



# SMiA

Structural Morphology in Architecture



**LiTA. Architecture Technology and Innovation Laboratory**

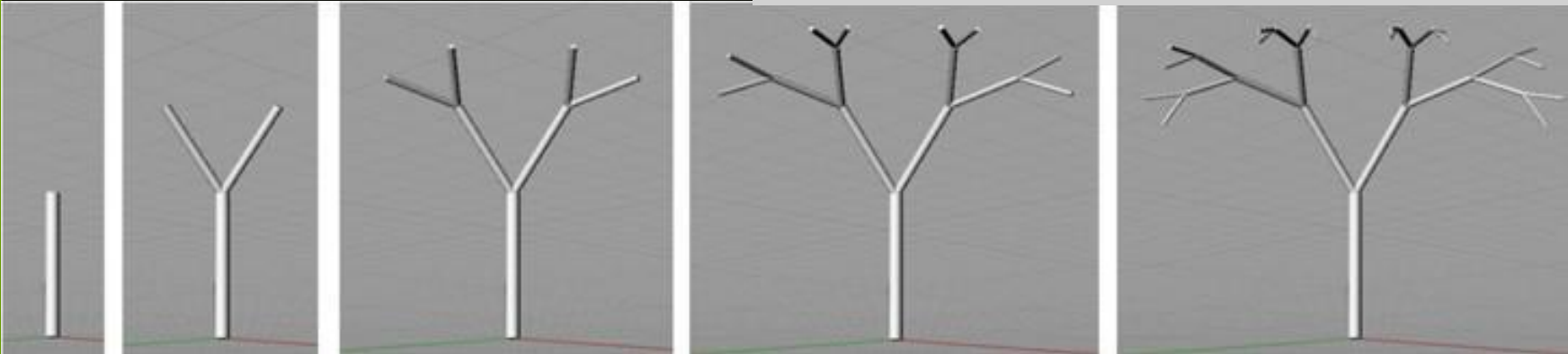
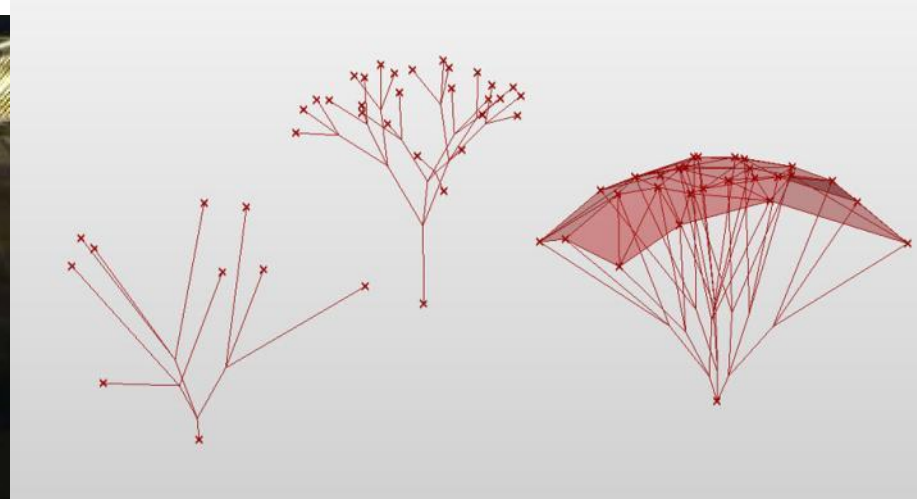
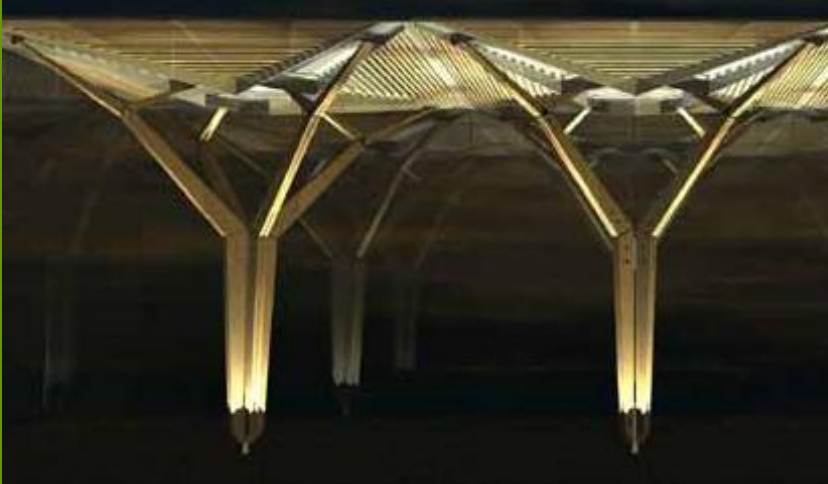
UNIVERSITAT POLITÈCNICA DE CATALUNYA

# TREE LIKE STRUCTURES



## TREE LIKE STRUCTURES

## OBJETIVE



Understand **the concept of reciprocal structure**

Study the **morphology**

Explore the formation of structural systems with a **groupings modules reciprocal**

## TREE LIKE STRUCTURES

## TOPICS

1. Concept: Tree like structure
2. Background
3. Morphology - iterations
4. Different Branching Patterns
5. Groupings of Tree like structures
6. Knots
7. Recent Research- Form finding



## TREE LIKE STRUCTURES



**1. DEFINITION:  
Reciprocal frame structure**

## TREE LIKE STRUCTURES

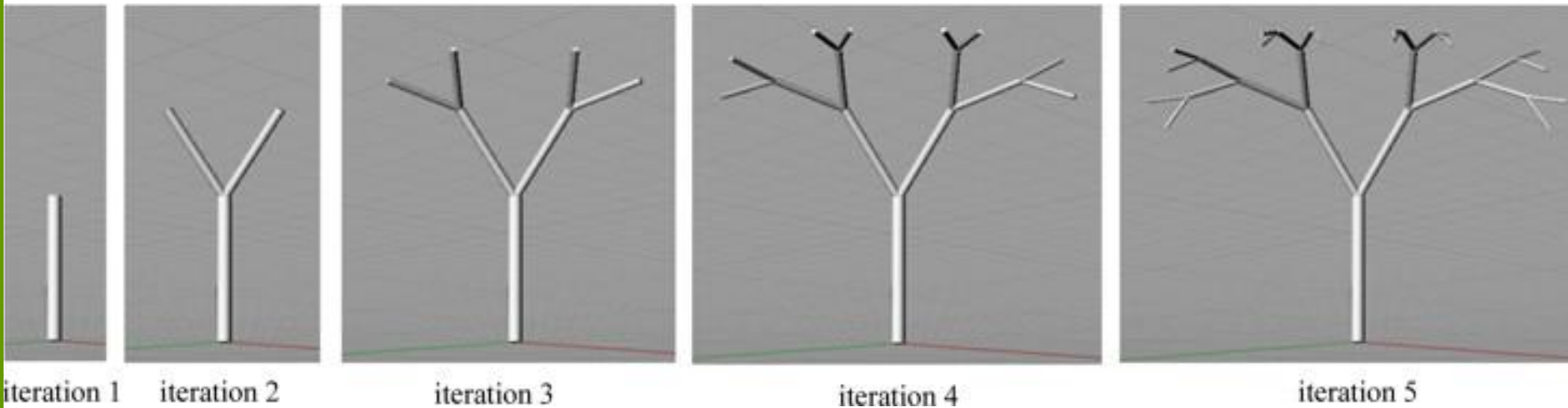
### 1. Concept: Tree like structure



**Treeform architecture** is based on natural forms such as where a tree's foliage serves as the roof. The branches and trunk are the support structure.

## TREE LIKE STRUCTURES

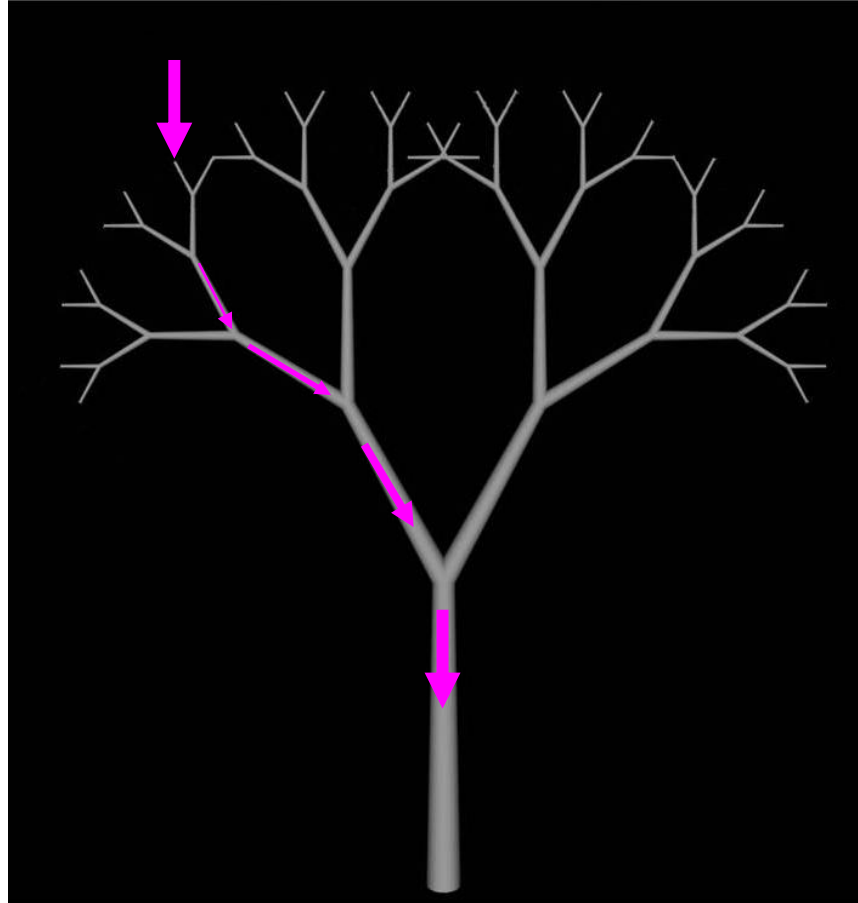
### 1. Concept: Tree like structure



**Branched supports are flat or spatial structural systems which consist of **separate branches**, each one of which forks out at a specific point (knot) **into at least two other branches**. Such structures can be subjected to tension, to compression, to flexion and to torsion.**

## TREE LIKE STRUCTURES

### 1. Concept: Tree like structure



Tree structures provide an efficient way to **transfer large surface loads** to a single point on the ground.



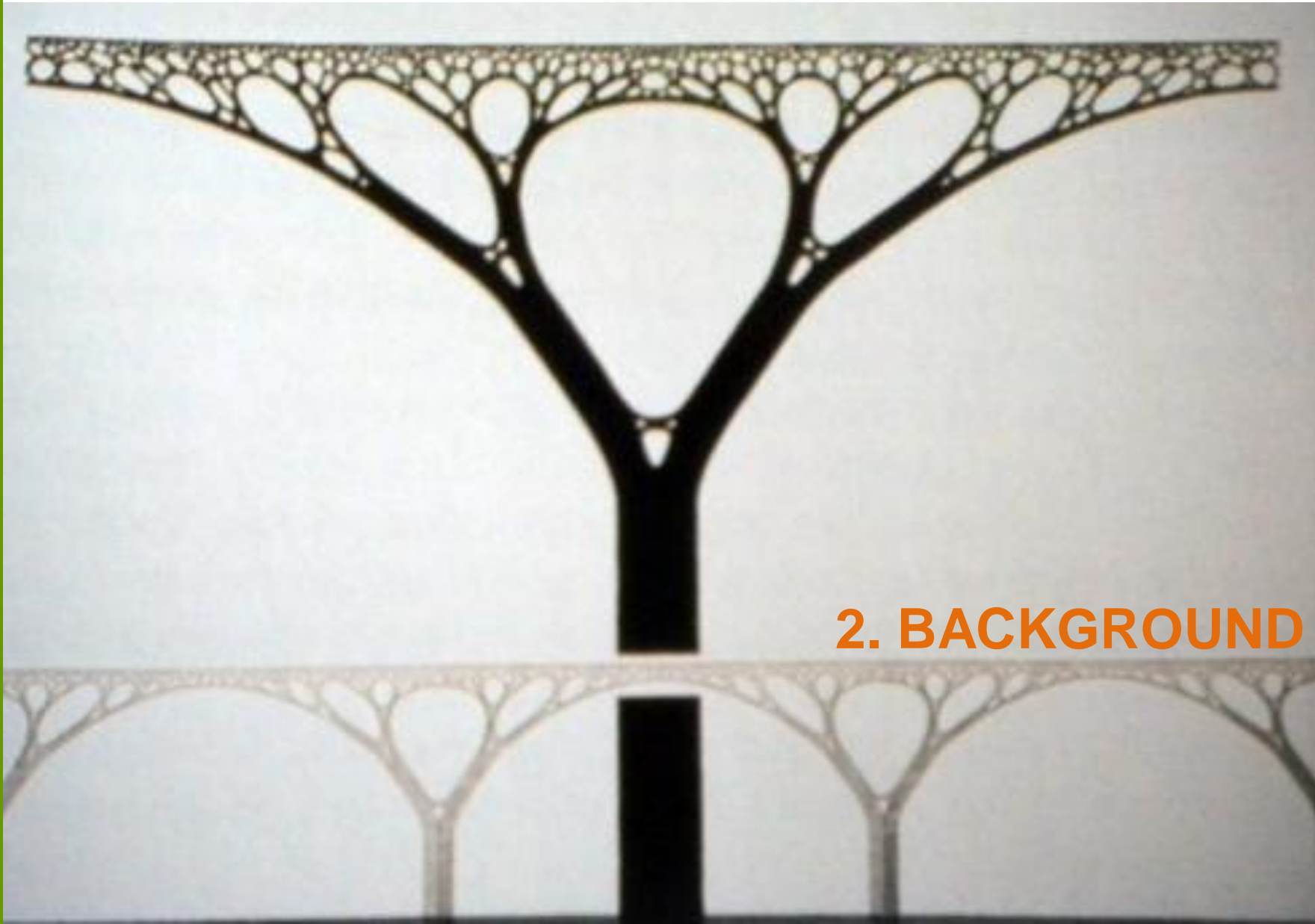
## TREE LIKE STRUCTURES

### 1. Concept: Tree like structure



**The use of branched structures enables the use of thinner structural members and covering larger spans (Otto, F. and Rasch, B., 1995).**

## TREE LIKE STRUCTURES



## 2. BACKGROUND

## TREE LIKE STRUCTURES

### 2. Background



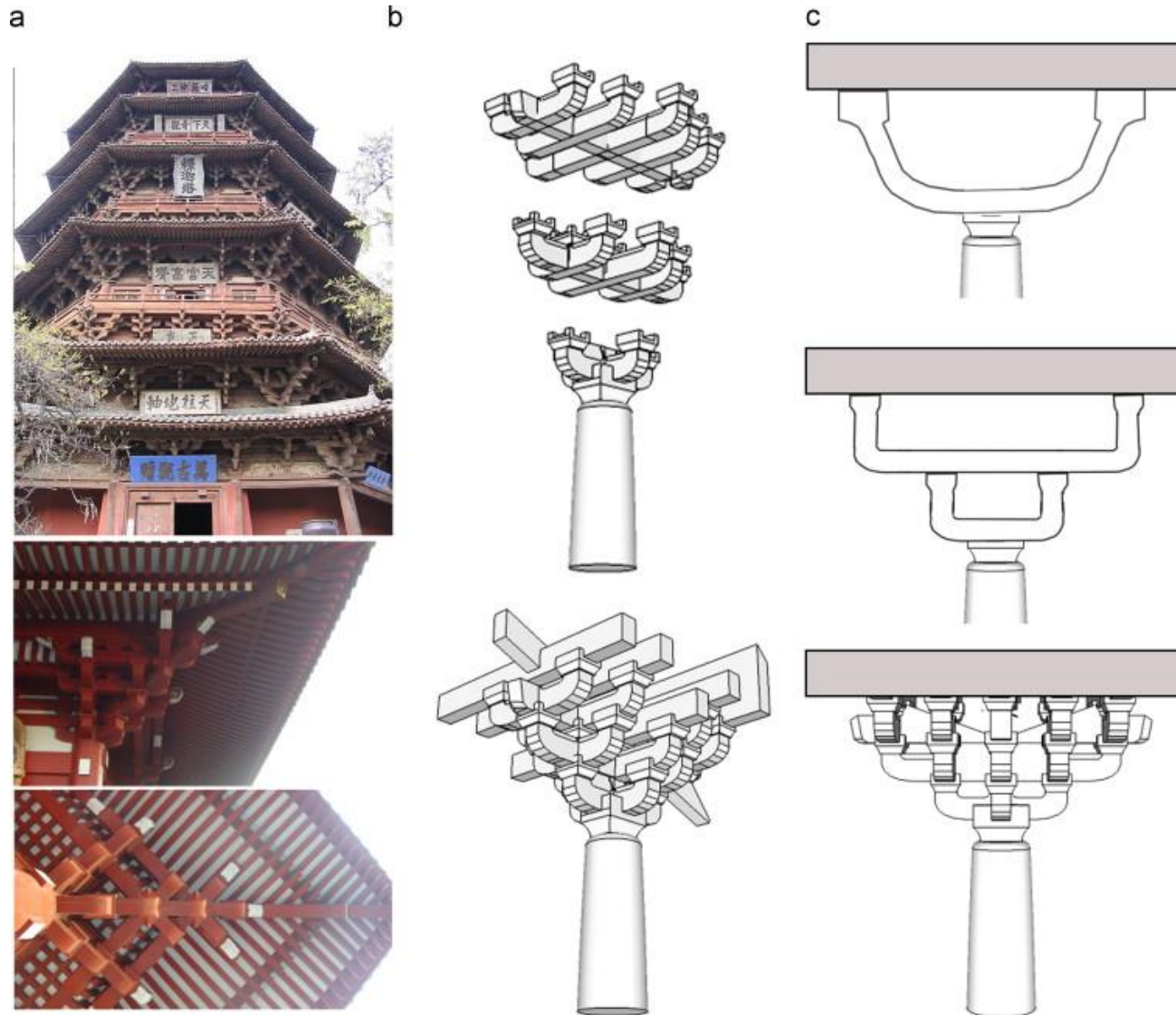
Rome built in 126 A.D

In post-Roman periods, we find many other examples of mimicking trees and plants as esthetic and decorative features

## TREE LIKE STRUCTURES

### 2. Background

One of the first examples of a true wooden dendriforms are the Chinese Dougong Brackets,



The Sakyamuni Pagoda of Fogong Temple, 1056 AD

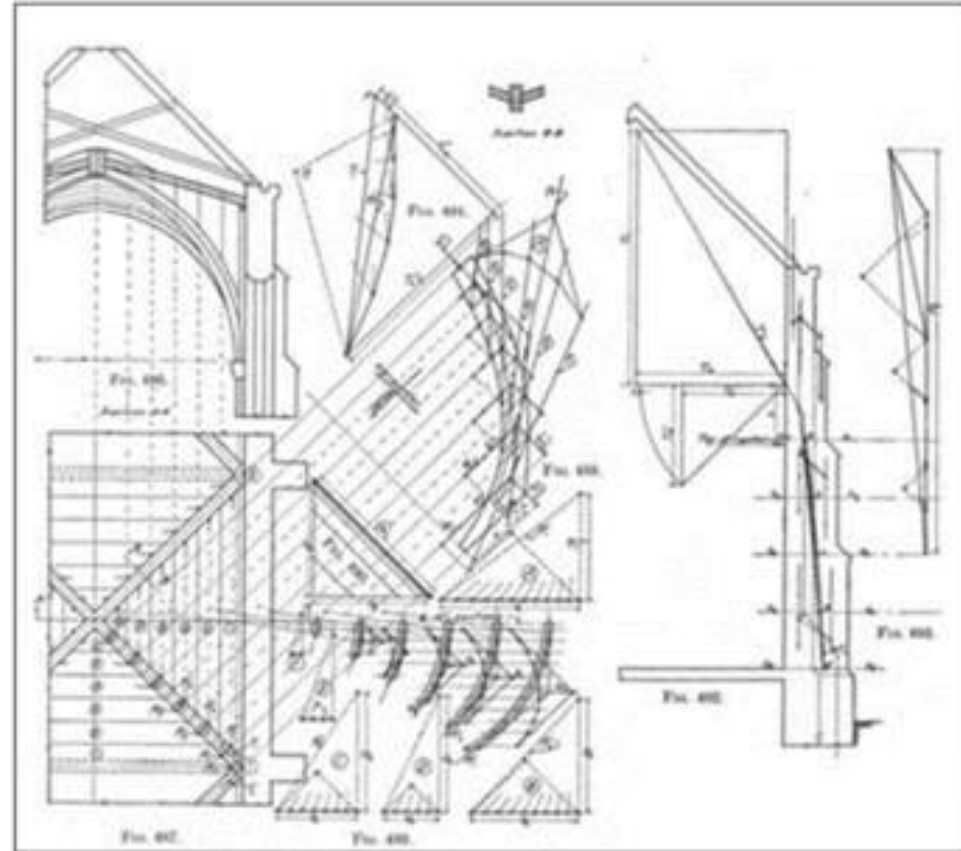
## TREE LIKE STRUCTURES

### 2. Background

a



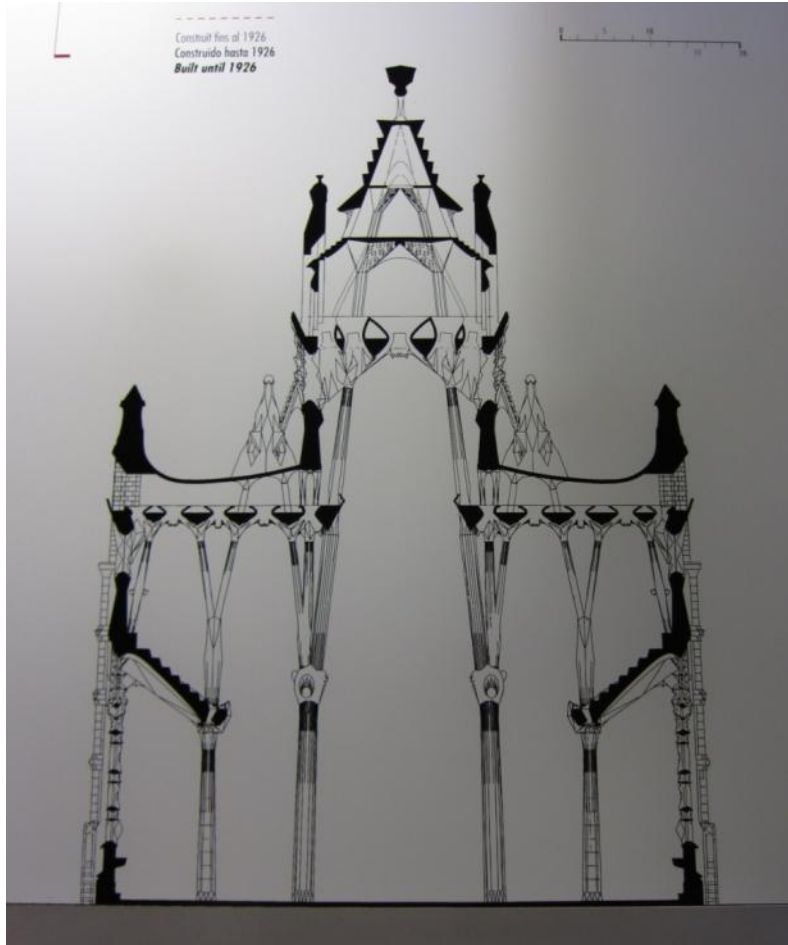
b



King 's College en Cambridge. Fan vaults were inspired by the structural appearance of a tree

## TREE LIKE STRUCTURES

### 2. Background



Gaudi's treelike. Sagrada Familia

## TREE LIKE STRUCTURES

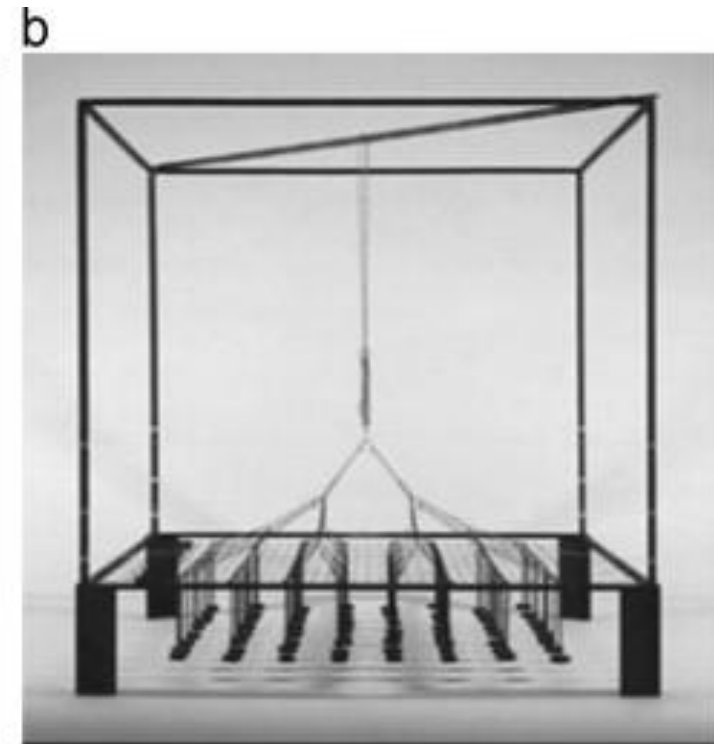
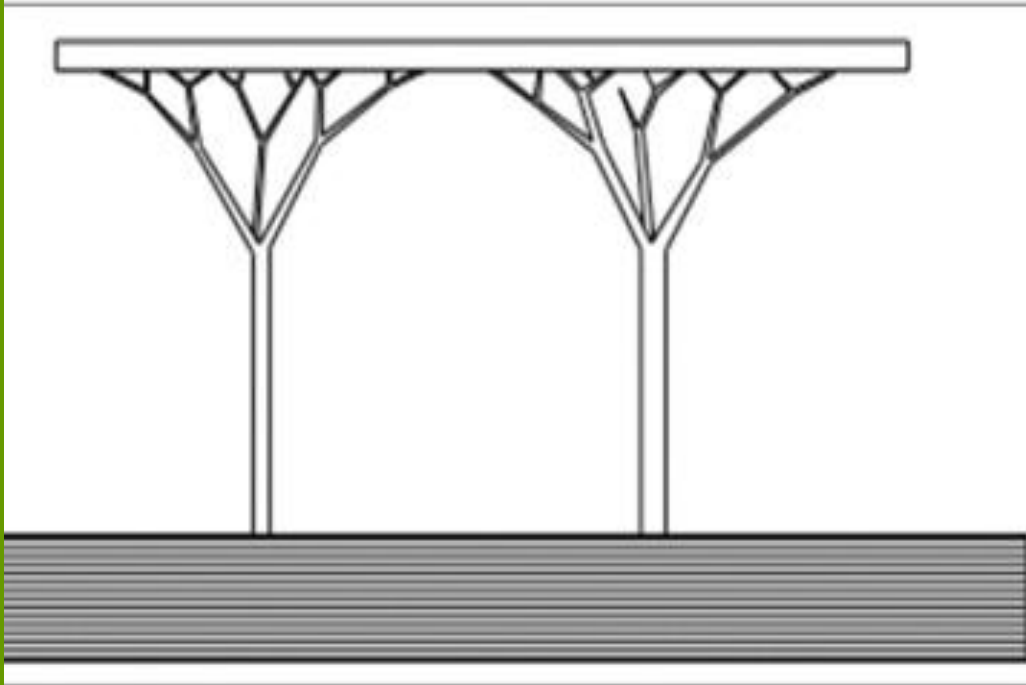
### 2. Background



Gaudi's treelike. Sagrada Familia

## TREE LIKE STRUCTURES

### 2. Background

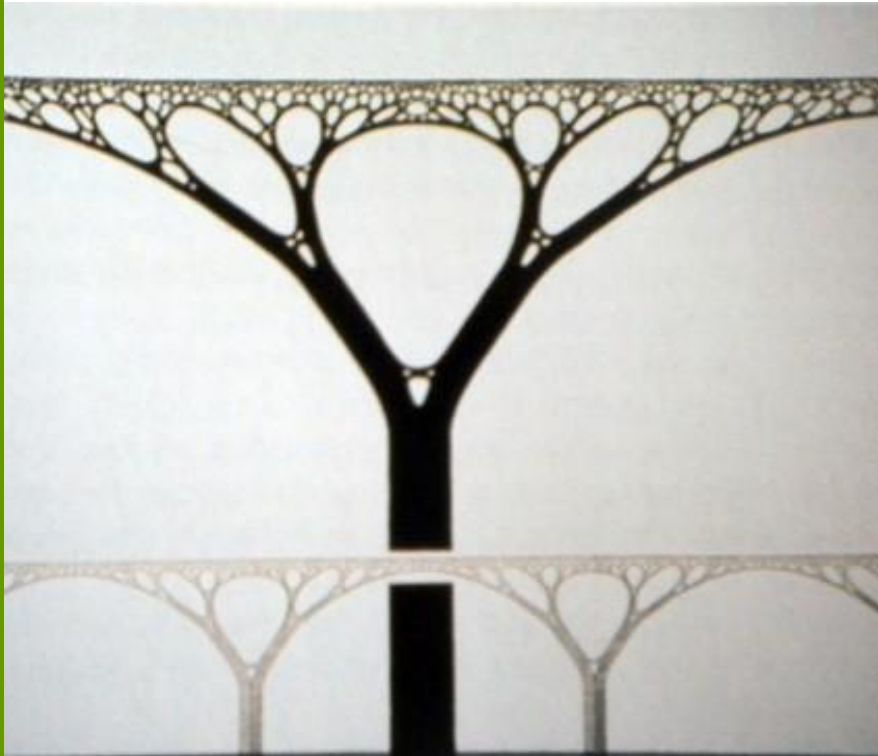


Otto's experiments with 'branching' structure: 1970s



## TREE LIKE STRUCTURES

### 2. Background



Otto's experiments with 'branching' structure: 1970s

# Structural Morphology in Architecture



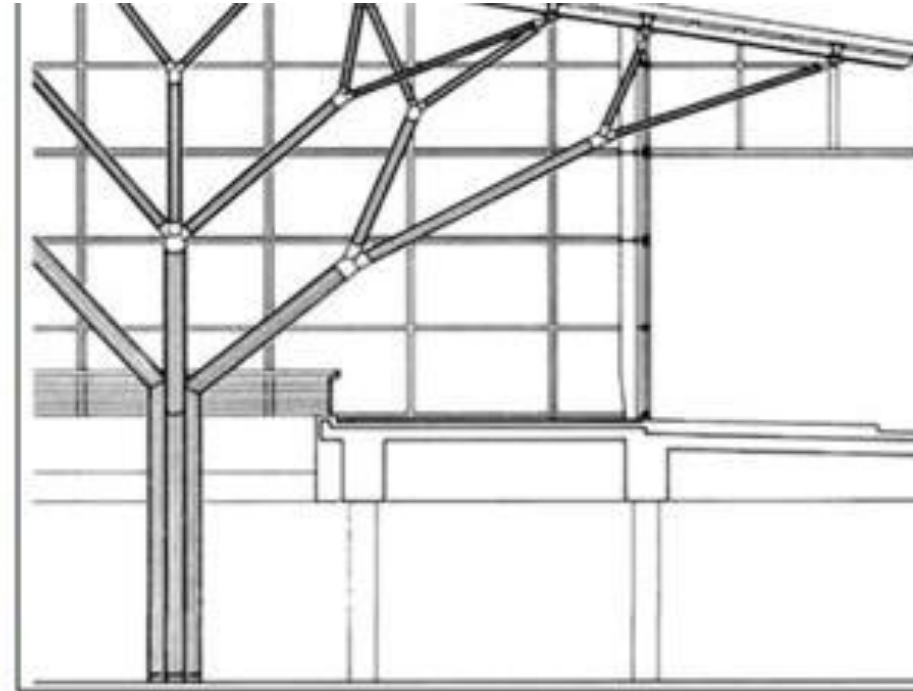
## TREE LIKE STRUCTURES

### 2. Background



## TREE LIKE STRUCTURES

### 2. Background



Stuttgart Airport Terminal building built in 1992

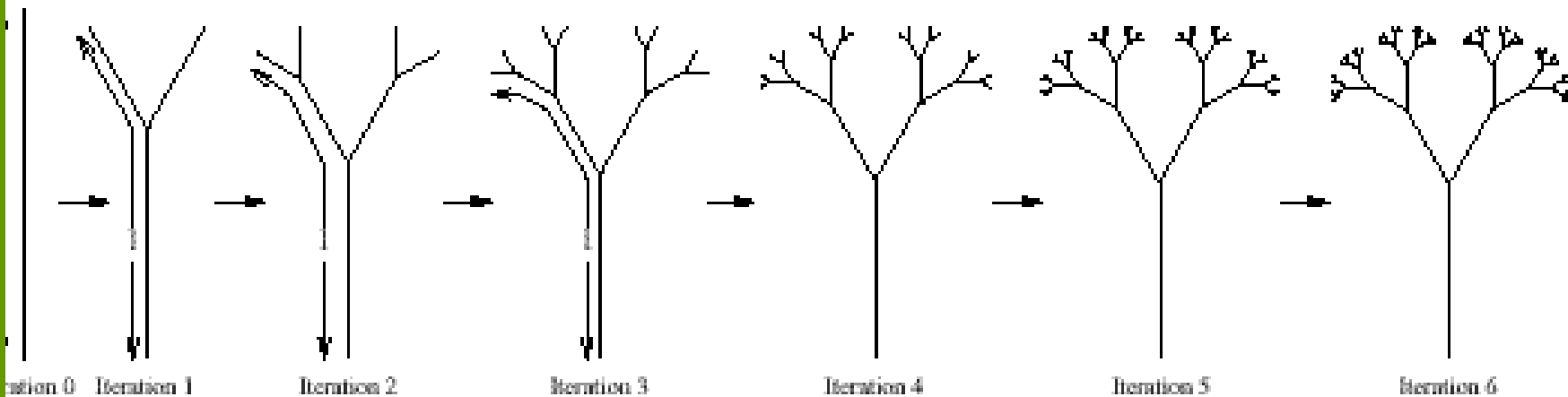
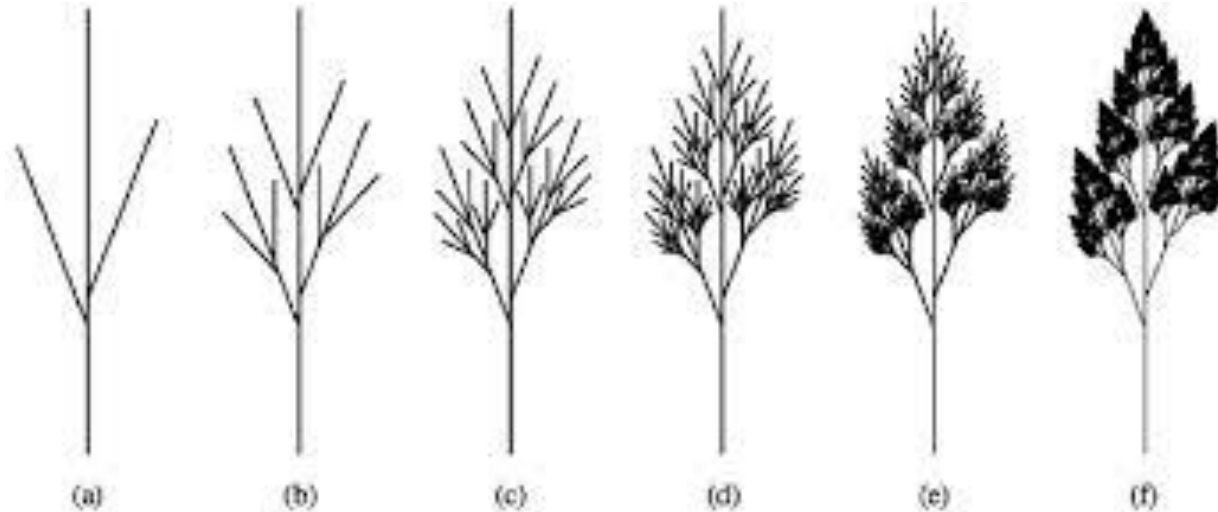
## TREE LIKE STRUCTURES

### 3. MORPHOLOGY



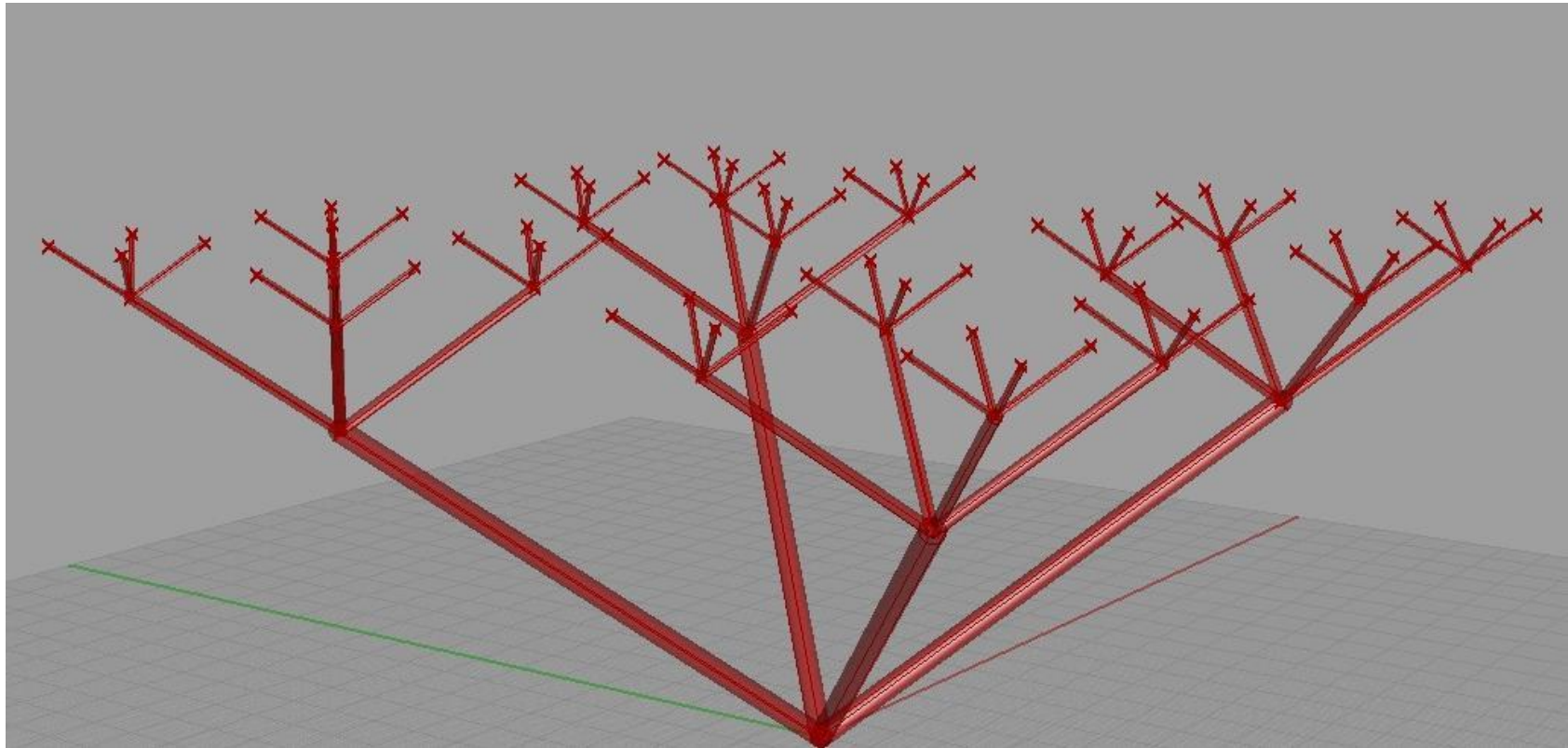
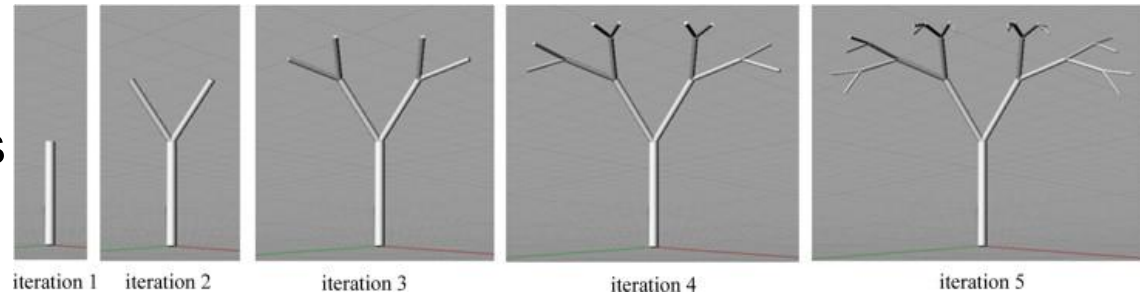
## TREE LIKE STRUCTURES

### 3. Morphology - iterations



## TREE LIKE STRUCTURES

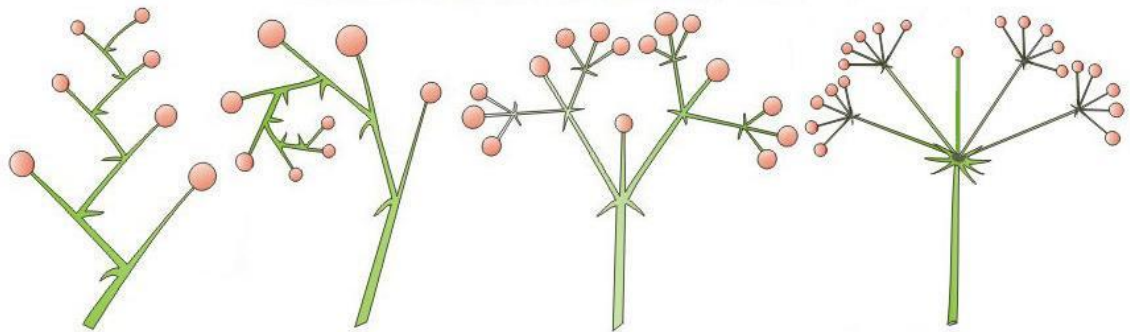
### 3. Morphology - iterations



## TREE LIKE STRUCTURES



## 4. DIFFERENT BRANCHING PATTERNS

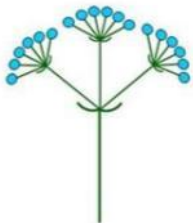


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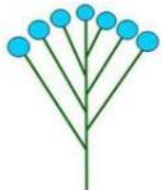
### 4. Different Branching Patterns



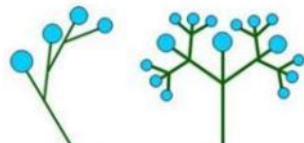
umbela



umbela compuesta



corimbo



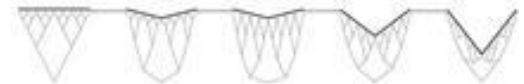
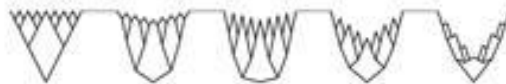
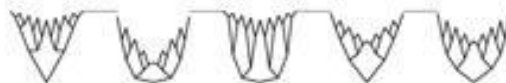
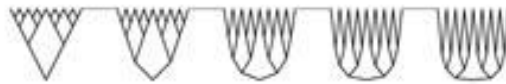
cima escorpioidea

dicasio

cimas

branching

surfaces

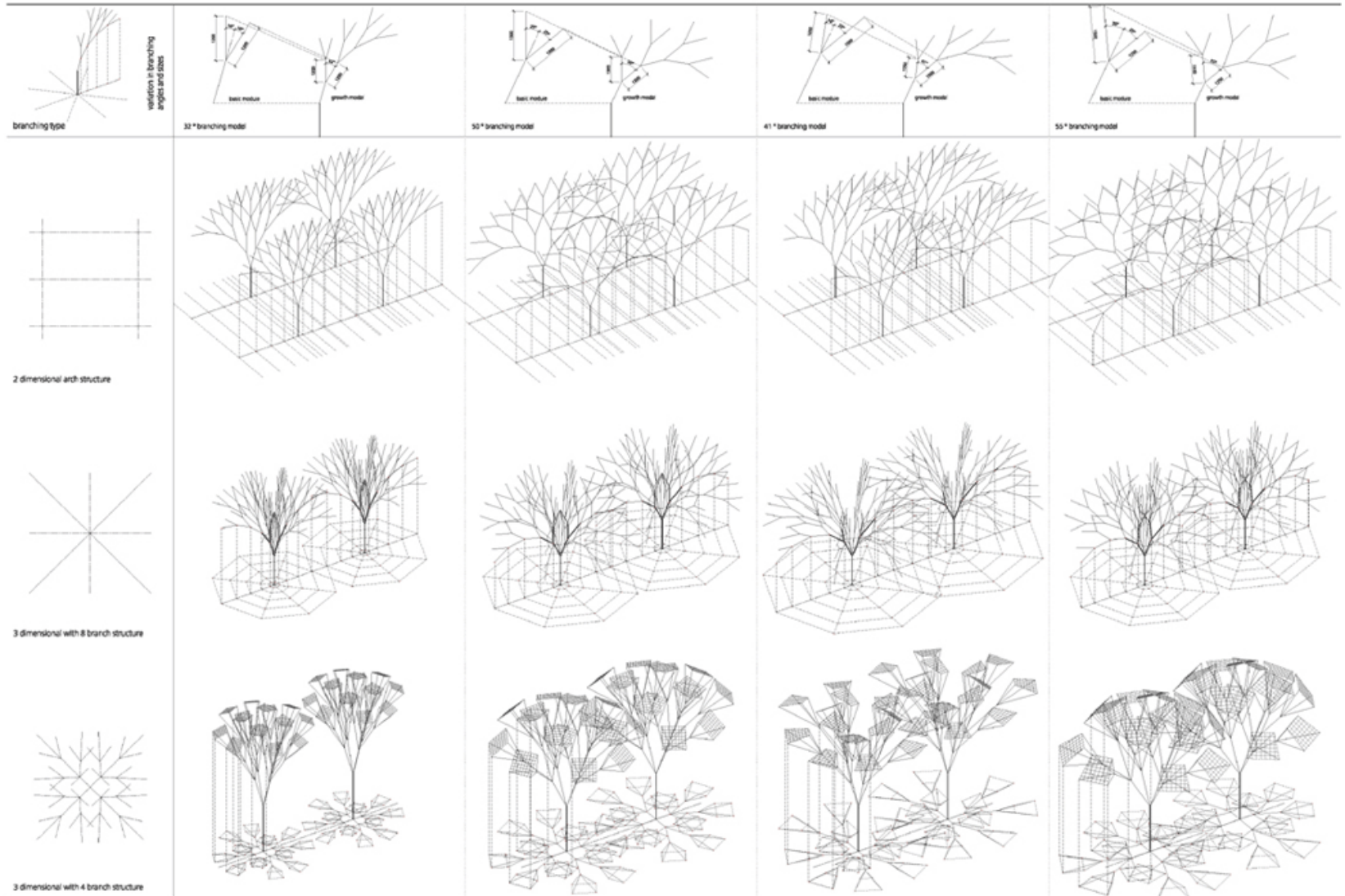




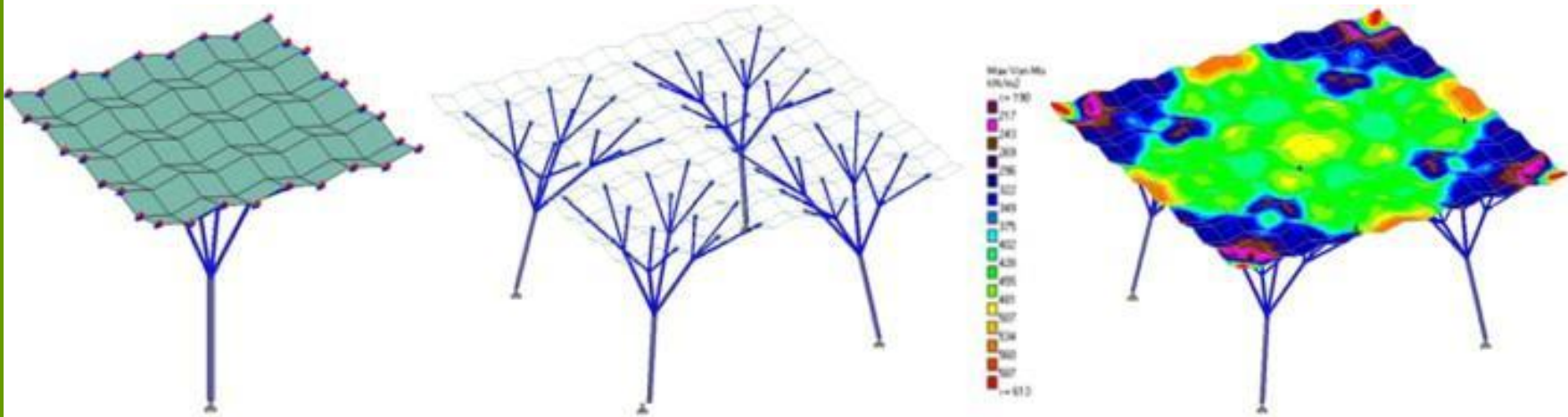


## TREE LIKE STRUCTURES

### 4. Different Branching Patterns



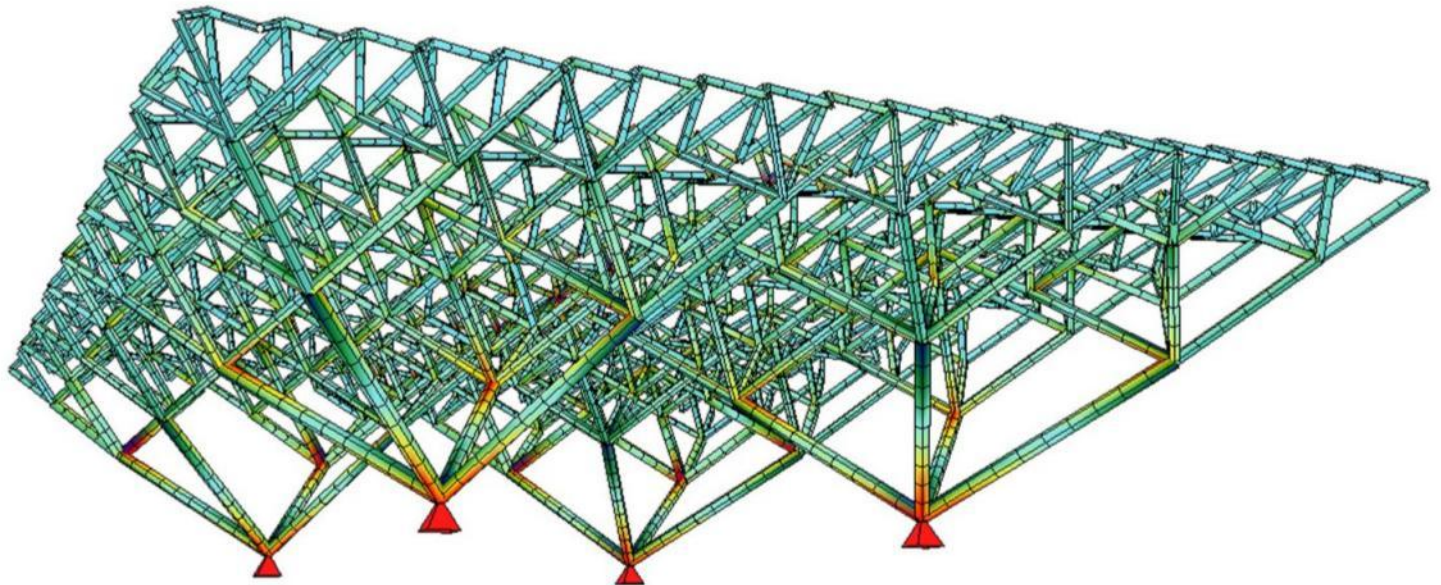
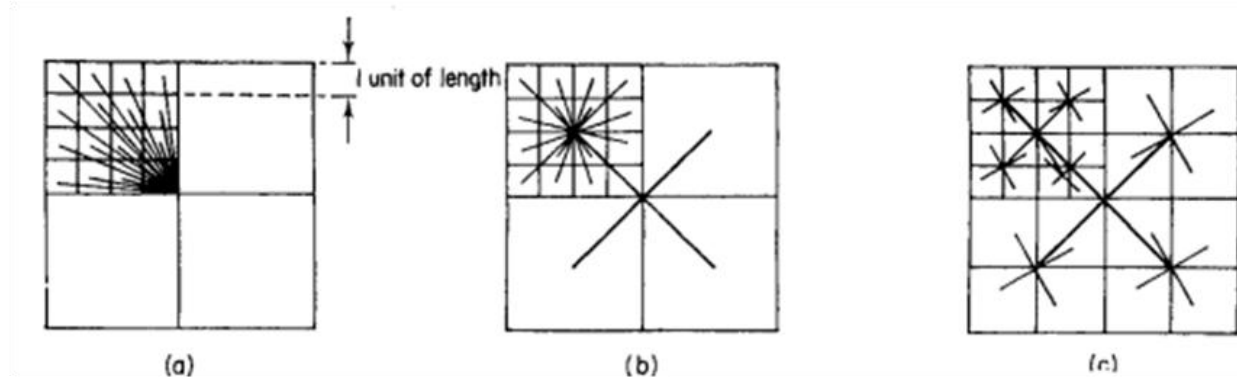
## TREE LIKE STRUCTURES



## 5. GROUPINGS OF TREE LIKE STRUCTURES

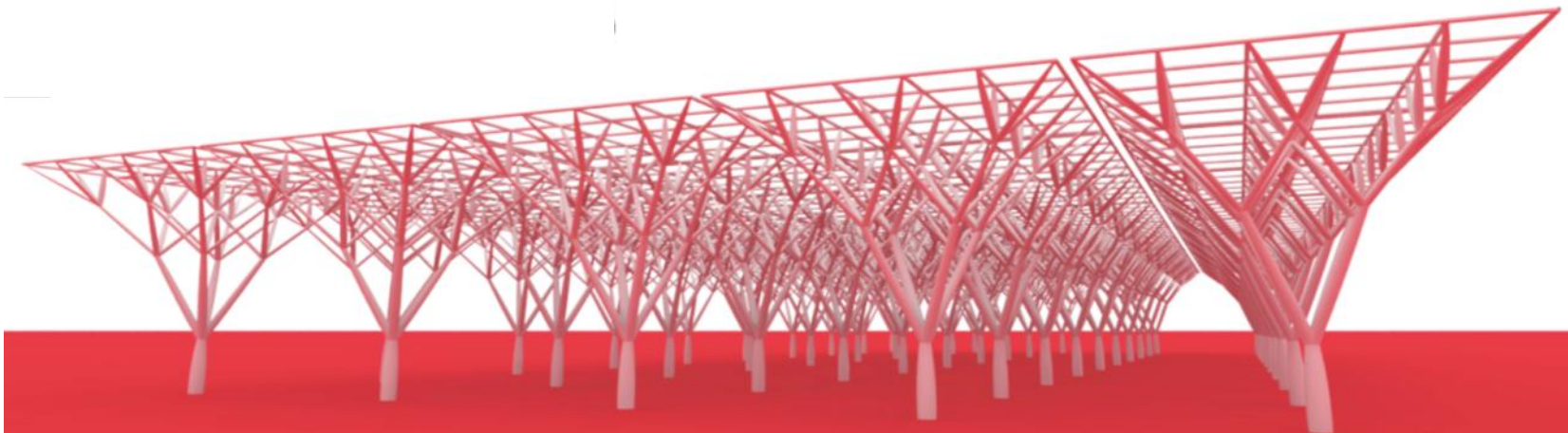
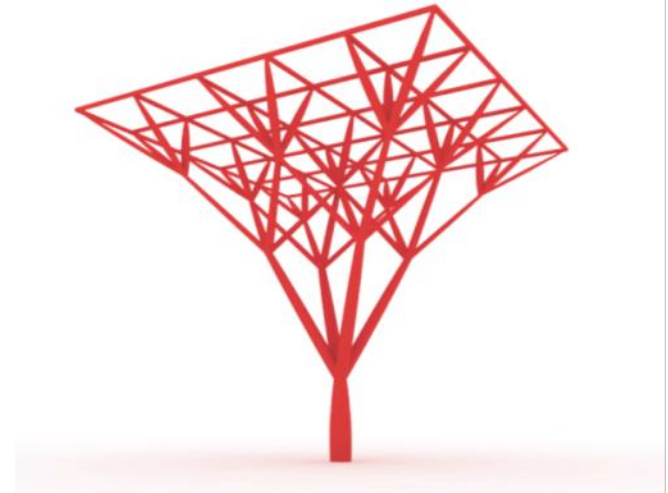
## TREE LIKE STRUCTURES

### 5. Groupings of Tree like structures



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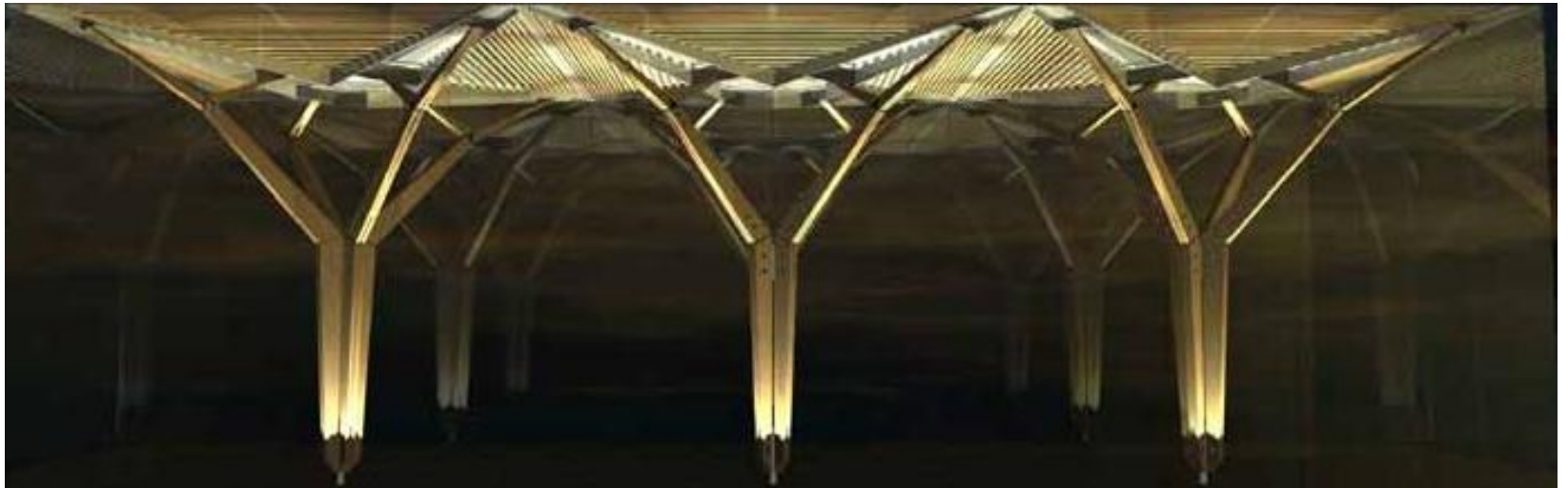
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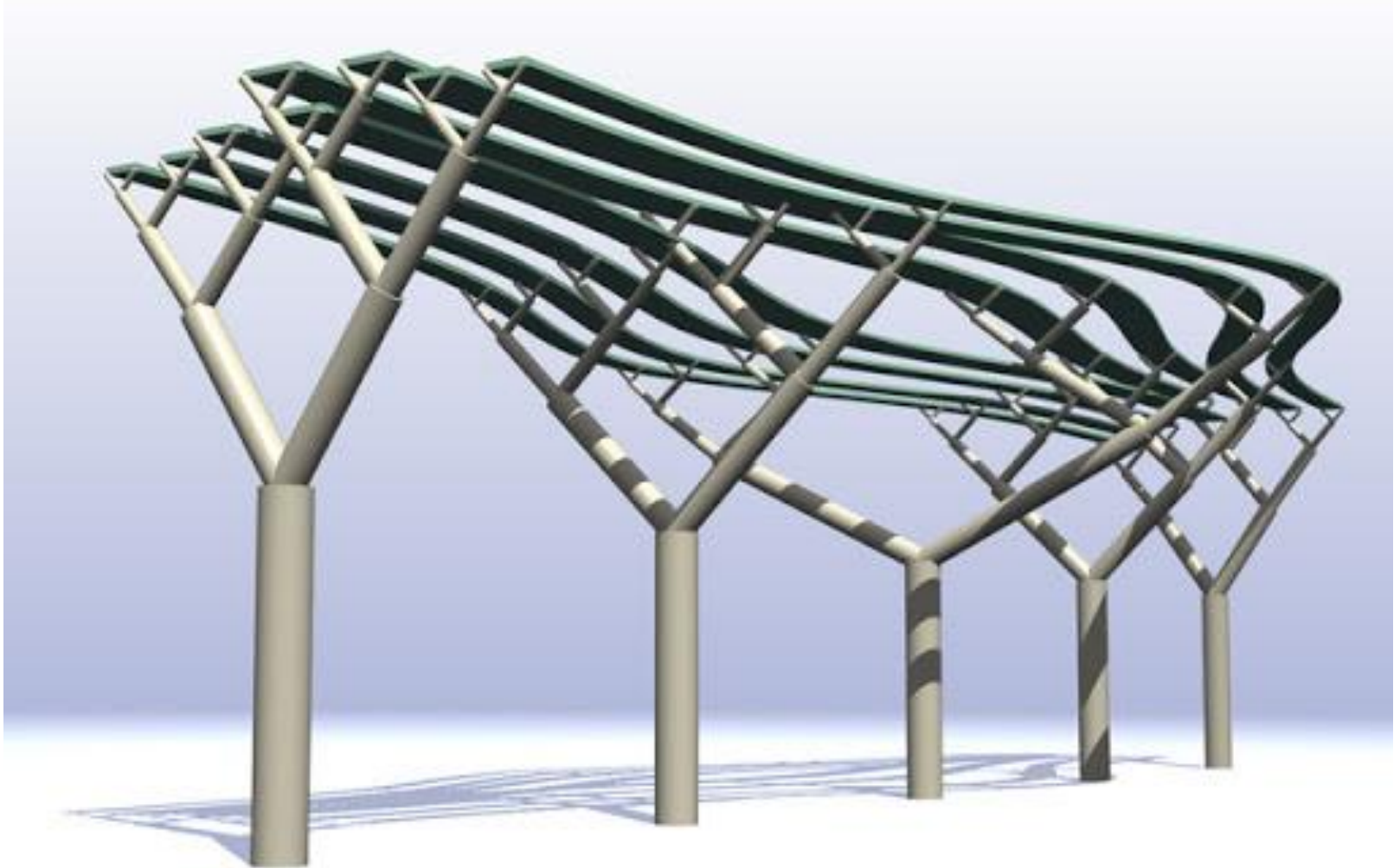
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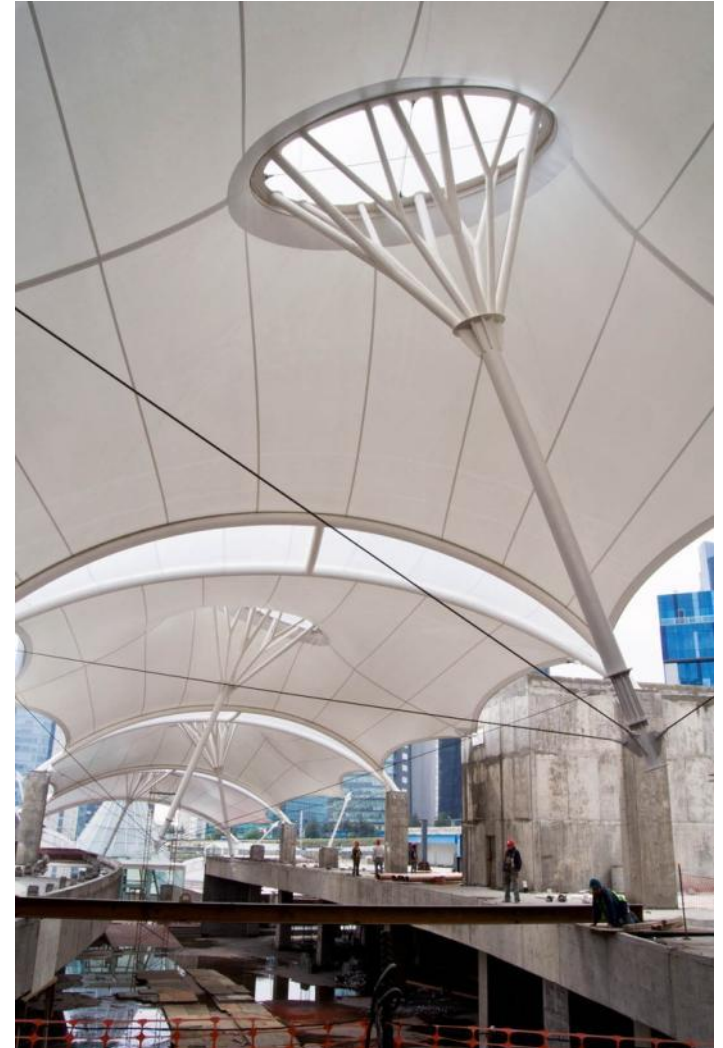
### 5. Groupings of Tree like structures





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L'arbre de Flonville

## TREE LIKE STRUCTURES

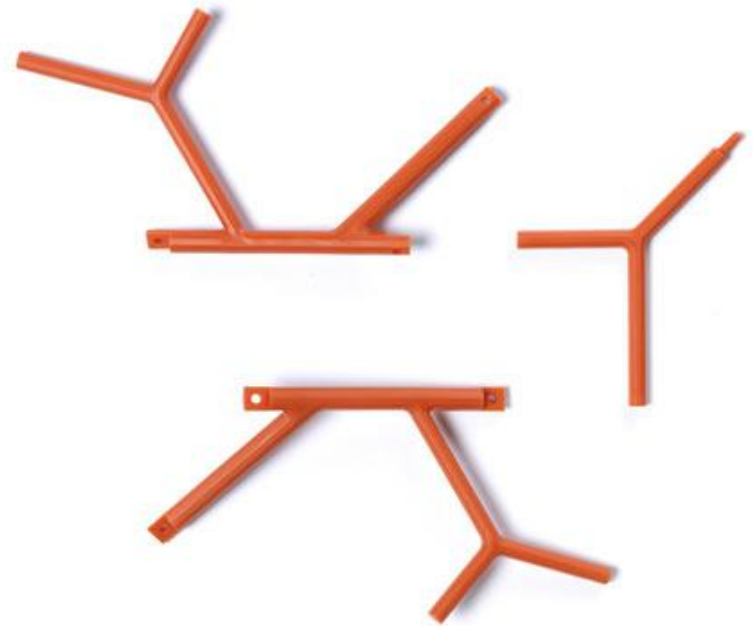
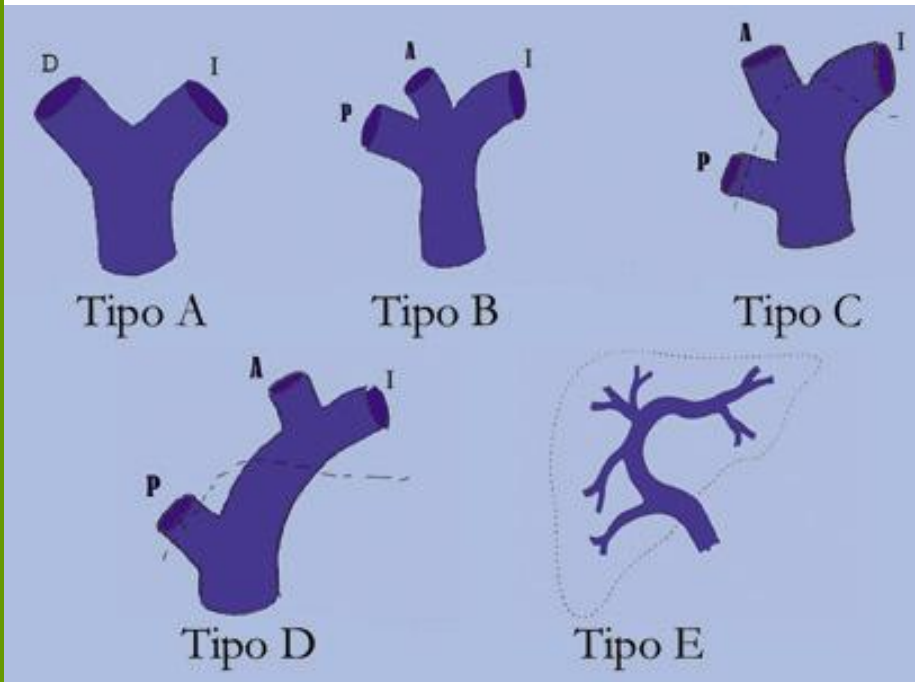


**6. KNOTS**

# Structural Morphology in Architecture

## TREE LIKE STRUCTURES

### 6. Knots



# Structural Morphology in Architecture

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### 6. Knots



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# Structural Morphology in Architecture

## TREE LIKE STRUCTURES

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# Structural Morphology in Architecture

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## TREE LIKE STRUCTURES

### 6. Knots



# Structural Morphology in Architecture

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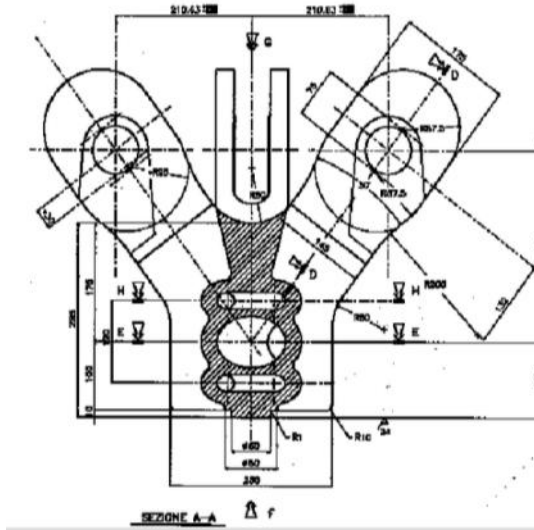
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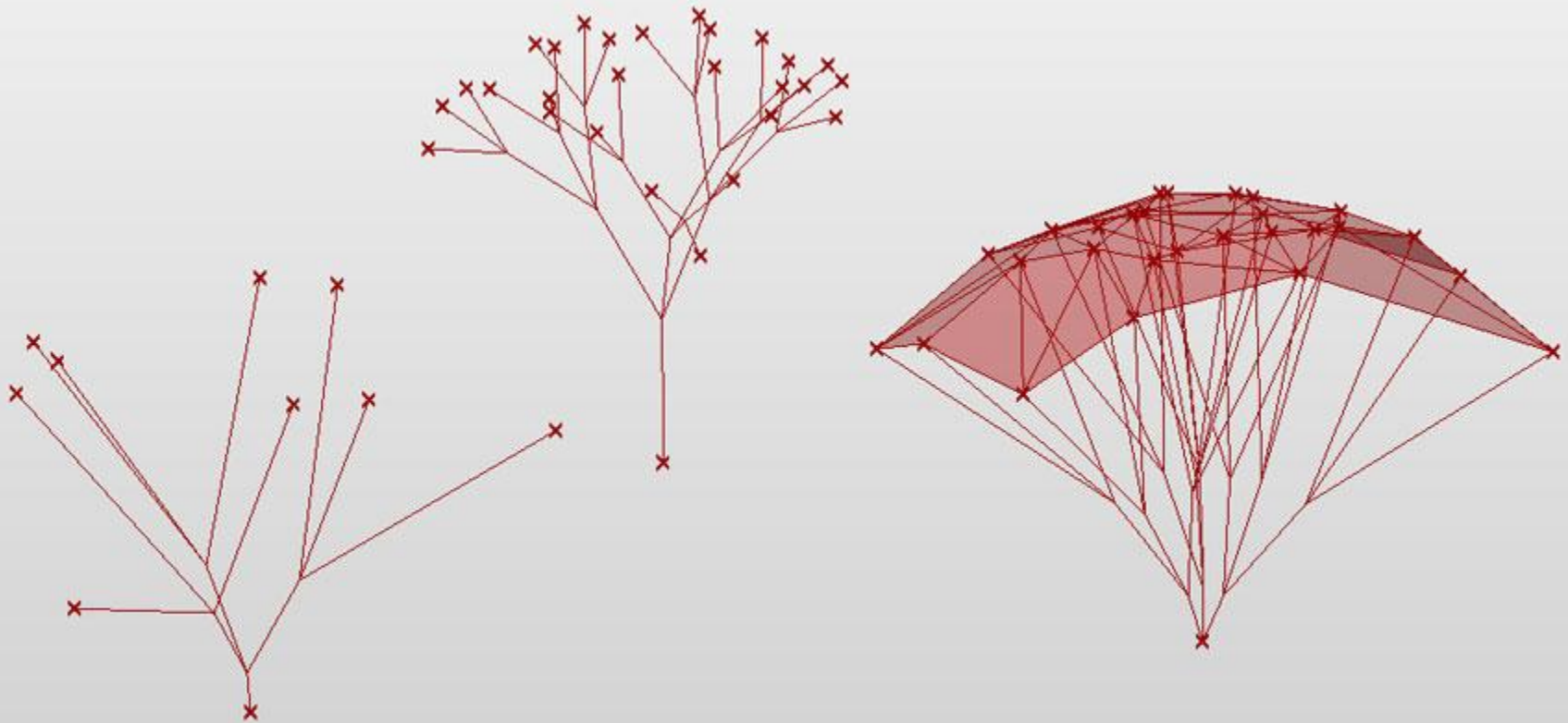
# Structural Morphology in Architecture

## TREE LIKE STRUCTURES

### 6. Knots



## TREE LIKE STRUCTURES

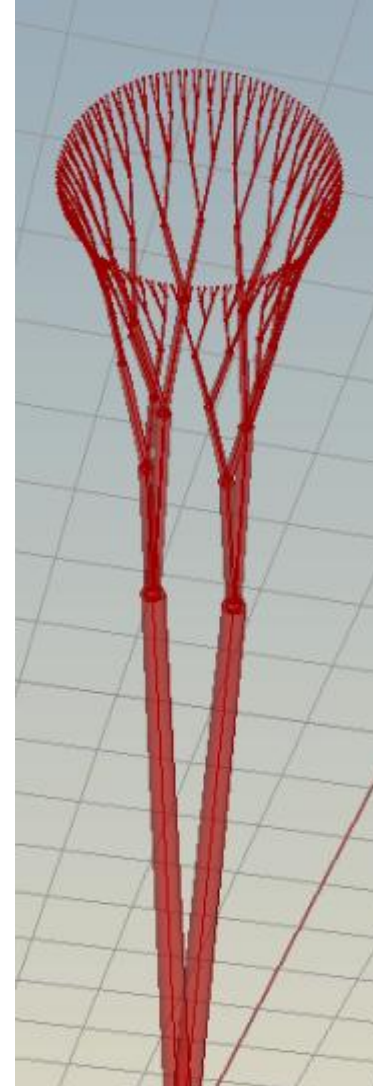
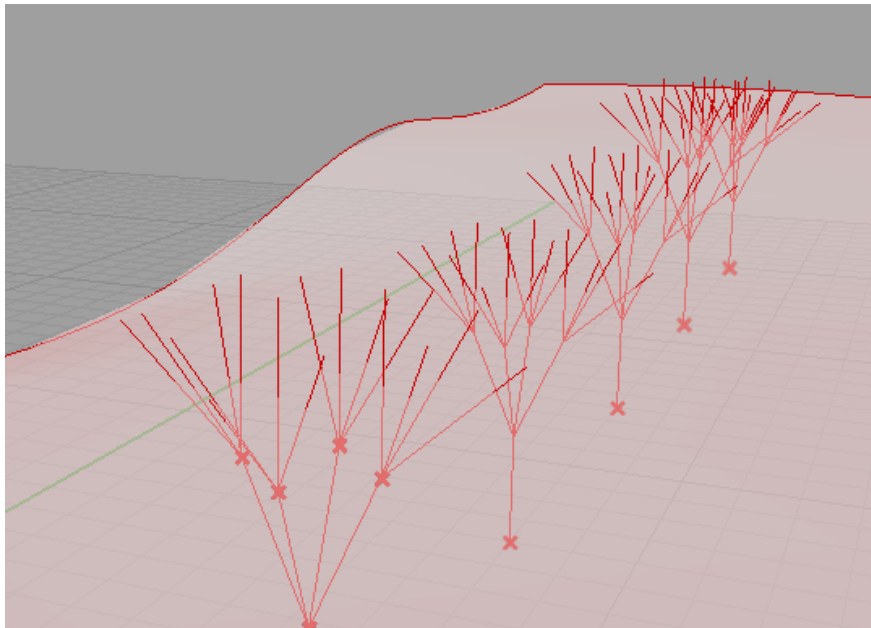
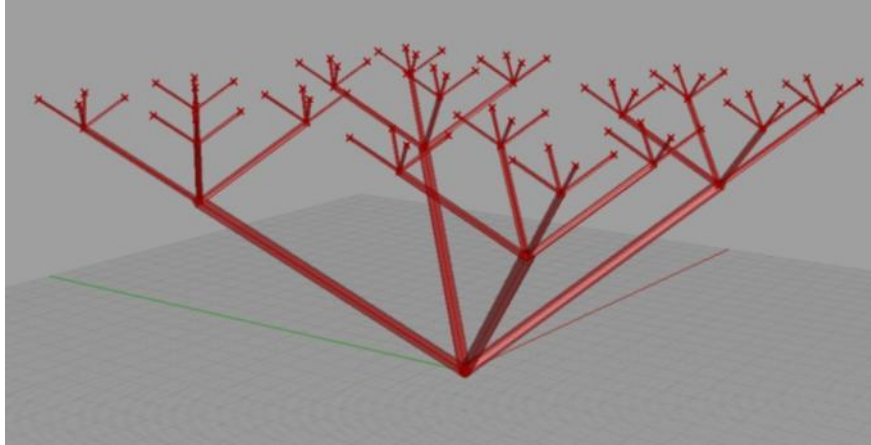


**6. RECENT RESEARCH- FORM FINDING**

# Structural Morphology in Architecture

## TREE LIKE STRUCTURES

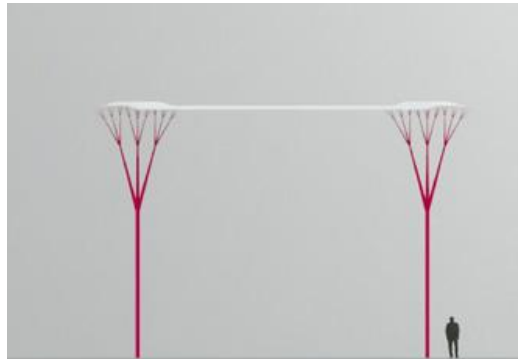
### 6. Recent Research- Form finding



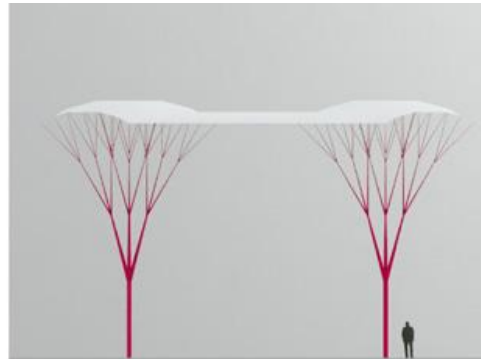
# Structural Morphology in Architecture

## TREE LIKE STRUCTURES

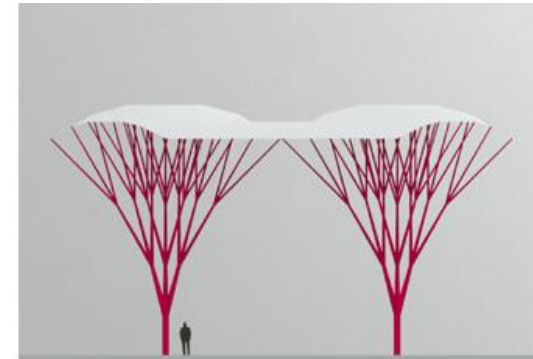
### 6. Recent Research- Form finding



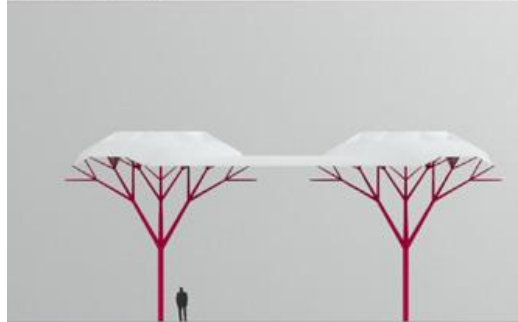
Branching study #1



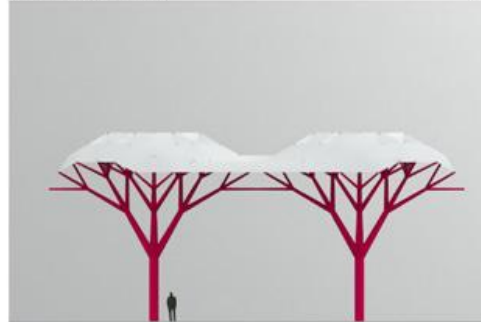
Branching study #1



Branching study #3



Branching study #4



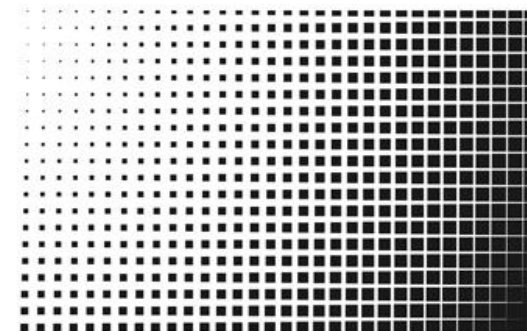
Branching study #5



Branching study #6

# Branching studies

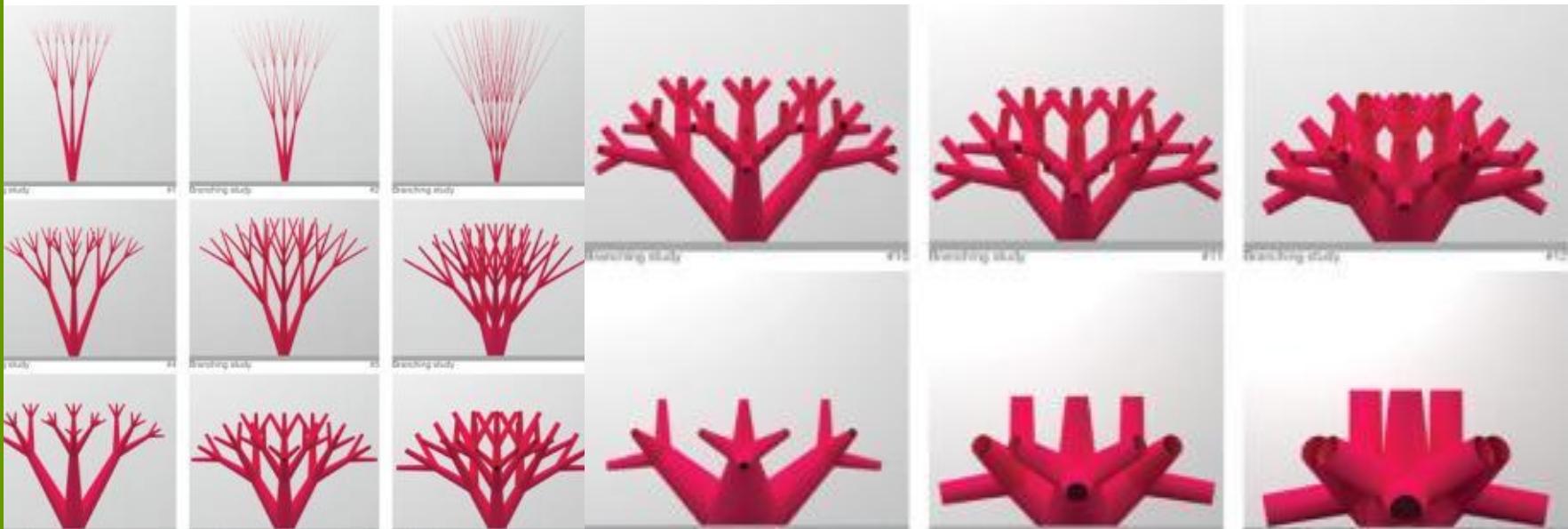
<http://morphocode.com>



# Structural Morphology in Architecture

## TREE LIKE STRUCTURES

### 6. Recent Research- Form finding





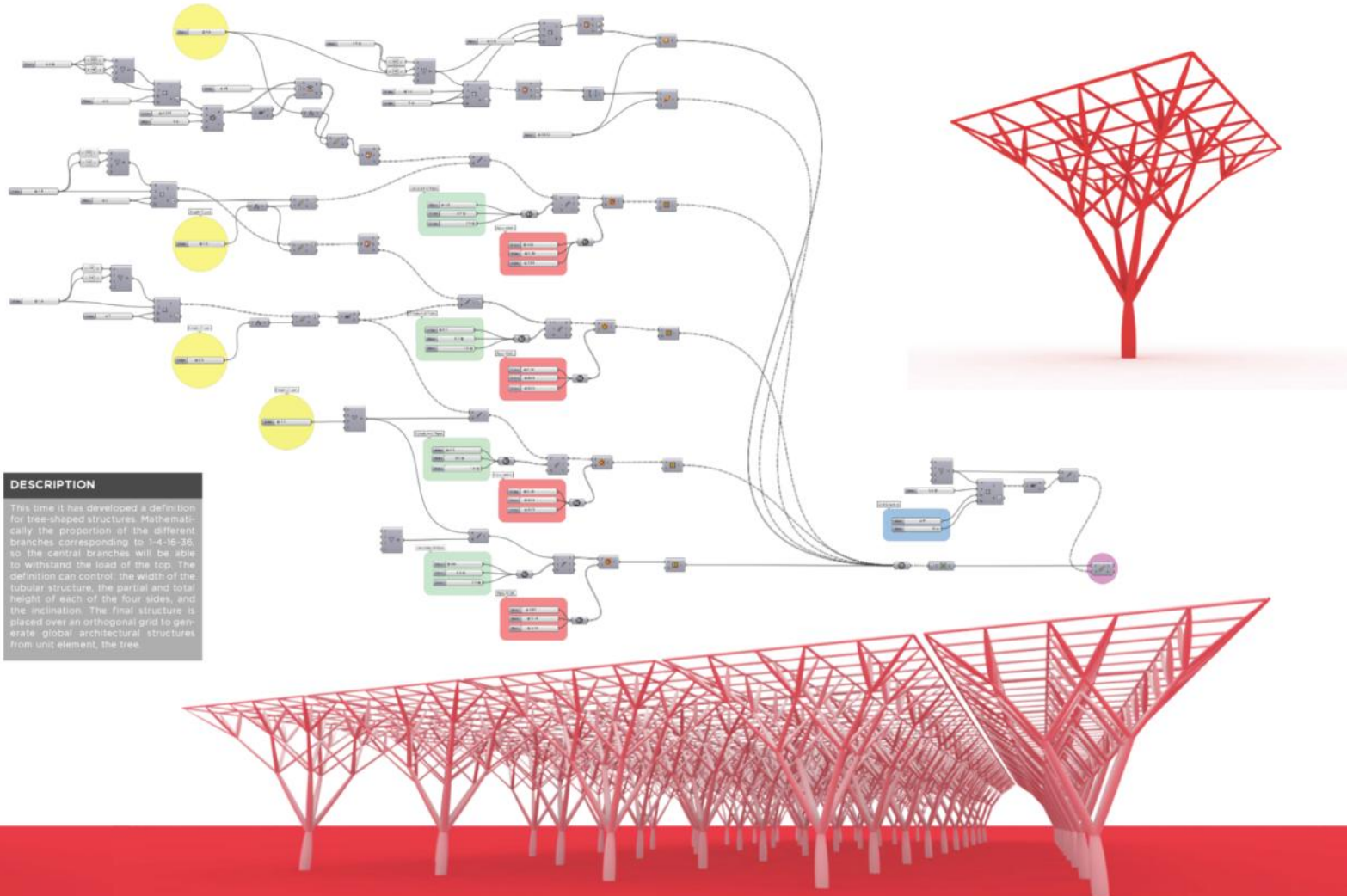
# Structural Morphology in Architecture

## TREE LIKE STRUCTURES

### 6. Recent Research- Form finding

06 TREE STRUCTURE

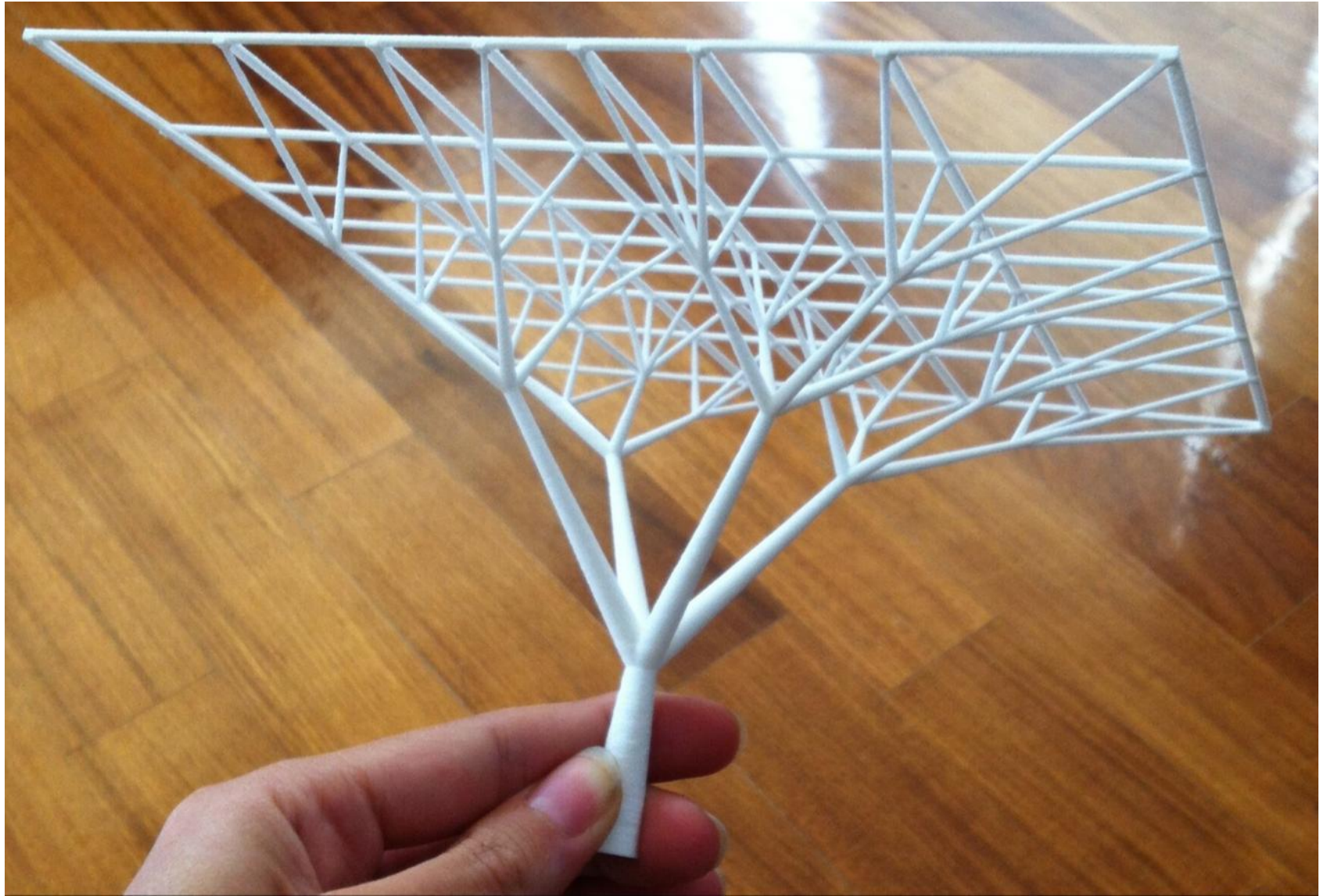
ARQUITECTURA DE VOLTERETA



# Structural Morphology in Architecture

## TREE LIKE STRUCTURES

### 6. Recent Research- Form finding

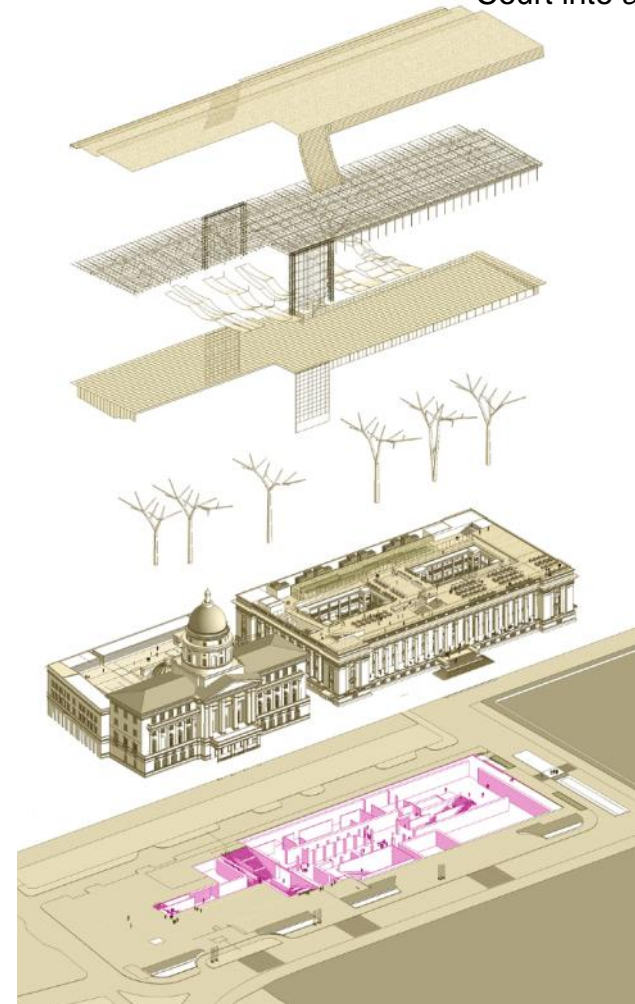


# Structural Morphology in Architecture

## TREE LIKE STRUCTURES

### 6. Recent Research- Form finding

Singapore National Art Gallery  
2008 Winning proposal @ STUDIO MILOU Architects  
The transformation of Singapore's former City Hall and Supreme Court into a National...



**THANKS FOR YOUR ATTENTION !!**