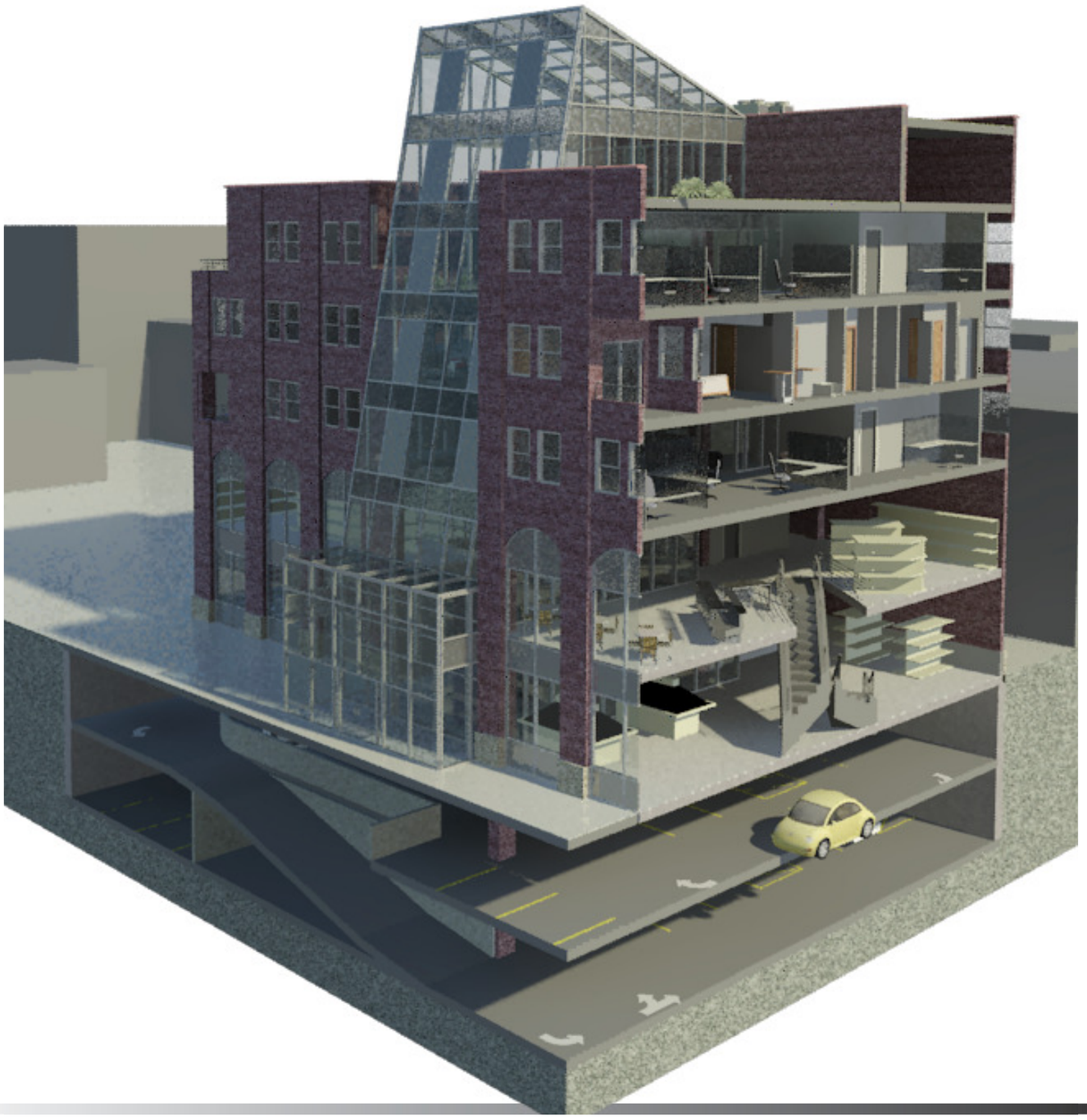

Questions and Comments