Affine Transformation 3

Computational Visual Design Laboratory
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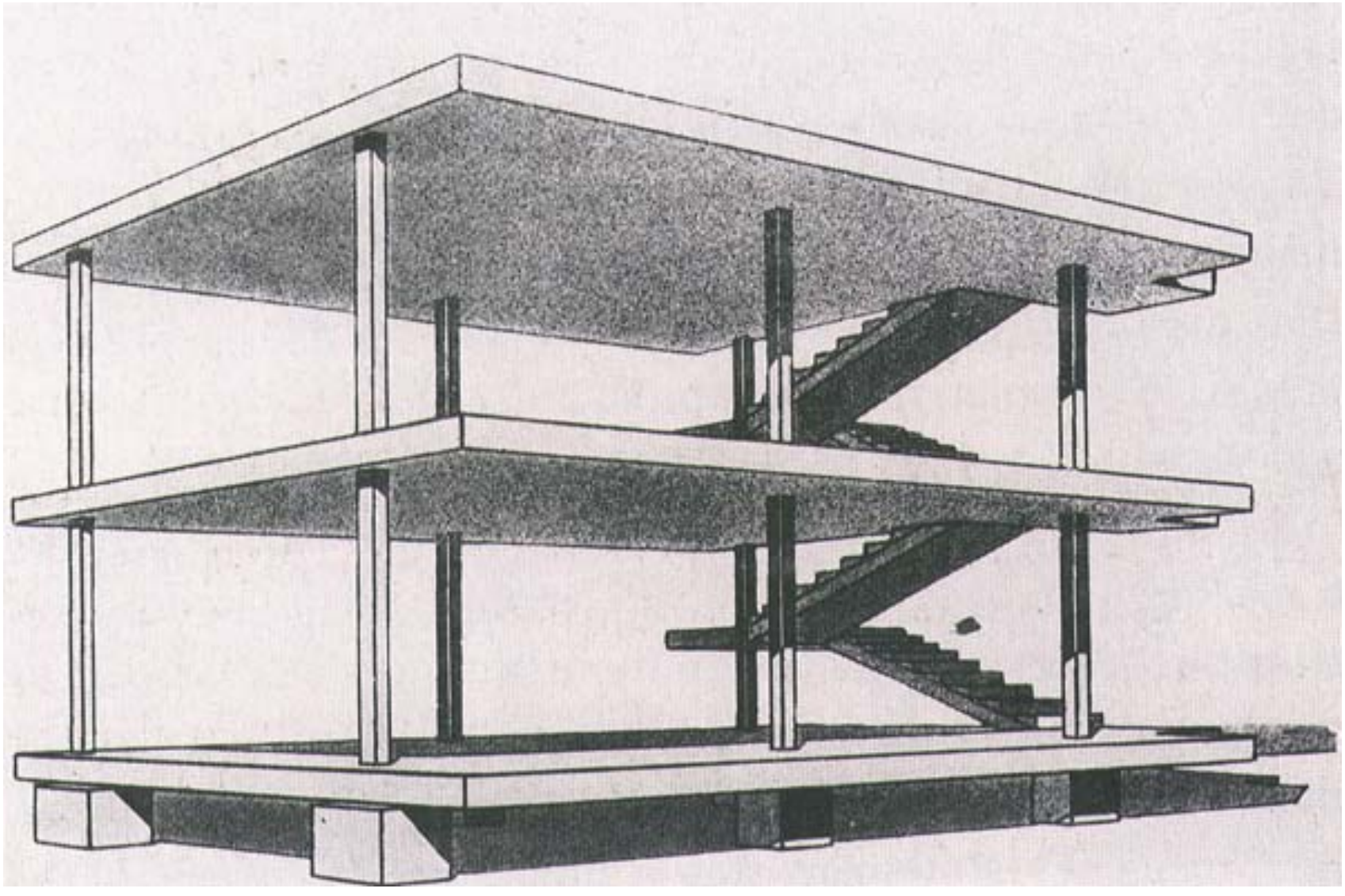
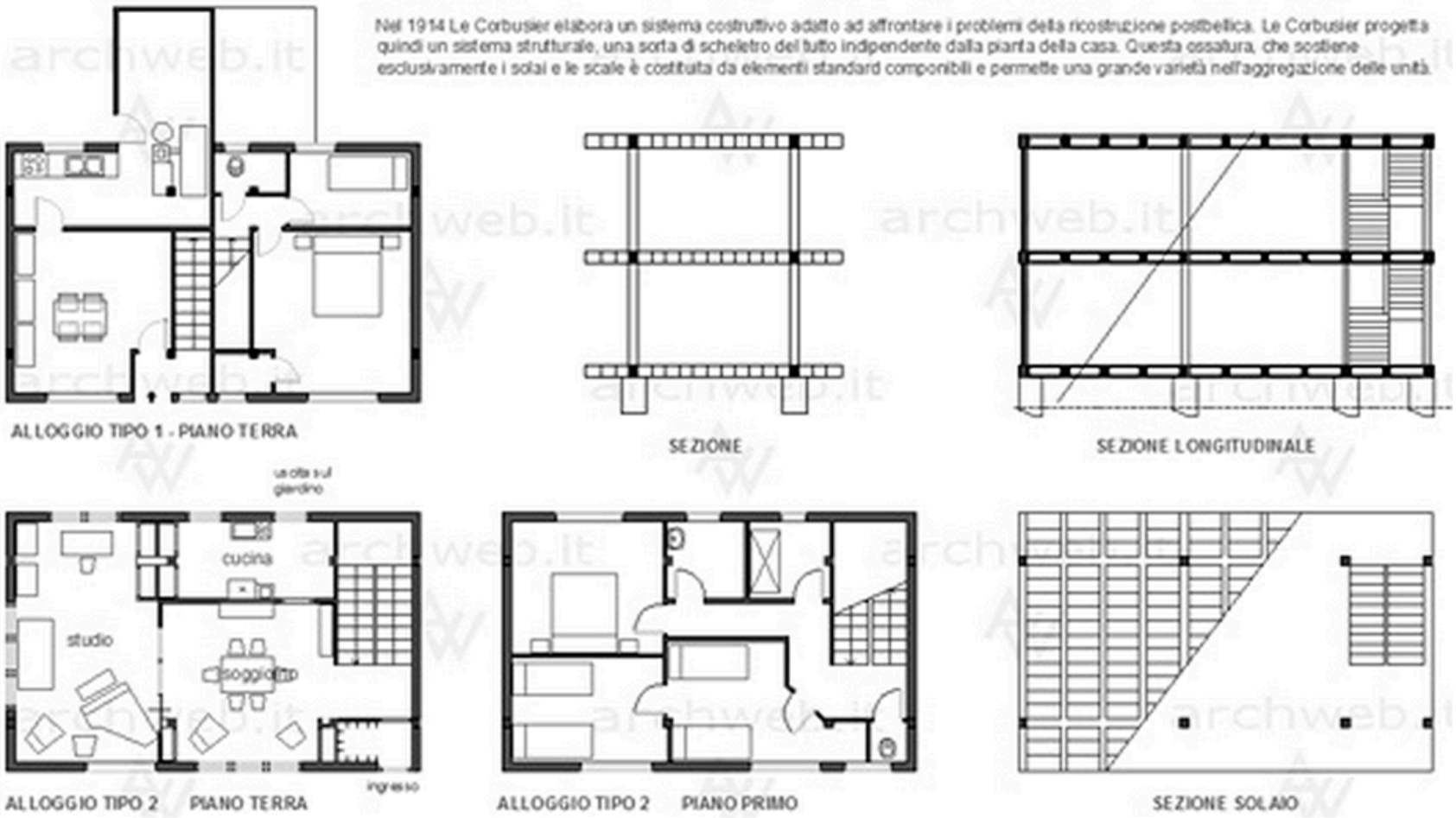
Contents

A great example: Maison Domino

Le Corbusier in 1920's developed the Maison-Domino, a basic building prototype for mass production with free-standing pillars and rigid floors.



A great example: Maison Domino



The building fabric

A functional breakdown of the construction

- foundations
- building frame
  - beams
  - pillars
- building enclosures
  - horizontal enclosures
  - vertical enclosures
- building partitions
  - horizontal partitions
  - vertical partitions
- vertical communications
  - staircases
  - elevators
- mechanical, electrical, and plumbing (MEP) plants

Utility functions

```
from pyplasm import *
GRID = COMP([INSR(PROD),AA(QUOTE)])
```

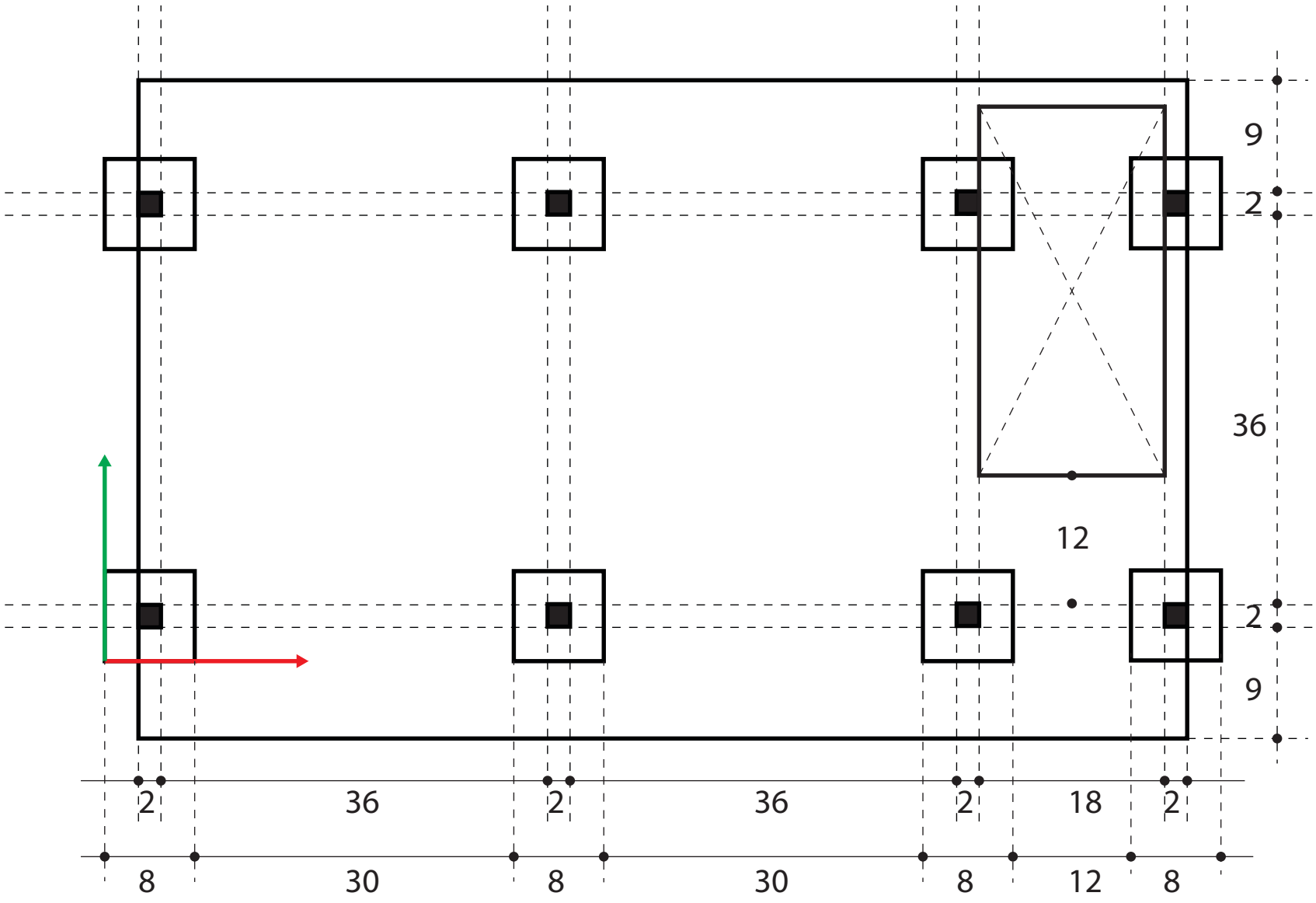
Input a list of lists of numbers

Output a geometric value (HPC – Hierarchical Polyhedral Complex)

Useful to generate a grid of convex cells from either 2 or 3 lists of positive or negative numbers, corresponding to full or empty cells, respectively

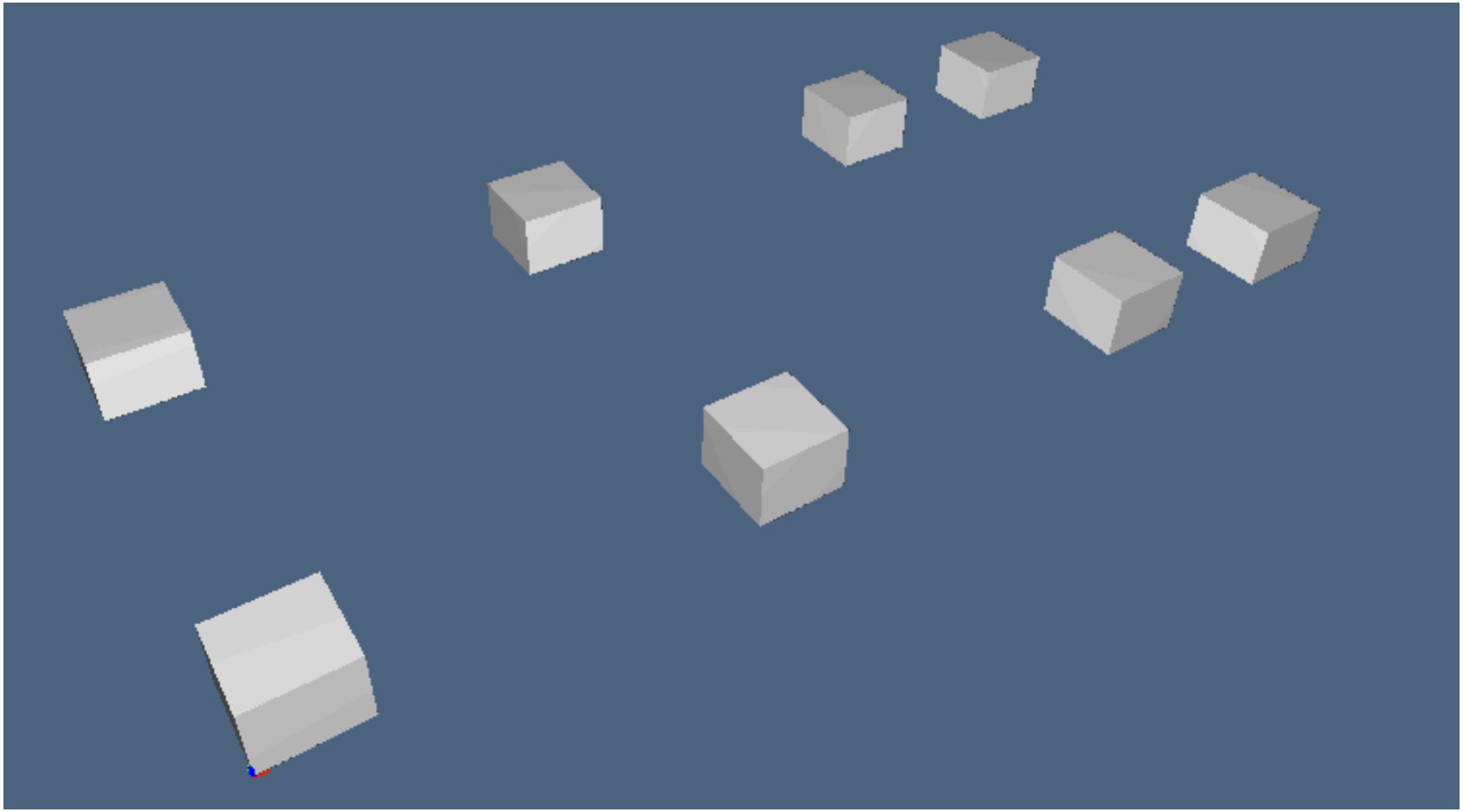
Unit size and measurements

let assume all measures given in multiples of of a module $M = 10\ cm$



Foundations

notice the position of origin of the coordinate frame

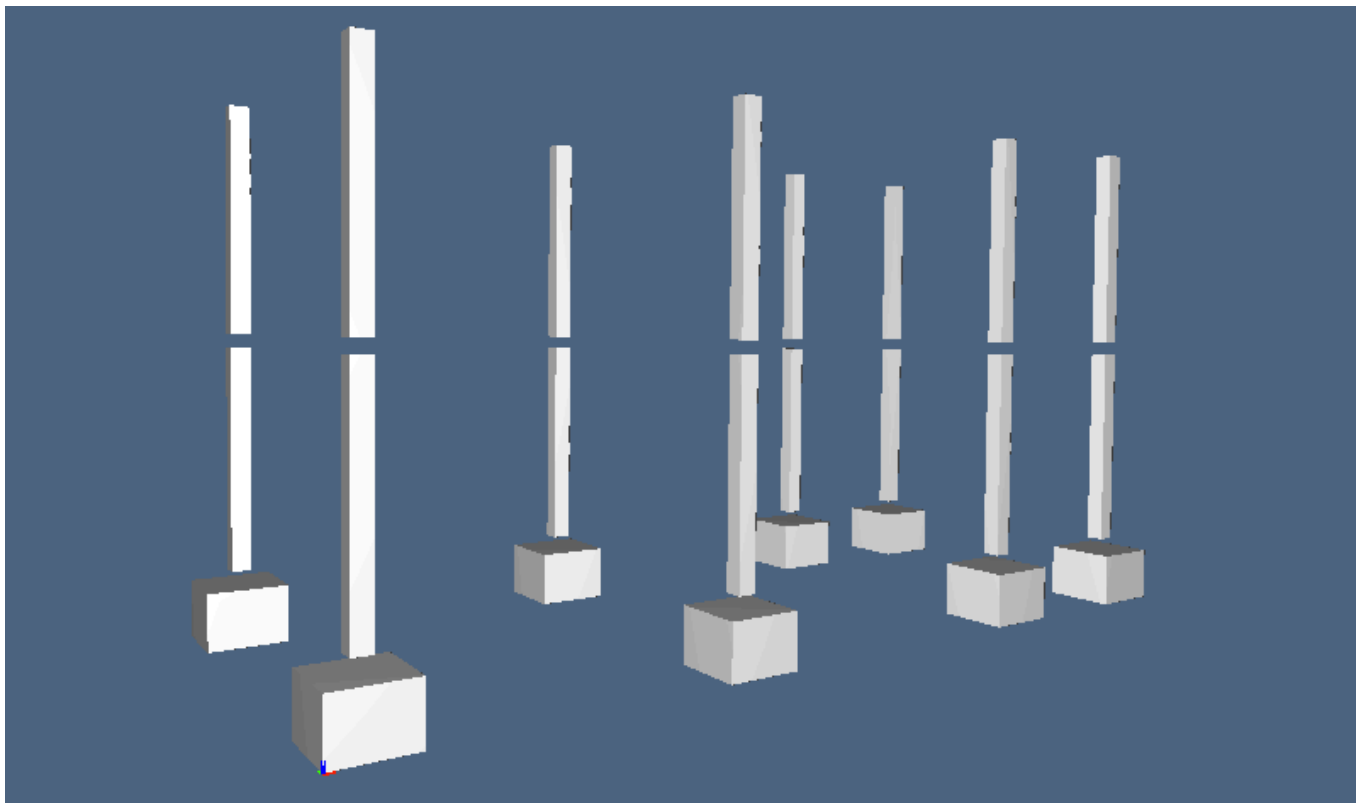


```
foundations = GRID([[8,-30,8,-30,8,-12,8],[8,-30,8],[6]])
VIEW(foundations)
```

Pillars

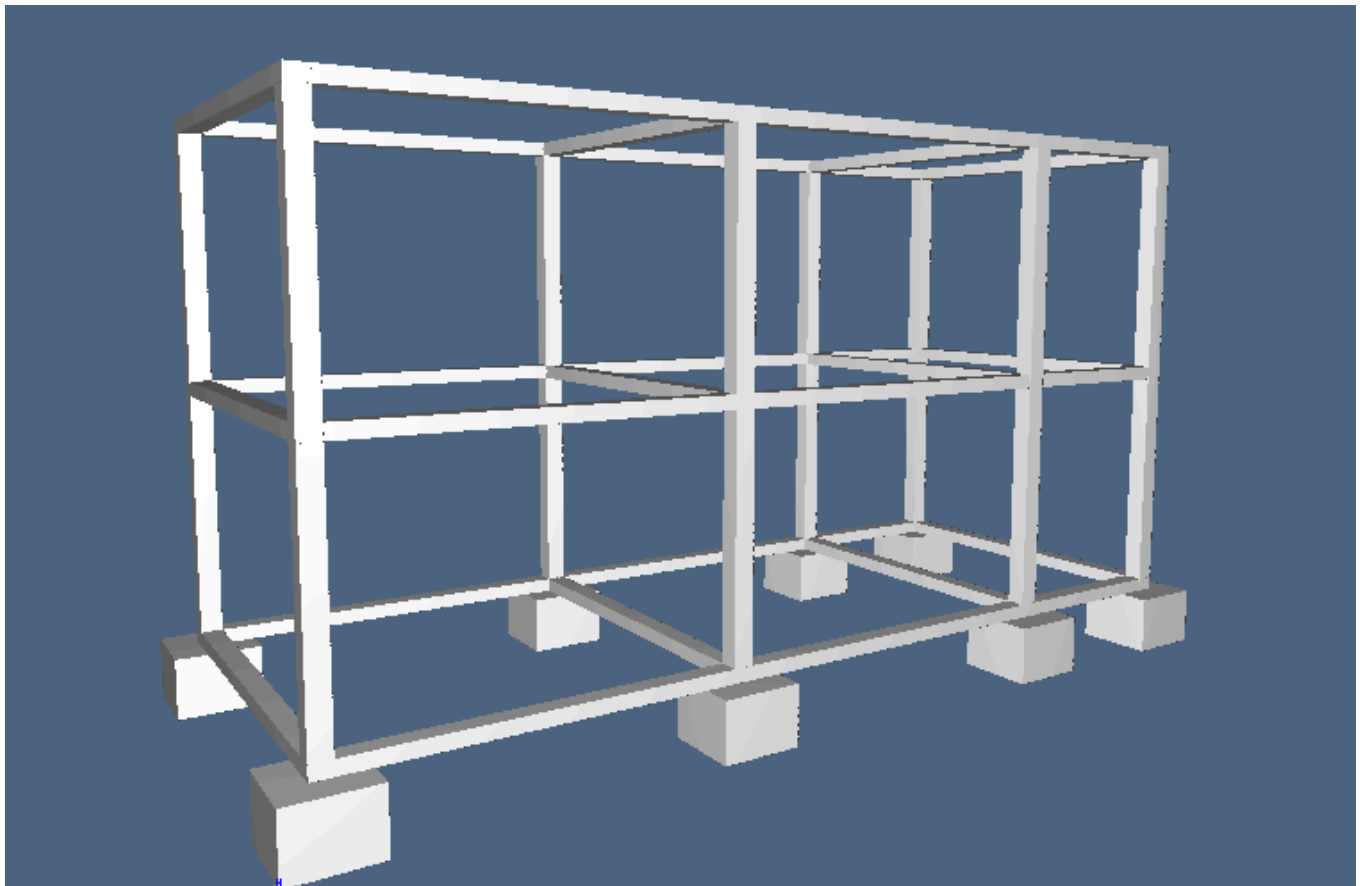
notice the initial (implicit) translation

```
pillars = GRID([[-3,2,-36,2,-36,2,-18,2],[-3,2,-36,2],
    [-7.4,23.6,-1.4,23.6,-1.4]])
building = STRUCT([foundations,pillars])
VIEW(building)
```

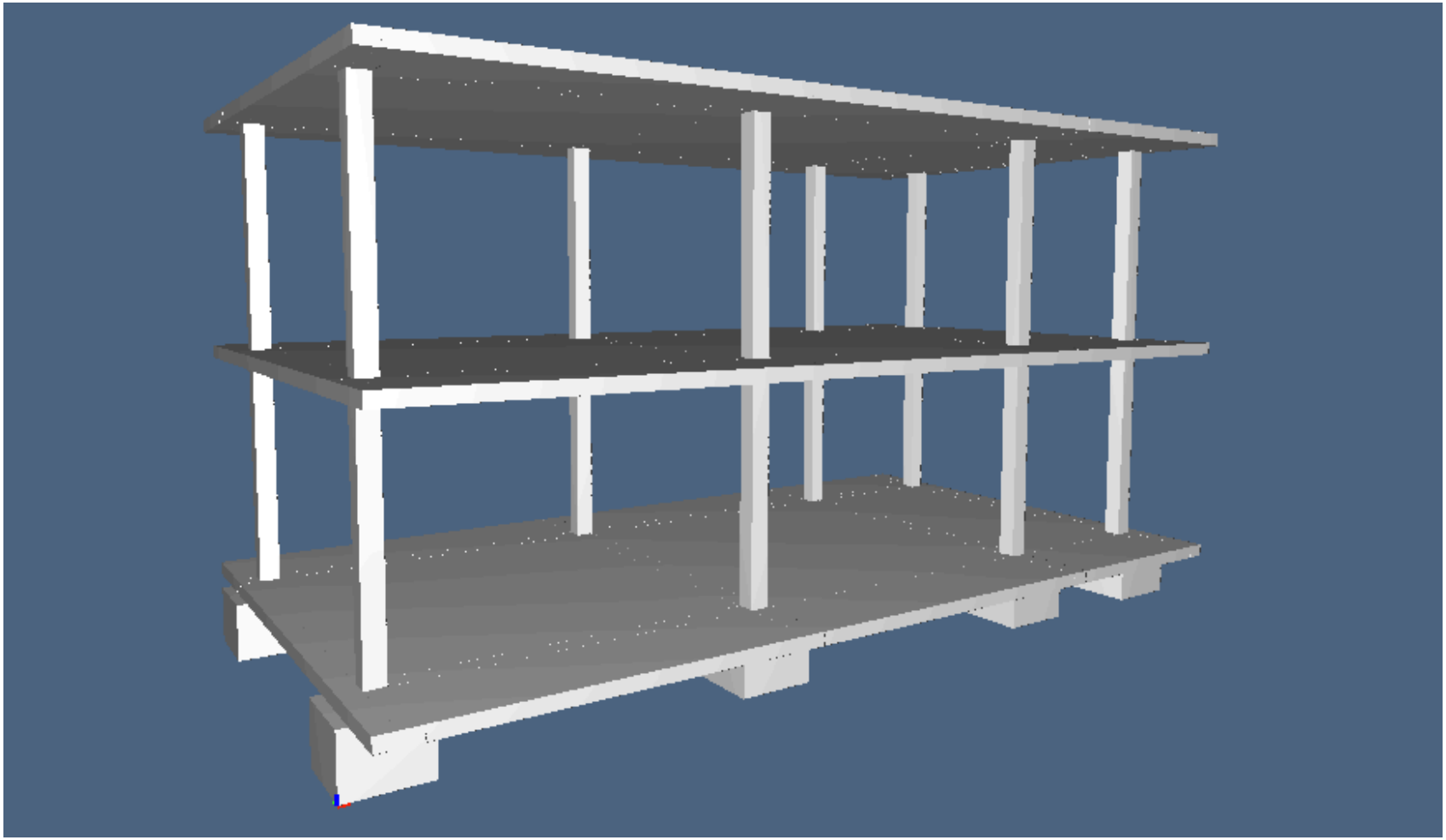


Building frame

```
beams_x = GRID([[-3,2,36,2,36,2,18,2],[-3,2,-36,2],
    [-6,1.4,-23.6,1.4,-23.6,1.4]])
beams_y = GRID([[-3,2,-36,2,-36,2,-18,2],[-3,2,36,2],
    [-6,1.4,-23.6,1.4,-23.6,1.4]])
beams = STRUCT([beams_x,beams_y])
frame = STRUCT([foundations,pillars,beams])
VIEW(frame)
```



Horizontal enclosures and partitions



```
horiz_partitions = T(2)(-6)(GRID([[-1,2,2,36,2,36,2,18,2,2],
    [9,2,36,2,9],[-6,1.4,-23.6,1.4,-23.6,1.4]]))
building = STRUCT([frame, horiz_partitions])
VIEW(building)
```

Horizontal enclosures and partitions

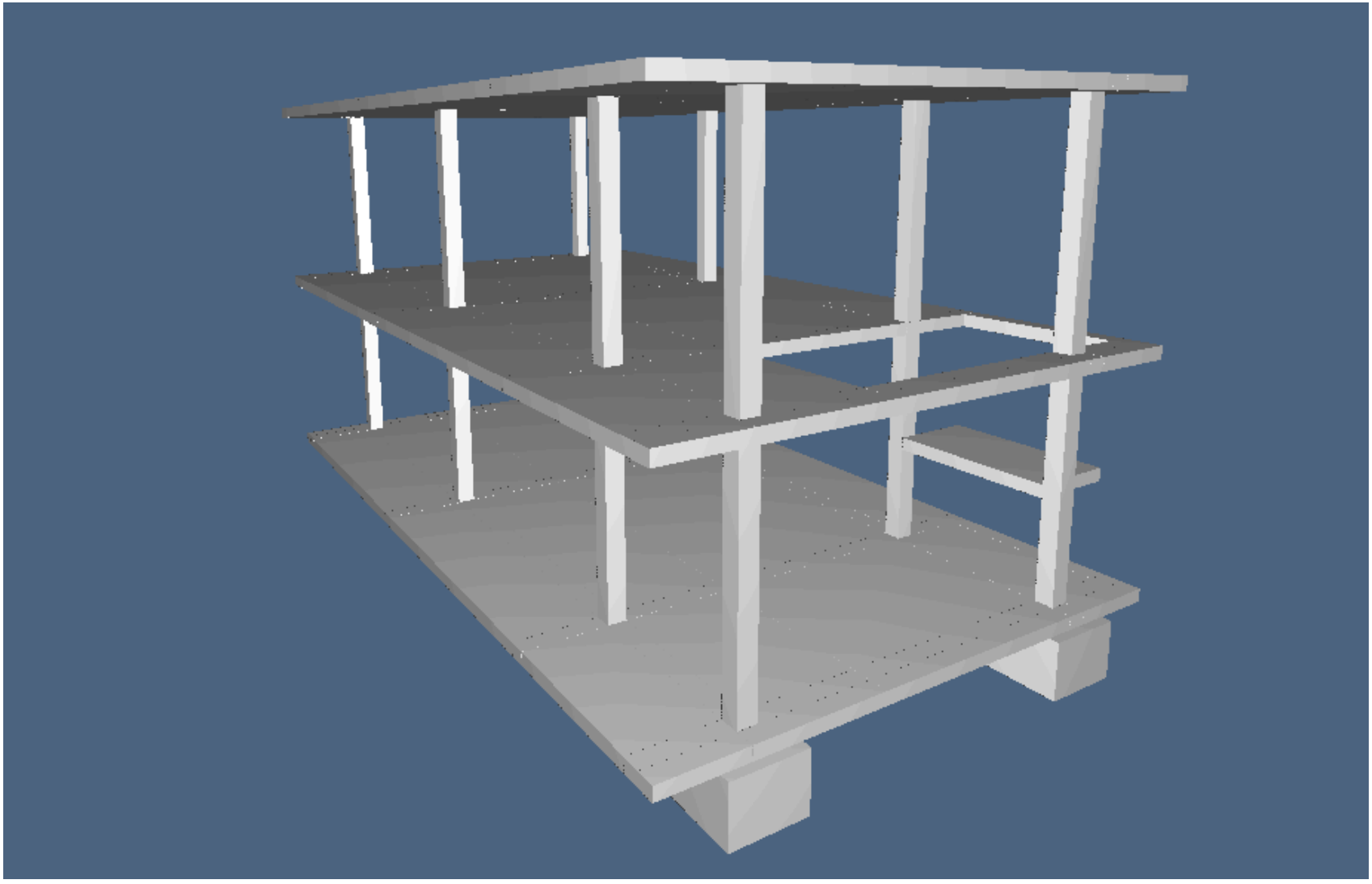
When Boolean operations are available, to make some hollows is much easier :o)

```
hollow = T([1,2,3])([5+38*2, 5+12, 6+25])(CUBOID([18,33,1.4]))
horiz_partitions = DIFFERENCE([ horiz_partitions, hollow])
building = STRUCT([frame,horiz_partitions])
VIEW(building)
```

otherways:

```
hpartition1 = GRID([[-1,2,2,36,2,36,2,-18,2,2],[9,2,12,24,2,9],
    [-6,1.4,-23.6,1.4,-23.6,1.4]])
hpartition2 = GRID([[-1-2-2-36-2-36-2,18],[9,2,12,-24,-9,2],
    [-6,1.4,-23.6,1.4,-23.6,1.4]])
hpartition3 = GRID([[-1-2-2-36-2-36-2,18],[9,2,12,24,2,9],
    [-6,1.4,-23.6,-1.4,-23.6,1.4]])
hpartition4 = GRID([[-1-2-2-36-2-36-2,18],[-9,-2,-12,-24,9],
    [-6,1.4,-23.6/2 +1.25,1.4]])
horiz_partitions = STRUCT([ hpartition1, hpartition2,
    hpartition3, T(2)(-6)(hpartition4) ])
building = STRUCT([frame, horiz_partitions])
VIEW(building)
```

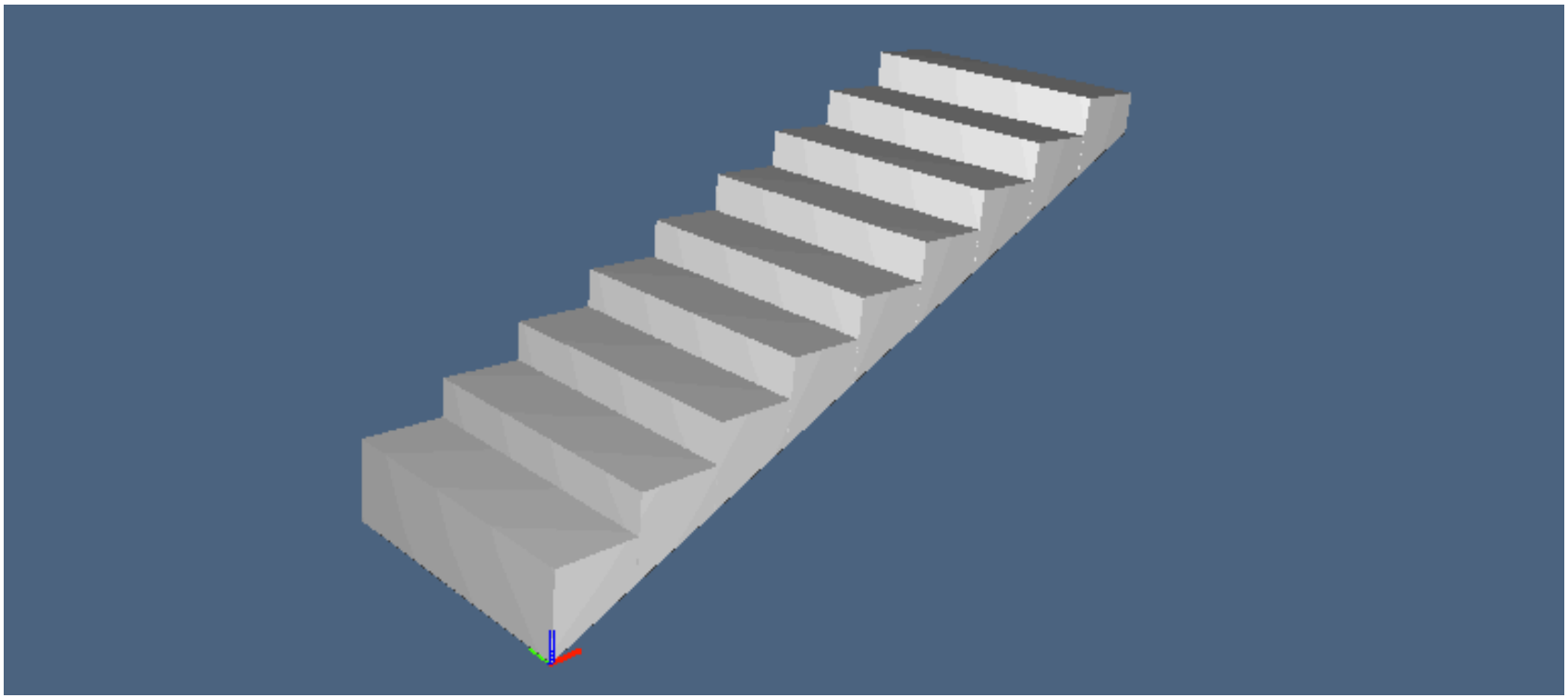
Horizontal enclosures and partitions



Staircases

Use MAP for permutations of coordinates

```
step2D = MKPOL([[[0,0],[0,2.65],[2.66,2.5/2],[2.66,2.65]],
    [[1,2,3,4]],None])
step3D = MAP([S1,S3,S2])(PROD([step2D,Q(9)]))
ramp = STRUCT(NN(9)([step3D,T([1,3])([2.66,2.5/2])]))
VIEW(ramp)
```

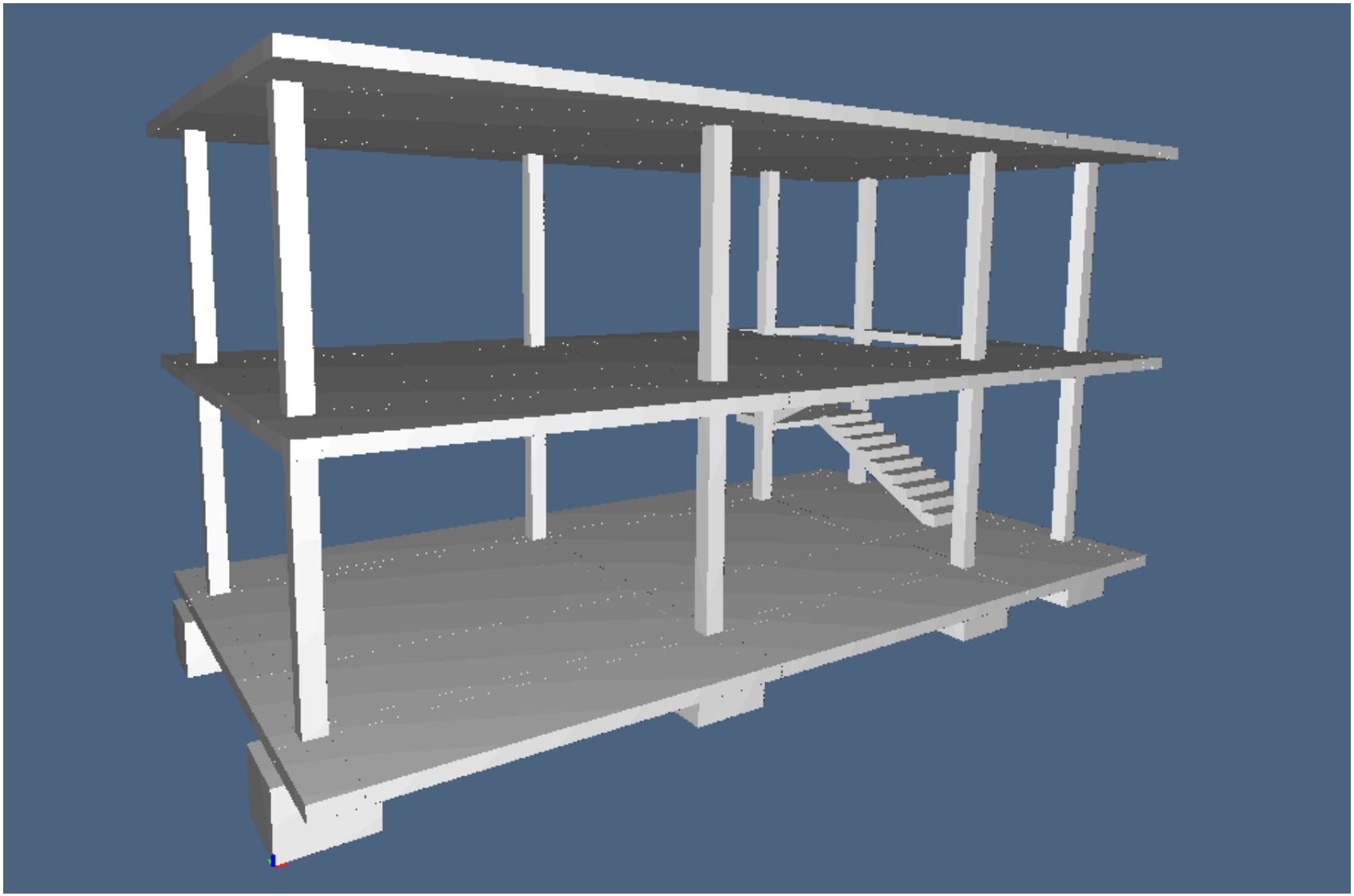


Staircases

```
ramp1 = T([1,2,3])([3+2+36+2+36+2+18,3+2+12,6])(R([1,2])(PI/2)(ramp))
ramp2 = T([1,2,3])([3+2+36+2+36+2,3+2+12+24,6+25/2])(
    R([1,2])(-PI/2)(ramp))
```

```
building = STRUCT([foundations,pillars,T(2)(-6)(horiz_partitions),
    S(3)(1.05),ramp1,ramp2])
VIEW(building)
```

Staircases

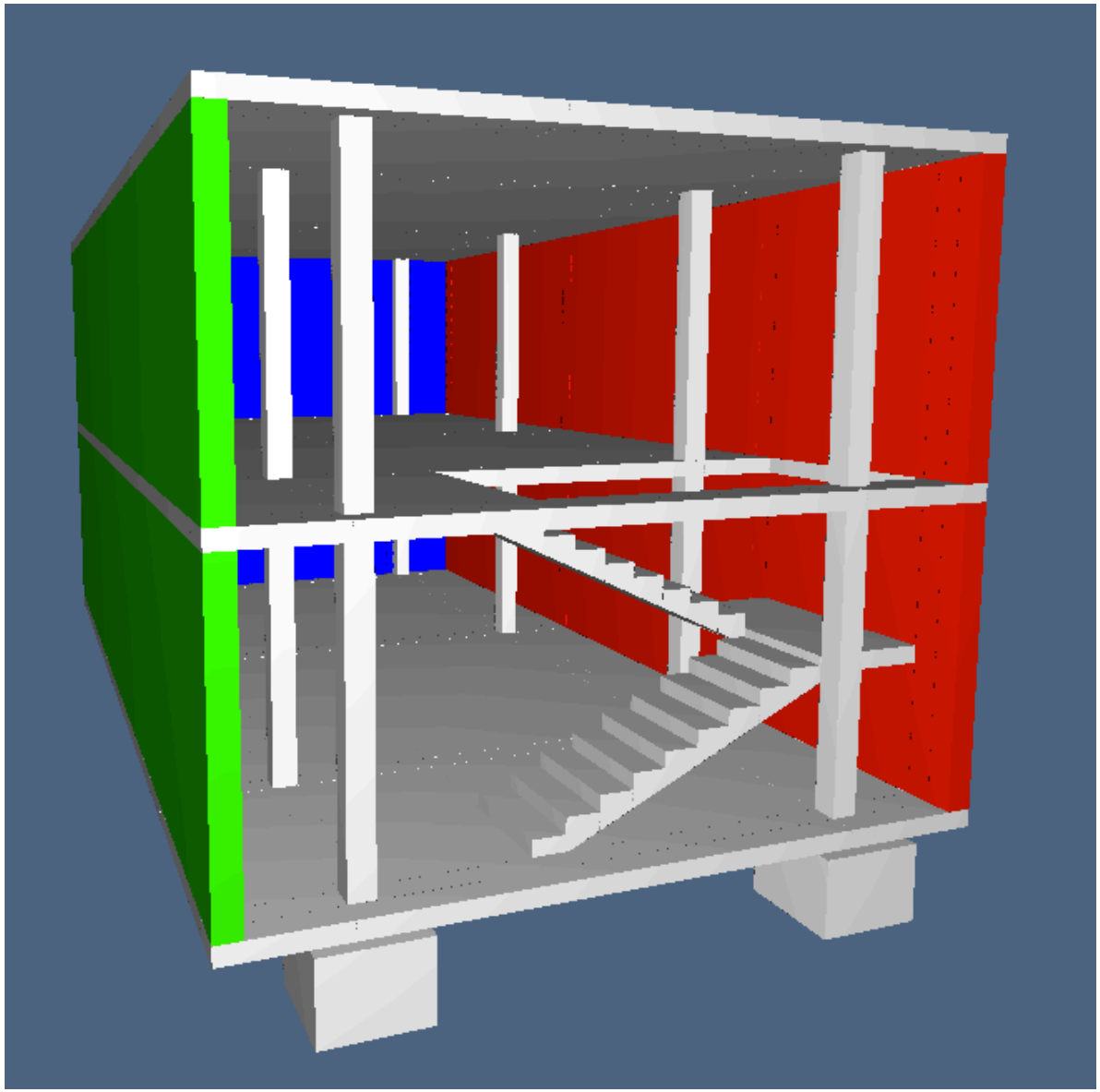


Vertical enclosures

Use colors to visually differentiate the external walls

```
enclosure_north = COLOR(RED)(GRID([[-1,2,2,36,2,36,2,18,2,2],
    [-5,-2,-12,-24,-7,2], [-6,-1.4,23.6,-1.4,23.6,-1.4]]))

enclosure_south = COLOR(GREEN)(GRID([[-1,2+2+36+2+36+2+18+2+2],
    [2], [-6,-1.4,23.6,-1.4,23.6,-1.4]]))

enclosure_west = COLOR(BLUE)(GRID([[-1,2],[-2,4,2,36,2,4,6],
    [-6,-1.4,23.6,-1.4,23.6,-1.4]]))

building = STRUCT([foundations,pillars,T(2)(-6)(horiz_partitions),
    ramp1,ramp2,enclosure_north,
    T(2)(-6)(enclosure_south),T(2)(-6)(enclosure_west)])

VIEW(building)
```

Vertical enclosures



Internal partitions

```
wall01 = COLOR(YELLOW)(T([1,2])([3+2+36+2+36+1, 3+2+12])(
    GRID([[1],[24,-2,7],[-6,-1.4,23.6,-1.4,23.6]])))
building = STRUCT([foundations,pillars,T(2)(-6)(horiz_partitions),
    ramp1,ramp2, enclosure_north,T(2)(-6)(enclosure_south),
    T(2)(-6)(enclosure_west), wall01])
VIEW(building)
```

Internal partitions