The Heron Tree

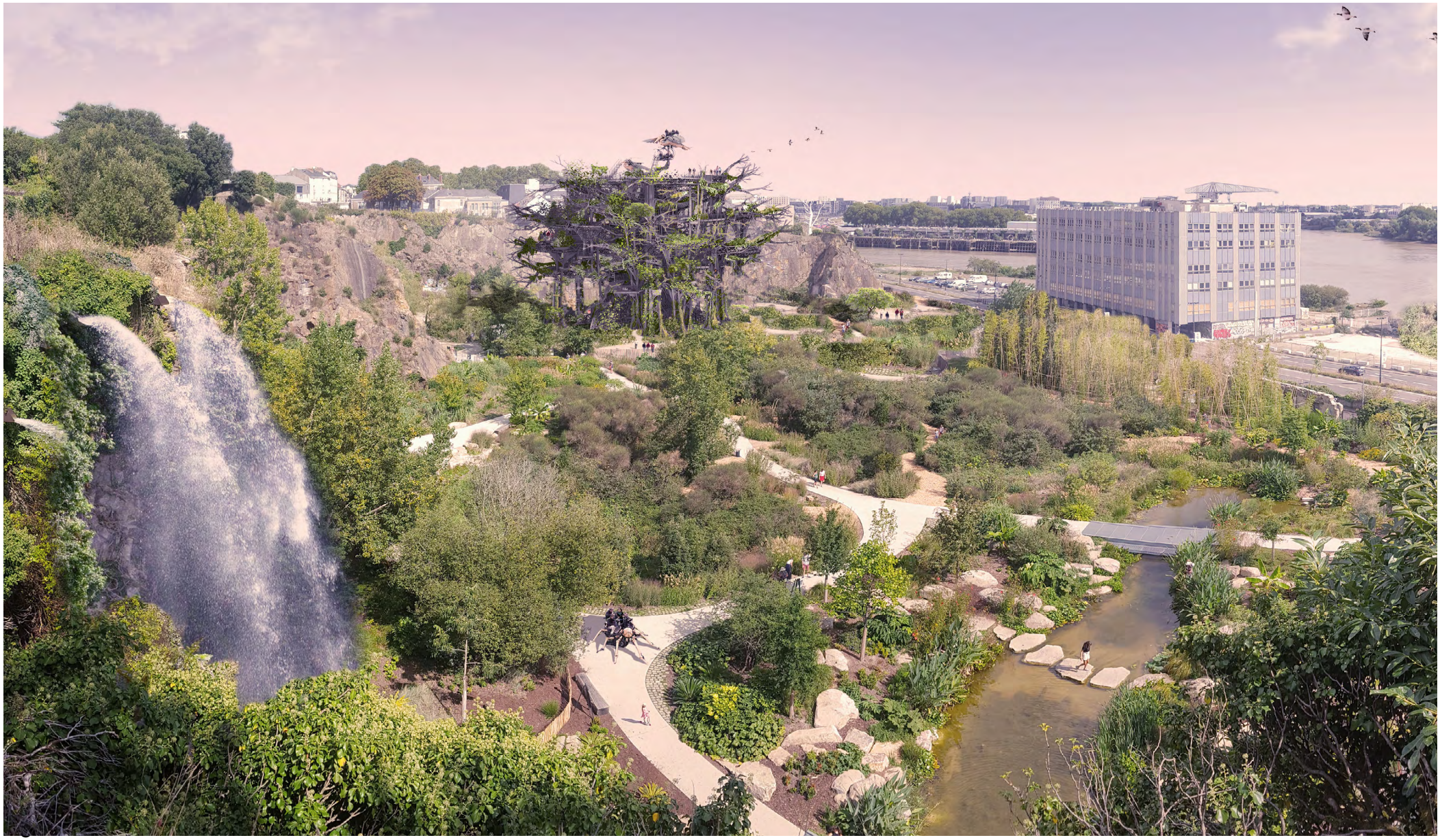
Press kit
Presentation of studies

COMMENT VÉGÉTALISER LES ÉTAIS ? 19/07/18

Contents

THE HERON TREE

PRESENTATION BY THE CREATORS



The Heron Tree is located at the centre of the carrière Misery, a quarry overlooking the river Loire, the Île de Nantes, and Trentemoult. Whether you approach on foot from the banks of the Loire, take the river shuttle or arrive from square Schwob located above the quarry, it presents a striking sight among the rugged cliffs of the Sillon de Bretagne escarpment.
The flora, which has grown there naturally there over the decades and is enhanced by the Extraordinary Garden designed by Phytolab, sets off the Heron Tree and its Hanging Gardens to best advantage.
This organic architecture transforms the quarry into an urban garden without equal anywhere in the world.

Picture this... As you get closer to the Tree, the details of the branches come into focus in an all-encompassing vision. As you look up through the network of branches, you can see the Heron circling in the sky, mechanical animals, and hundreds of visitors.
This is a true city in the sky.

The Heron Tree is 35 metres high and 50 metres in diameter; it weighs over 1,000 tonnes and can host 400 people.

Access is via a double-helix staircase located inside the trunk, with landings leading off to the branches. Visitors can experience the architecture itself as well as the Hanging Gardens growing within the structure of the branches in the form of micro-landscapes. As you walk around, you will come across a peaceful sloth, giant humming birds, a chameleon, birds of paradise – an entire mechanical bestiary.
At the top of the Tree, climb under a Heron's wings or onto its back for a circular ride 45 metres above the ground.

The Giant Elephant is an urban machine accessible to all and you can follow its as it walks along its route. In a similar manner, you can discover the Heron Tree by day and by night. Like a living green ark, the Heron Tree sits in the public space and is accessible to all. "We want to build it and share it with local inhabitants, and tell this incredible artistic, human and industrial story in real time here in Nantes, and worldwide.

« Like a living green ark, the Heron Tree sits in the public space and is accessible to all»

François Delaroziere et Pierre Orefice

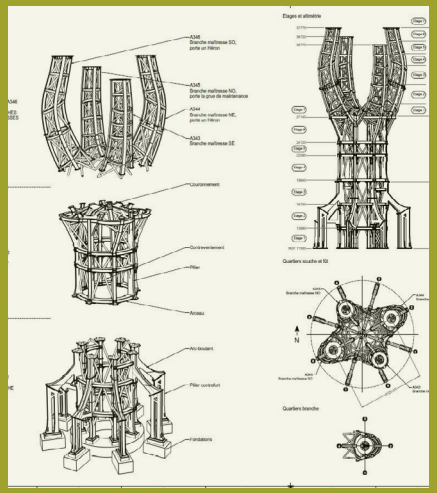
Project aims and study objectives

In order to fully assess the challenges associated with creating the Heron Tree, it is necessary to understand the incredible complexity of this multifaceted work. The Heron Tree is:

A **monumental work of art** integrated into the urban public space. Each element of the structure will be designed and sculpted in minute detail.

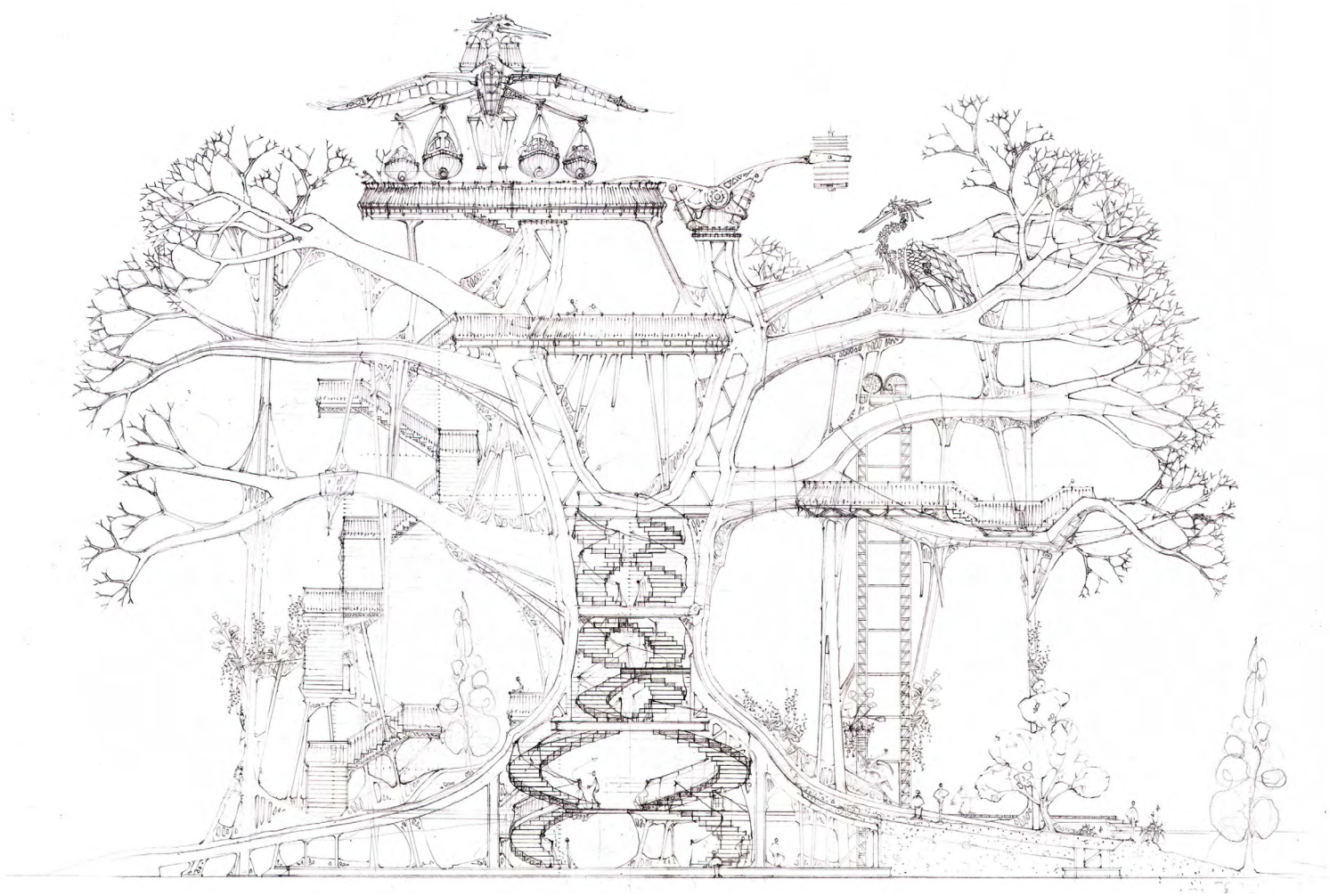
A **unique experience** for visitors. We are setting in motion living machines which conjure up the natural world and fairground rides, as visitors move between branches in a circular or vertical manner.

A **genuine industrial and technical challenge** The metal frame has a particularly complex geometry. The position and size of each element is designed to create a harmonious whole. Nothing in the Tree is mass-produced; all the structural elements are unique.



A **living work of art** covered in flora forming the Hanging Gardens. It is crucial to ensure that plants perched in a branch 35 metres above the ground have the right growing environment, which is no small feat!

These aims are what make the Heron Tree so interesting and unusual. They are also what make it an incredible jigsaw of technical constraints which have to be addressed together in an integrated manner. This is reflected in the studies which we have carried out over a period of three years from 2017 to 2020, with a multidisciplinary team of some sixty designers from La Machine and external partners. The study phase draws to a close in 2021 with the construction of a full-scale Giant Heron. We now have to validate the construction principles for this machine which will fly 45 metres above ground.



The Heron Tree must also address various problems specific to its architecture, such as the structure's response to wind, exposure to lightning, and evacuation in the event of a fire. A number of digital tools have also had to be developed to prepare for the next phase of the venture. This press kit outlines the thinking behind the feasibility of the project.

KEY FIGURES

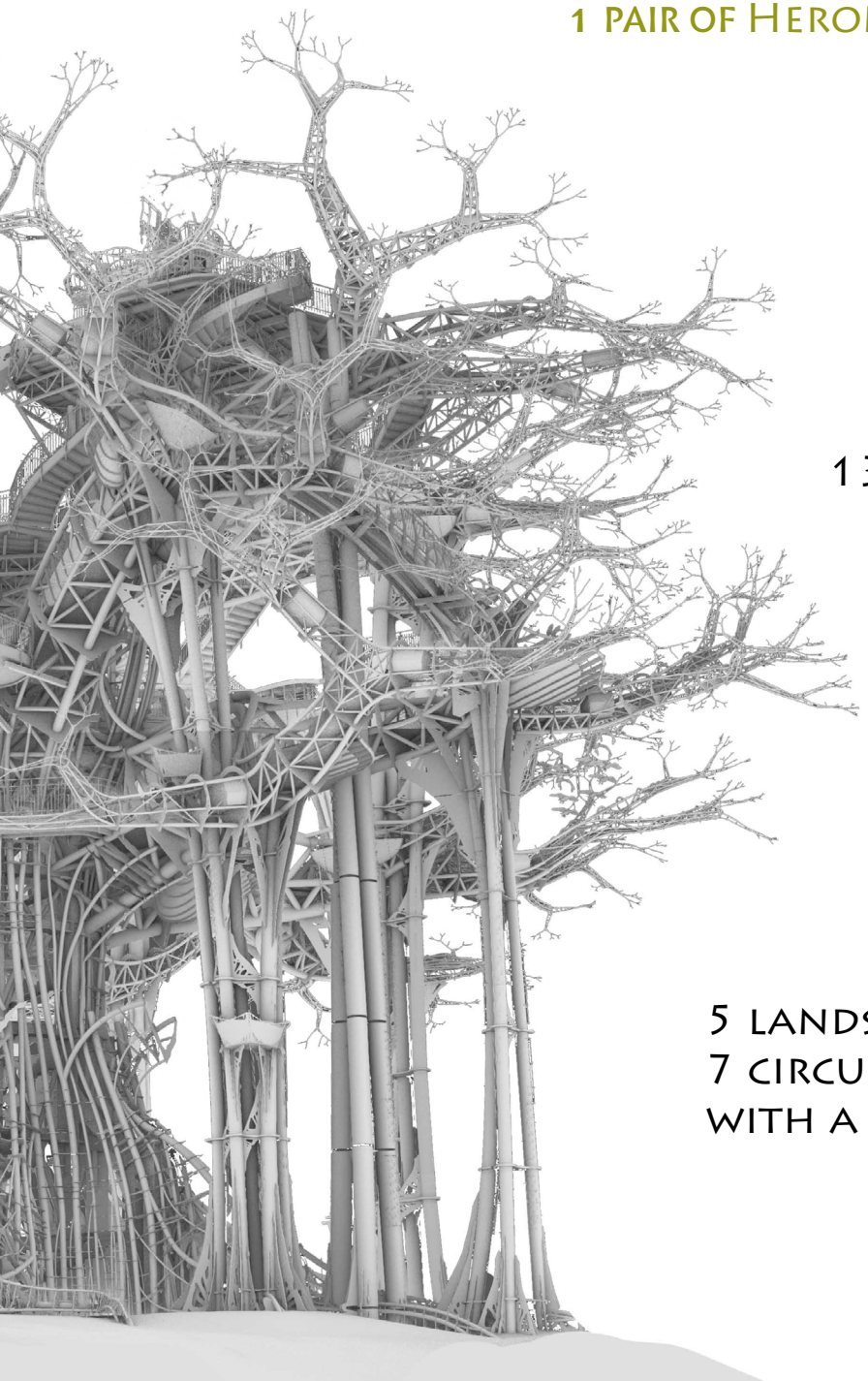
35 METRES HIGH, EXCLUDING THE HERON

17 BRANCHES TO WALK AROUND

28 ANIMALS IN THE MECHANICAL BESTIARY

55 METRES SPAN TO BRANCH TIPS

1000 TONNES TOTAL WEIGHT



1 pair of Herons

420 people maximum in the Tree

43metres above the ground on the heron ride

135 Tonnes of earth for the hanging Gardens

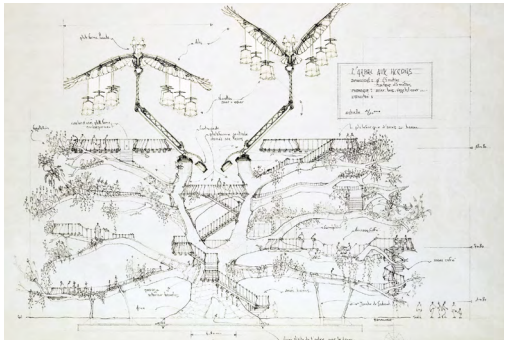
130 species of plant

5 landscaped areas
7 circuits open for 7 months of the year (May to november) with a 2-week special opening period at Christmas

PROJECT TIMELINE 2000 TO 2021

The Heron Tree project has had a long maturation period of twenty years.
It all began in 2000 with an initial drawing by François Delaroziere which laid the foundations for the project: a giant tree, hanging gardens, and a mechanical bestiary topped by a pair of Herons on which visitors can ride. The technical studies and prototypes which followed reveal in particular the structural challenge posed by the construction of steel branches measuring in excess of 20 metres.

2000



First drawing of the Heron Tree

The project was originally conceived as part of a huge regeneration scheme for the Île de Nantes, in collaboration with the urbanist Alexandre Chemetoff. This drawing shows the basic outline of the project: a giant tree, Hanging Gardens and Heron rides for visitors. The trunk already features a staircase and terrace for visitors.

2001

Full steel model on a 1:100 scale

This initial model for the Heron Tree built by François Delaroziere, Pierre Orefice and Claude Rigo, explores visitor flows in the Hanging Gardens. The walks, walkways and staircases are represented with coloured thread.

2005

Lime wood model on a 1:50 scale

This model was produced after the initial digital model, which was designed using geometric data from the 2001 steel model. The various circuits are still represented with coloured thread. The wood gives a more accurate representation of the overall geometry of the branches. The terraces, belvederes and Heron platform are also modelled.

2007

Branch prototype, 1:1 scale

A full-size branch protype was made to explore all construction, assembly and visitor constraints, as well as planting. Along with the Giant Elephant and the Galerie des Machines, the prototype branch for the Heron Tree forms part of the first tranche of the "Machines de l'Île" project. This unique Laboratory is still a test bed for ongoing studies.

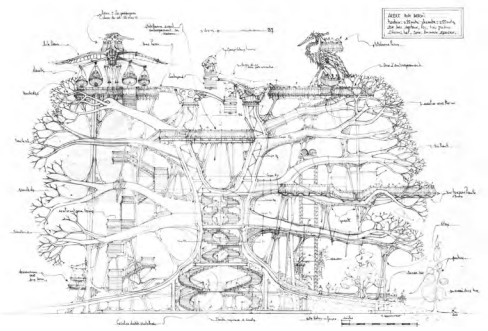
As research progressed, the shape of the banyan tree emerged in 2017 and prompted a revised drawing. The staircase at the centre of the trunk also grew in size and increased to two flights in the form of a double helix. The Heron booms and access staircases were also redesigned. The following pages trace the key stages in the development of the project.

2012

A new Galerie des Machines

Following the inauguration of the Marine Worlds Carousel, the Galerie des Machines has been refurbished to showcase the Heron Tree. Treehoppers, an inchworm and mole are on display. The 1:10 scale model is located in the middle of the gallery. It is the first model to present the full scope of the artistic vision and technical intent via the planting and mechanical systems which bring the herons to life.

2017



Second drawing of the Heron Tree

The project now features props. These are supports for the branches, inspired by the banyan, a tree with lianas dropping down from its branches which become strong enough to support them. These are also the starting point for the roots. It also shows the staircases in greater detail and the new booms for the Herons. A lift has been added and the staircase in the trunk has expanded and has become a double helix.

2018

Prototypes for planters

Many planter options for greenery for the Hanging Gardens were tested. Research focused on steel planters integrated into the structure of the branches. Three prototype planters were produced. They were installed on the Parc du Grand Blottereau site and were also used to experiment with planting.

2019

Model of the tree base in 1:5 scale

This model was created in two stages as part of the preliminary study for the Heron Tree and represents a section of the base of the Tree and the first level of branches. It makes it possible to work in detail with very fine granularity and to test different technical solutions. In 2018, the model consisted of the base of the Tree, the bar and its terraces, a branch, a lift, and a staircase. In 2019 it was fully planted up and a new branch was added.

2021 : A family of Herons makes its appearance

As a result of discussions between the project initiators and Nantes Métropole, the Heron Tree project evolved. The Hanging Gardens became home to a pair of Grey Herons. These wading birds nest in a tall tree. Their promontory is located at the top of the Tree and has views over these lush gardens and the river Loire.

These herons are extremely large. The wingspan of the largest bird is over 42 feet. Their nest is made of tree branches. It is located beneath a branch where it is sheltered from the wind. The herons take turns to sit on and guard their single egg, which is probably the largest bird egg ever seen. It will have a long incubation period of two summers and a winter before it hatches and the pair will give birth to a heron chick.

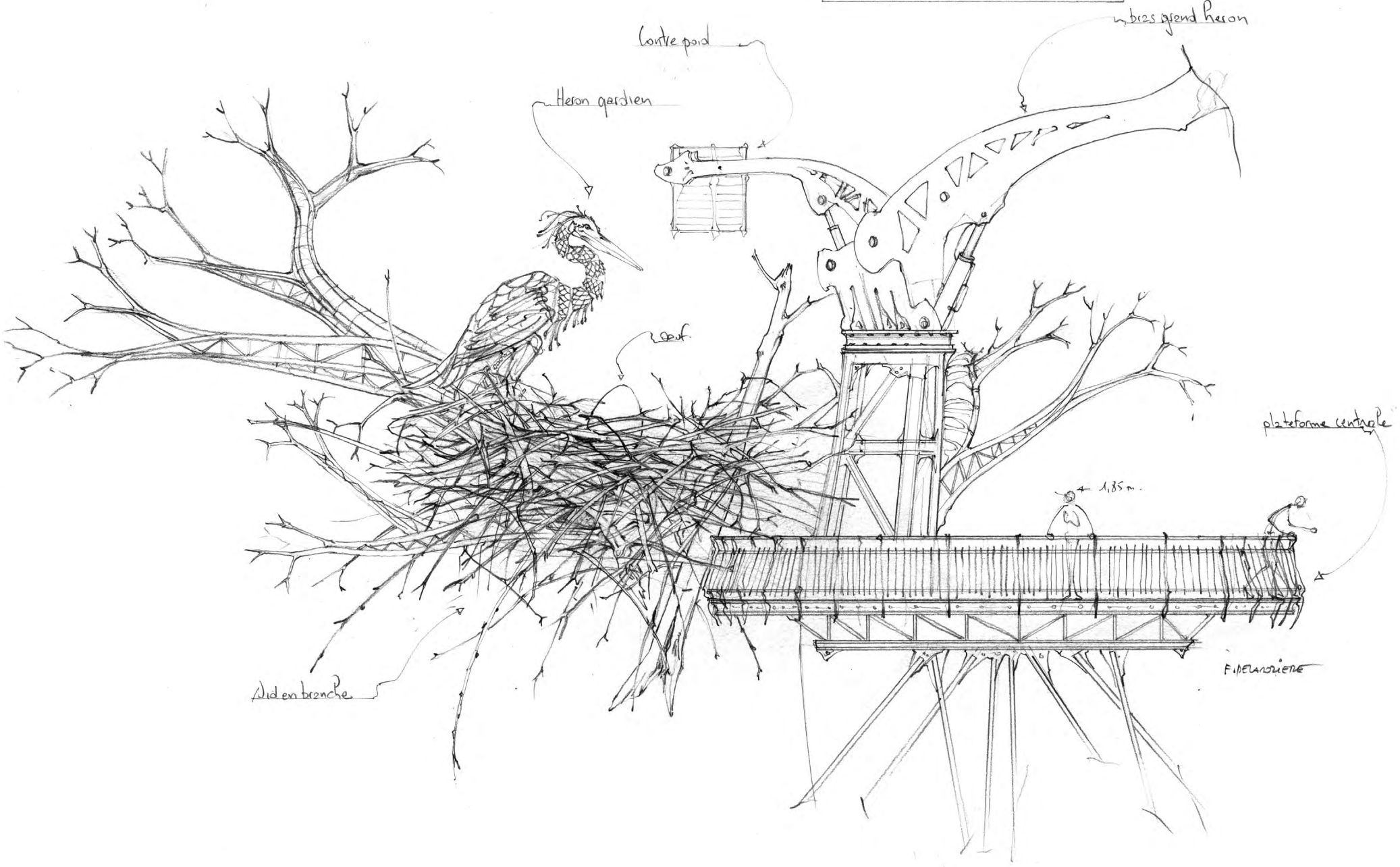
This is a simple story. Adults and children can potentially relate to it and tell it in different ways.

Like the Giant Elephant, the shock of the difference in scale between reality and the lives invented here will provide a talking point for different generations. The Heron Tree is a never-ending source of thrills and surprises, stimulating the imagination, inspiring awe at the technical and mechanical know-how, and exploring the living world.

This story also offers an opportunity to speculate about the city of the future and to change our perspective on our own city. These living sculptures in the midst of local residents' everyday life bring a new dimension to our perception of space. This manifestation of art in the public space creates a shared experience which brings us together and promotes interaction.

" The Heron Tree is a never-ending source of thrills and surprises, stimulating the imagination, inspiring awe for its technical and mechanical know-how, and exploring the living world."

NID DU HERON et SON OEUF
Bois, tronc et branches
heron de la galerie



Modelling and sculpting the Tree

The base and trunk of the Tree

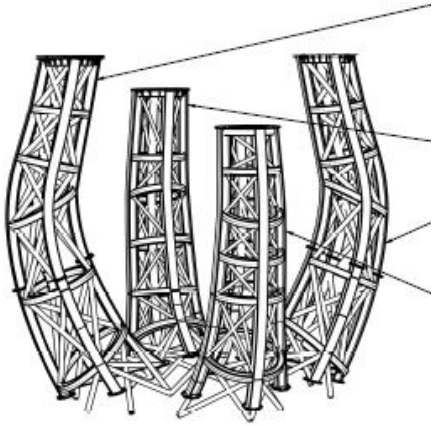
The Heron Tree sits on top of a green mound which shows off its shape to best advantage and allows its steel roots to fan out. No vehicles are permitted around the base of the Tree and the paths are treated like mountain or forest trails; they look as if they have been created in the greenery over time by a succession of ramblers. They are in fact fully accessible to all visitors, including wheelchair users, in the designated areas. Visitors approaching the Tree or standing beneath its branches can see the full array of living things within it. They can move freely without charge around the foot of the Tree in this area which is part of the public space.

The trunk of the tree is the core of the structure and facilitates the operation of the Hanging Gardens circuit. It is constructed entirely from steel and is made up of several sections:

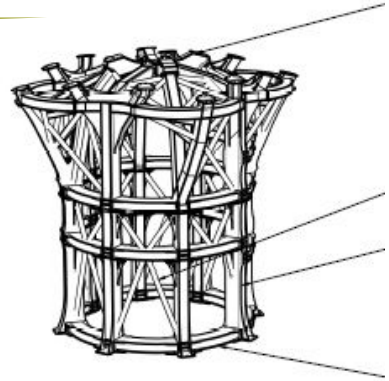
- A stump, which supports the whole structure; it is surrounded by buttresses for stability and the roots fan out from it
- A cylindrical trunk to which the first stages of branches are attached
- A crown from which the four Main Branches extend to support the top levels of branches, the herons and their platforms, and the maintenance crane.

This primary structure supports the branches and central double-helix staircase. It is completely covered in steel bark made from steel tubes which climb vertically and horizontal decorative metal sheets. The whole structure is divided into small sections which can be easily transported and assembled.

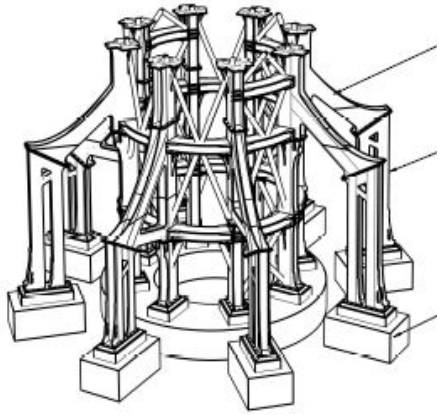
MAIN BRANCHES
50 tonnes



TRUNK
60 tonnes



STUMP
50 tonnes



BARK

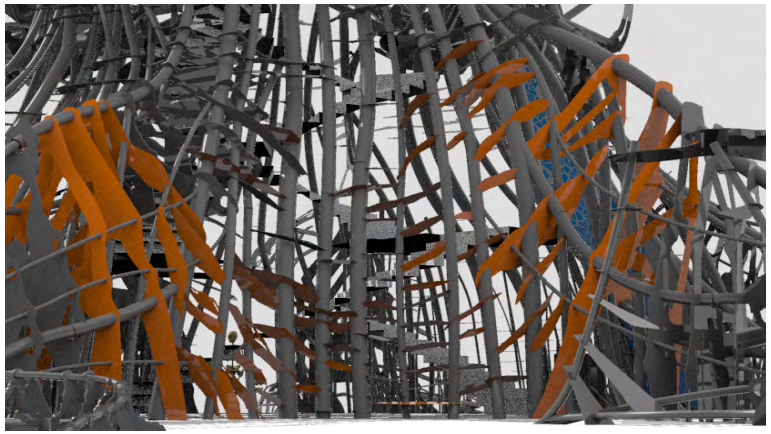
This bark presented a real artistic challenge as it forms the outer shell of the tree and gives it its shape and fibrous appearance. The design required an iterative working approach involving 2D drawing, sculpture and digital modelling. A prototype was created which made it possible to validate the methodology. The methodology will be applied to the whole trunk when the Tree is manufactured.

Research began with a digital sketch of the surface of the bark. This incorporated relationships with the trunk, openings for branches, circulation elements and all the technical constraints such as the fluids network, etc. This was followed by a wax model on a reduced scale, where the sculptor focused on giving the tree attractive, robust and organic bark lines.

Once the sculpture was approved, a 3D scan was made and imported to the digital model. Steel tubes were then designed to mould to the shape of the sculpture. This forms the basis of the production model. It also includes all the technical dependencies relating to structural sizing, manufacturing, transportation and assembly.

Visitors enter and exit the trunk via an access control system in the base of the Tree. A large gate in the bark of the tree, between two roots, is open during the day. Visitors can then walk freely around the Hanging Gardens.

Wax Sculpture

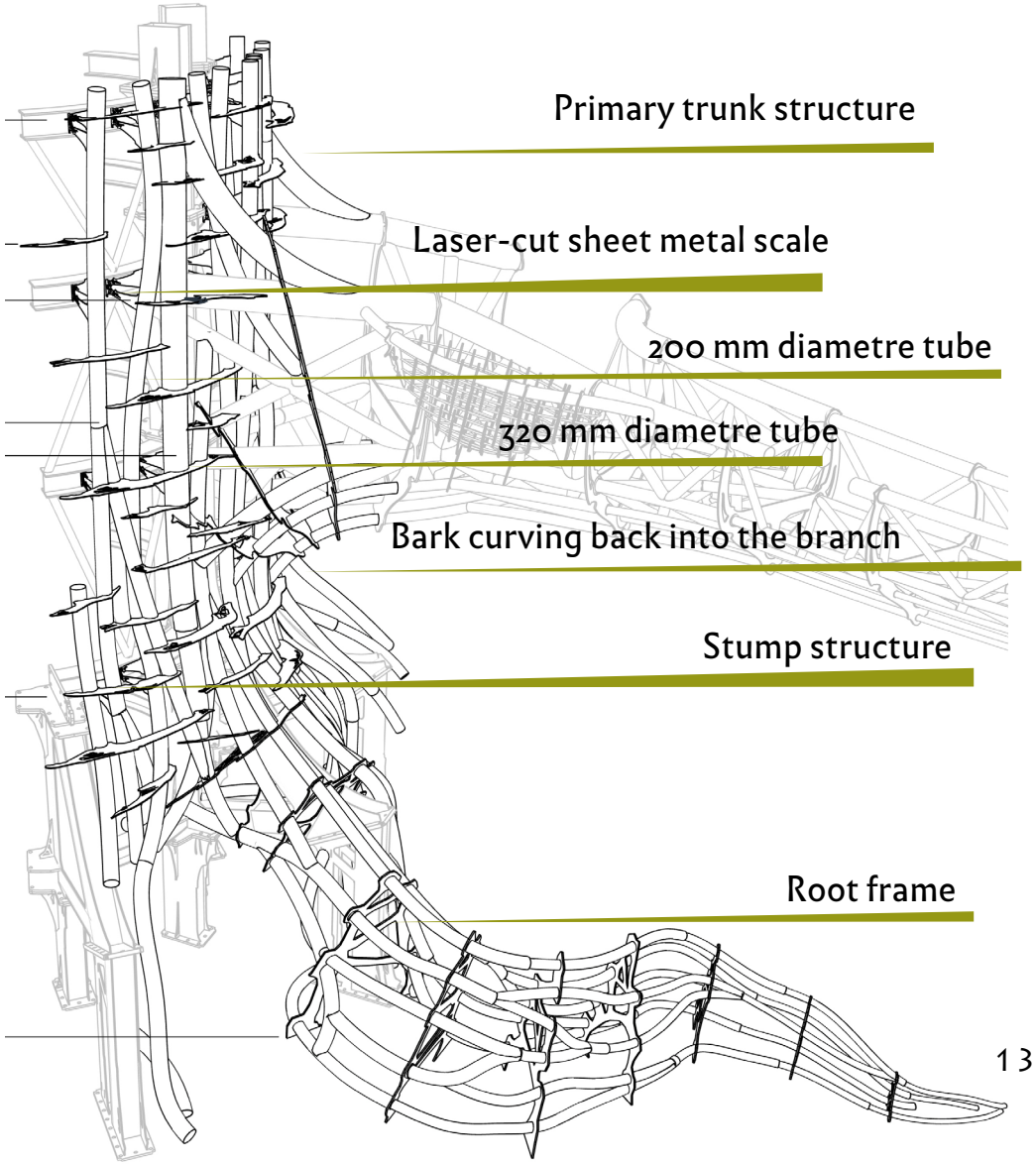


3D Scan and digital modelling

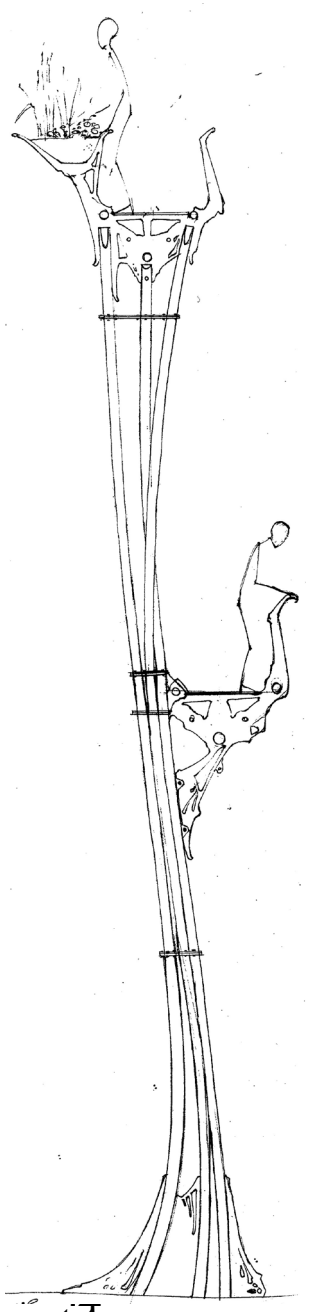
Steel prototype on a 1:5 scale

Roots

The roots are an extension of the bark of the trunk and are sculpted using the same process. They are also made from steel tubes forming “fibres” and perpendicular laser-cut sheet steel frames. They are all different and fan out over a mound covered in vegetation. They are not a structural component of the Tree. They are made up of welded sections which can be transported and bolted together onsite. Plants will climb over these steel roots.



PROPS



One of the major design challenges for the Heron Tree was finding a structure that could mimic nature. It was actually impossible to build precariously poised branches with a span of over 20 metres, bearing visitors, gardens and mechanical animals, without any posts or structures to support all this weight.

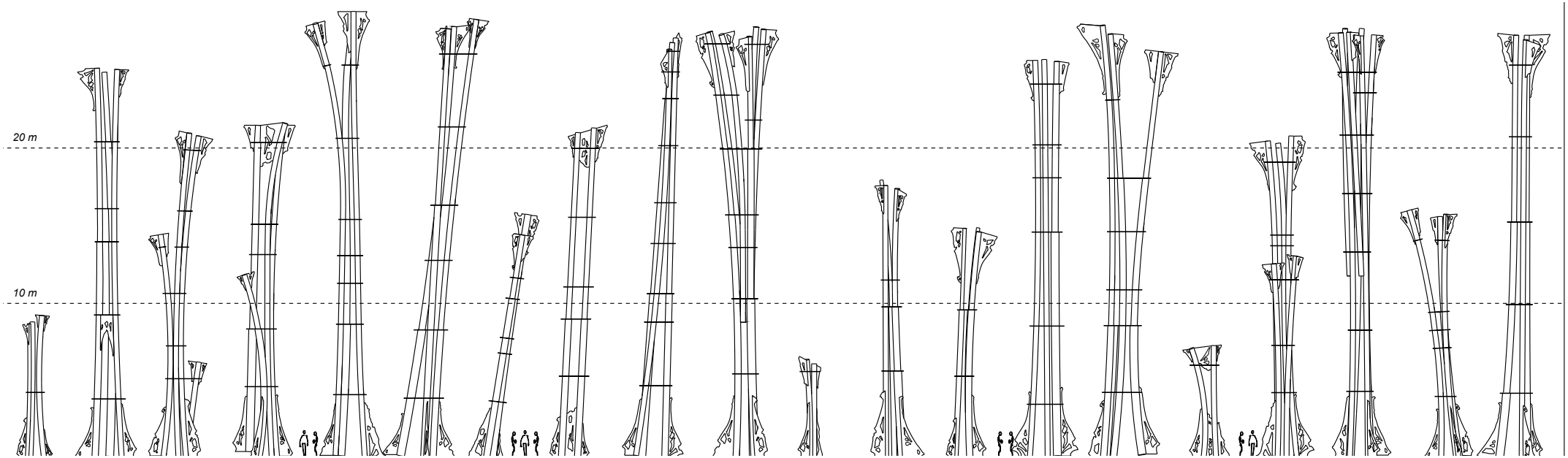
Nature itself creates this type of structural reinforcement. Banyan trees belong to the ficus genus and are close relatives of the fig tree family. They can grow into giant trees spanning over a hectare. In order to achieve this, branches put out aerial roots which drop right down into the ground and provide structural support and nourishment.

The design for the Heron tree was inspired by the banyan tree. Long lianas trail from the branches down to the ground and form supports which allow the tree to spread out above ground. We call these lianas “props” – a term used in the construction industry to describe a vertical component of the framework supporting a structure.

" Each prop is a structural and aesthetic component, a part of the Tree which tells its own story "

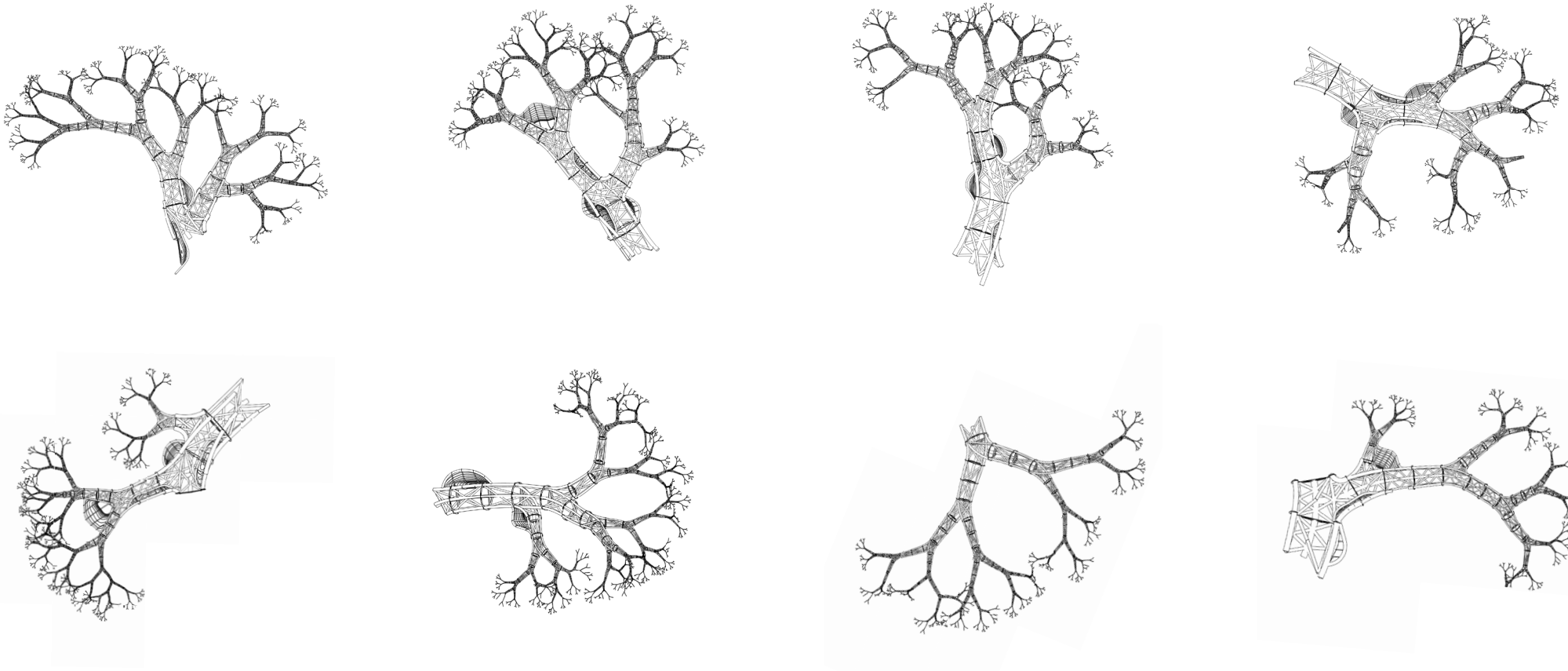
Each prop for the Tree is a bundle of lianas consisting of between 2 and 6 straight or tapered steel tubes ranging from 20 to 50 cm in diameter. Each prop is unique. They “drop down” from branches in a random manner to make the metal appear organic. Some props come down from the highest branches and go straight into the ground. Others mingle with lower branches or only start from the lowest branches. Each prop is an aesthetic and structural component, a part of the Tree which tells its own story. Moreover, structural studies showed that a geometry with several tubes was preferable because it offered greater resistance to horizontal pressures than a single vertical post with a large diameter. Nature is clearly a master of design.

At ground level around the base of the Tree, the props fan out and embed themselves in the ground to create a forest of lianas that visitors can explore. Vegetation will grow up around them and partially cover their structure.

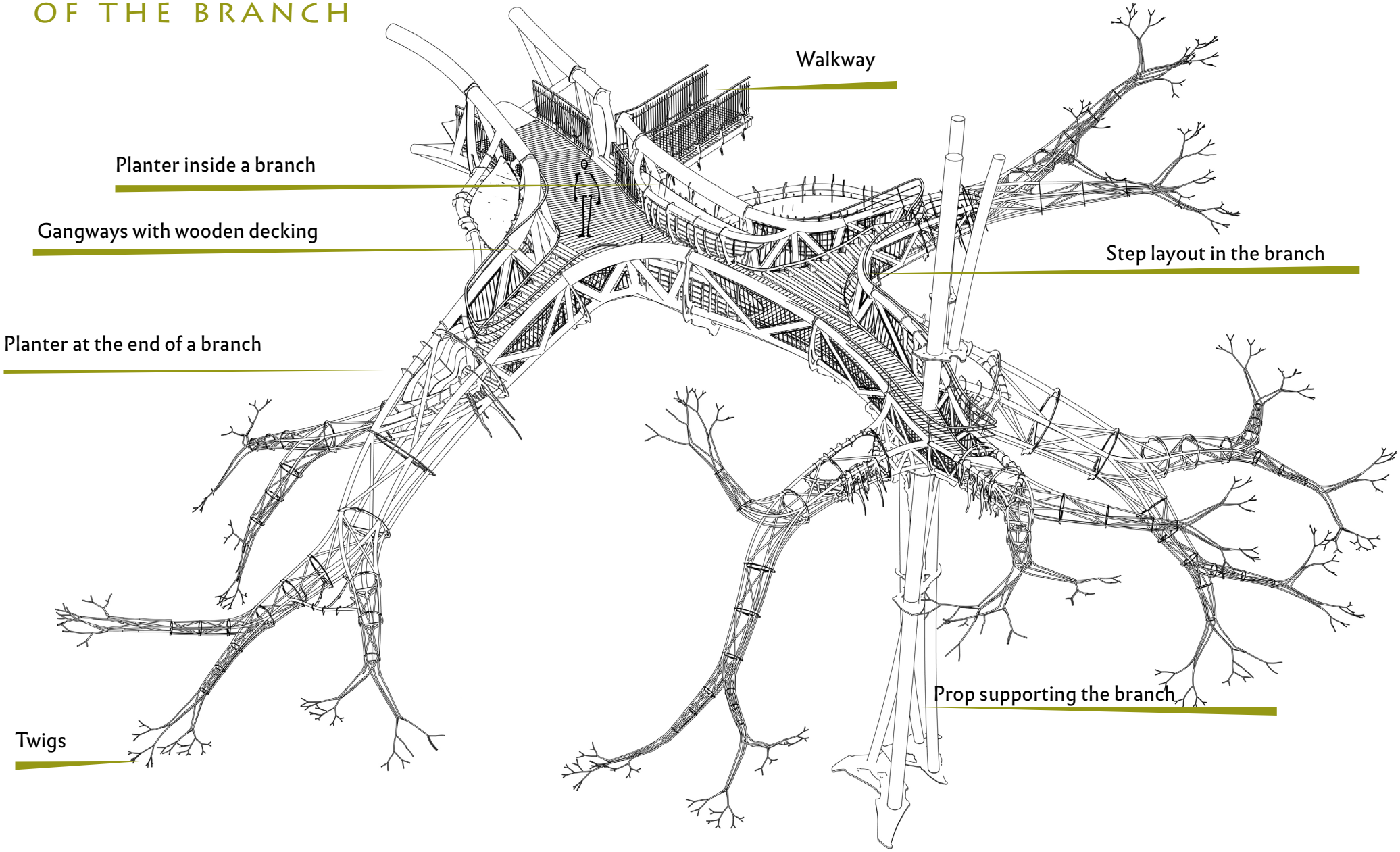


Branches

The branches are a major element of the Tree and are the focal point for all the major issues in the project relating to the structure, sculpture, visitors, mechanical animals, and micro-landscapes. Since the start of the project in 2020, they have been the focus of in-depth research and a full-size prototype branch was created in 2007. This branch can be visited on the forecourt of the Nefs de Nantes hangar and is still used as a laboratory for research, optimising construction details, and studying planting. The following pages are the culmination of this research and present the branches as they will feature on the Heron Tree.



THE FIRST SECTION OF THE BRANCH



The branches mainly spread horizontally over three levels (medium-height branches, high branches and canopy branches). The medium-height branches are connected directly to the trunk. The high branches and canopy branches are connected to the four main branches of the trunk.

They:
- facilitate visitor flow and connect the circuits to a network of walkways and staircases.
- provide sites for micro-landscapes, belvederes, and the mechanical bestiary.

The Tree has 17 steel branches. They are all different, but have the same exposed tubular structure: five main tubes forming the principal structure and three smaller tubes. These tubes are tapered to sculpt the branch from a spatial perspective. Each branch is divided into several boughs. The twigs at the ends of the branches are slender finely-wrought structures. Each branch section is made up of several segments; a segment is the area between two frames, which are the laser-cut steel sheets which form the cross-section of the branch.

The different segments of a branch
The geometry of the branches changes significantly as they move further away from the trunk. Close to the trunk, branches are covered in bark forming a tunnel through which visitors walk to reach the branch proper. A little further along, the branch is at guard rail level and visitors are surrounded by planters forming an immersive landscape. In the middle of the branch, a lightweight guard rail guides the visitor to the end of the gangway, which is 60cm wide. The end of the branch is not accessible to visitors and the structure is covered in greenery. These raised areas provide an excellent vista over the Extraordinary Garden, the Tree as a whole, the cliffs, and the river Loire.

Staircases and Belvederes

The Heron Tree is an aerial walk and visitors climb up the structure via a number of staircases:

The double-helix staircase

At the centre off the trunk is a double-helix staircase. It takes visitors up to the branches, providing access to the first levels. It comprises winding flights and fixed landings anchored externally to the 8 structural pillars of the trunk, and suspended internally from the vault of the trunk. A central 16-metre void forms an atrium. Climbing these stairs is similar to entering a steel cathedral.

Staircases in the branches

Staircases in the branches, notably around the fringes, connect the various levels of the circuit. A number of landings linking the branches make it possible to evacuate visitors on the Hanging Gardens circuit and take them back down to the base of the Tree as quicky as possible. Like the walkways, these staircases are structural elements built between the branches to create walking routes. They cling to the structure of the Tree in a variety of ways, on a branch or prop, or are suspended.

The Heron circuit staircase

The staircase providing access to the Herons is the largest staircase structure. Incorporating a series of flights of stairs and horizontal landings, it moves between branches in the air and takes visitors right up to the Heron platforms. There is a challenging 173-step climb. It is made easier by numerous horizontal landings where visitors can have a rest and observe the branches of the Tree, which are teeming with life. The staircase on the cliff which winds its way along the rockface mirrors the staircases on the Tree from an aesthetic perspective.

Belvederes

At the top of the Tree, there are further viewpoints called belvederes and balconies, perched on the highest branches. The belvedere is the highest point of the Hanging Gardens circuit. A series of two promontories at different altitudes and facing in different directions offers spaces to rest and admire the view. The highest point of the circuit is 32m above ground.

“ Climbing these stairs is like entering a steel cathedral. “

ACCESSIBILITY

Accessibility is a core design issue, in terms of the construction of visitor facilities and fairground rides and also their operation.
The creators and constructors have come up with a number of solutions to make the Giant Elephant, Marine Worlds Carousel and Galerie des Machines accessible. Since the opening of the Machines in 2007, the operator and Nantes Métropole have worked together to develop spaces accessible to visitors and have ensured that all tours are compliant in respect of handrails, step nosings, lighting, noise reduction, floor markings for the visually impaired, signage, etc.

However, the Heron Tree poses fresh accessibility challenges. Visitors to the Hanging Gardens and the Heron rides climb to a height of 30 metres above the ground via staircases or along a route from branch to branch. The branch-to-branch route involves a number of walkways and staircases connecting the branches. In order to make the first level accessible all the way round, it has been designed virtually on the level with a very shallow gradient. A 12-metre lift comprising four trellised pillars reminiscent of the Eiffel Tower takes visitors up to the medium-height branches. The openwork structure allows passengers to look out and see the machinery and large glass panels seal off the shaft at landing level for security.
Able-bodied visitors are not permitted to use the lift as the climb up the Tree is an integral part of the visitor experience. The Tree is also fully compliant with regulations relating to visually impaired visitors.

The preliminary study set out the fundamental principles for accessibility to all levels of the Tree and opened up avenues for thinking about how to host all visitors, including those with different types of disability. Implementing these principles will involve consultation with non-profit associations who will be able to inform the designers' decision-making and thinking about what the Heron Tree can offer to everyone.

Planting the Hanging Gardens

History, experiments and prototypes

The prototype branch

When the project started in 2002, initial collaboration with Claude Figureau, the director of the botanical gardens in Nantes, raised the idea of recreating an ecosystem which could adapt to the specific constraints of the Tree (low volumes of substrate, severe exposure to frost, and lack of water). The plant palette put together with the help of a worldwide network of seed exchanges between botanical gardens consisted partly of plants which grow in temperate medium-altitude zones and have demonstrated their ability to cope with these constraints.

The prototype branch for the Tree has made it possible to carry out an extended phase of experiments from 2007 right up to the present and develop the principles for planting. The plant palette has been expanded, and natural fertilisers and minerals have been specified and added into the drip-feed irrigation system. The concept of integrating a frost protection system for exceptionally severe and protracted spells has been tested.

Most significantly, we have incorporated containers with much larger volumes into this branch and improved substrate to enhance water retention. This has allowed us to plant larger specimens and to consider the possibility of creating micro-landscapes.

This research has all been carried out in close association with the Green Spaces Department in Nantes, as well as regional nurseries, as the issues around planting are similar to those involved in reintroducing greenery into urban environments.

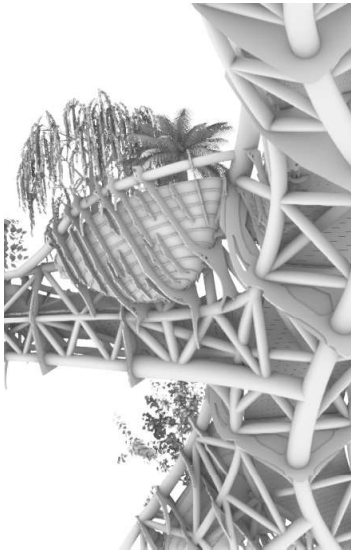
“ The issues around planting are similar to those involved in reintroducing greenery into urban environments.”

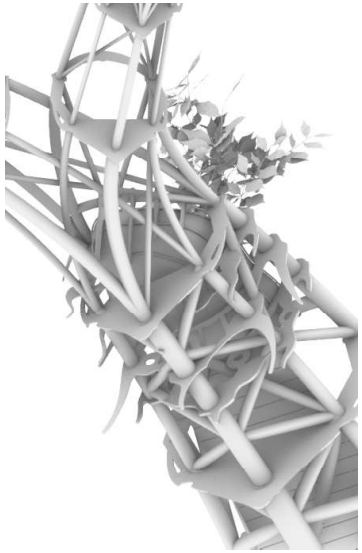
Towards the final planter shape: the prototypes

At the start of the preliminary study, experiments on the Hanging Gardens with the Green Spaces Department resumed. Trials were primarily based around finding a good compromise between keeping the weight of the planting on the structure down and creating complex landscapes combining several layers of vegetation. Three planters were therefore built on a 1:1 scale and planted by SEVE on the Grand Blottereau flower production site. Their shape was very similar to the current planter design which treads a line between an element which is foreign to the Tree and a distortion in the wood of the branch. They are fully integrated into the steel structure and feature a significant amount of openwork to reduce the weight of the steel.

Issues around substrate

The heaviest element is the substrate, especially when it is waterlogged. Close attention was paid to the volume of the planters and they have been optimised as a result of prototyping. This ensures that plants can grow well with as little substrate as possible. This exercise reduced the total weight of the planters from 340 to 135 tonnes.

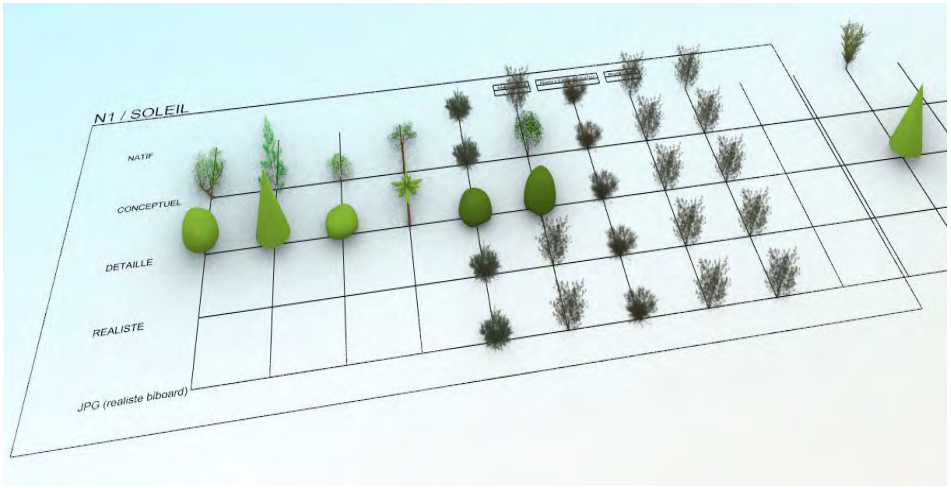




135 tonnes
of planters on the Tree:
33 tonnes of steel structure
91 tonnes of substrate
11 tonnes of plants

Planting micro-landscapes

The Heron Tree features multiple micro-environments created by the climatic constraints there, notably exposure to light and wind. These diverse conditions makes it possible to create varied and unusual planting schemes throughout the Hanging Garden in the form of micro-landscapes.
In the branches, micro-landscapes follow the sinuous curves of the steel which form habitats conducive to the growth of a unique flora in planters, in a manner reminiscent of large trees. The positioning of these planters on the branches creates green scenes via an interplay of perspectives.



On the lower levels, the planters wind their way along the paths inside the branches so that visitors are immersed in the gardens. They can smell aromatic plants, run their fingers over the leaves or pick a fruit. The larger planters on the outside of the branches add depth to the landscapes with their small species of tree which grow to a height of 5 metres. At the end of the branches, climbing plants propagate in the twigs to promote the spread of the foliage/garden over the entire Tree. The climbers are not confined to these planters but proliferate all over the Tree where the interplay of presence and absence acts as a foil for the steel structure and the gaps between the branches.
Extraordinary elements and details will surprise visitors and draw them into the various micro-landscape areas.

The garden at the base of the tree

The Tree will provide welcome shade for the garden which will be created around its base, replacing the current concrete laid in the 20th century. The entire area under the branches of the Tree will be planted and new trees will grow up through the lower branches in these improved growing conditions. Hundreds of planting points will be installed in the branches of the Hanging Garden to boost this diverse ecosystem. The Heron Tree in the Extraordinary Garden is a test bed for planting in urban environments and on buildings. These growing conditions are at the core of the urban issues facing buildings of the future which must meet the requirement for more extensive planting schemes.

"What is happening in the Chantenay quarry gives Nantes a head start in relation to the challenges facing all cities: creating greenery in cities and buildings."


THE MECANICAL BESTIARY

The mechanical bestiary

The Heron Tree is home to mechanical animals from all over the world, with 15 species and a total of 30 animals spread out along the access routes to the Hanging Gardens. Visitors will be able to glimpse them as soon as they enter the quarry. However, once they are in the Tree, they will have to look carefully as some will be in the bark, under a branch, in a pool, or flying around.

The mechanical animals in the Tree exist in the natural world and celebrate it. They will live in their preferred parts of the Tree, at one with the landscapes formed by the vegetation. Birds in particular are showcased as they are especially attracted to large trees.

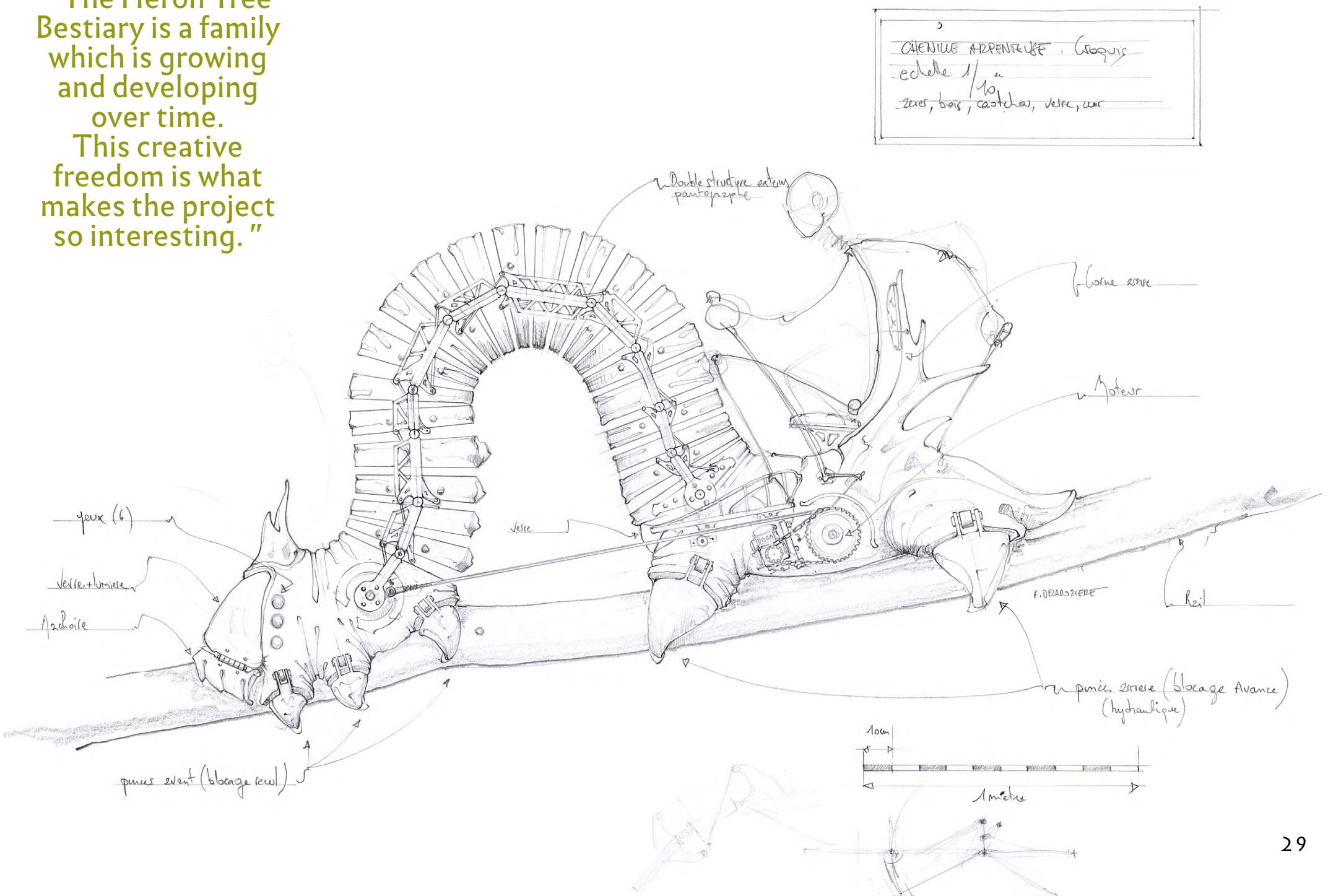
Some animals are autonomous, free to live their lives as they please, much to the delight of the visitors observing them. This is the case with the humming birds which collect nectar from flowers at will.

Most of the animals are activated by visitors. The Sloth hangs from a branch. When a visitor spins the control wheel very quickly, the Sloth moves extremely slowly. Some animals, such as the Bird of Paradise, are controlled by several people. The type of visitor interaction is specific to each mechanical animal. Technical Facilitators will provide visitors with explanations and instructions, just like in the Galerie des Machines.

The development of the bestiary

The Heron Tree Bestiary is a family which is growing and developing over time. Throughout the project development and construction phase, animals will be added, changed or removed. Once the Tree is open to the public, the Bestiary will continue to grow and new species will appear in future years.
This creative freedom is what makes the project so interesting.

" The Heron Tree Bestiary is a family which is growing and developing over time. This creative freedom is what makes the project so interesting. "



A FEW EXEMPLES OF ANIMALS

The Chameleon

Chameleons belong to the family of tree-dwelling sauria. Their mimetic ability, which allows them to change colour, makes them fascinating. They are distinctive because their eyes move independently of each other, their protractile tongues are used to catch their prey from a distance, their toes are arranged in two opposable groups to give them a good grip on branches and, lastly, their tails provide stability. These animals can flick out their tongues with great accuracy towards their prey and bring it back to their mouths; their tongue mucus is 400 times more viscous then human saliva.
In some species the tongue is almost twice as long as the animal's body. Chameleons shoot out their tongue in 1/25th of a second (at over 25 km/h) and snatch prey weighing up to a third of their own body mass, which they take back to their mouths in half a second.

The Giant Chameleon is 3.5 metres long and weighs 275 kg. It sits on a stainless-steel branch, on the lookout for prey. It can move backwards and forwards along the branch. Its globular eyes swivel in all directions in their sockets. Its tongue is activated by a motor which operates all the cogs and pinions which draw it along a track via a chain with a magnet at the end. The unit comes out to swallow a fly and is operated from a control room.

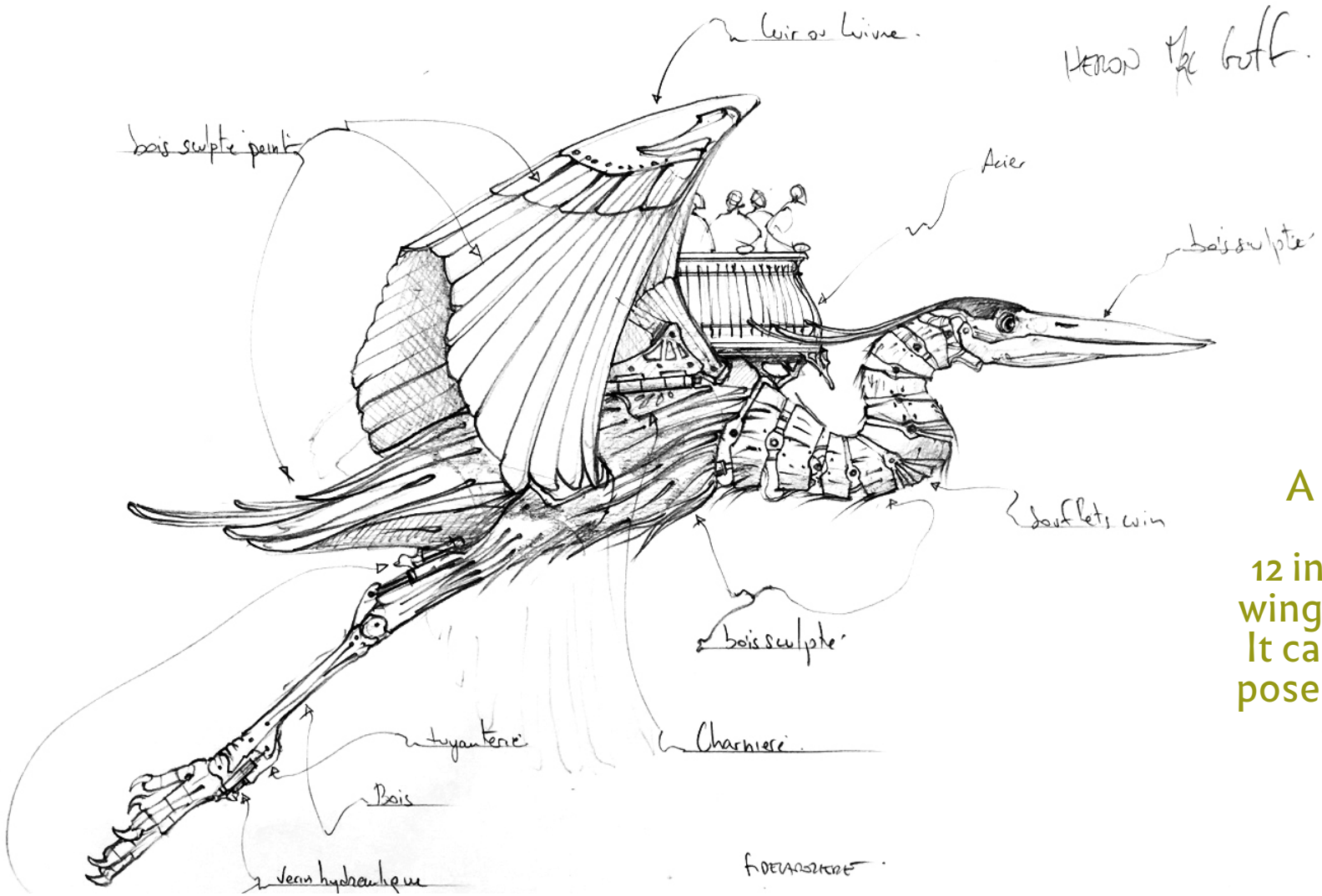
The sloth

The Sloth hangs peacefully from a branch. It wakes up when a visitor spins the control wheel. You have turn it extremely quickly to make it move extremely slowly. It moves under the branch, just like the real creature, using its strong paws. It can move backwards and forwards and turn its head freely through more than 180°. The Sloth's mechanism could be compared to a genuine Swiss watch. A single motor moves all four paws in two directions simultaneously, powered by a single actuator. It produces the force required to move it so that it can propel itself along the branch. This is a real technical feat which allows the Sloth to be very energy efficient. Its skeleton is made from stainless steel and it has a Lebanese cedarwood skin. These materials are extremely strong and will ensure that the Sloth has a very long and lazy lifespan. It will be installed under a branch so that visitors can move it from the control point located on the circuit below.

Many other animals will live in the Tree: a flock of birds, humming birds, a snake, squirrels, a barn owl, birds of paradise, a spider, wild geese, and Herons, of course !

The Giant Heron

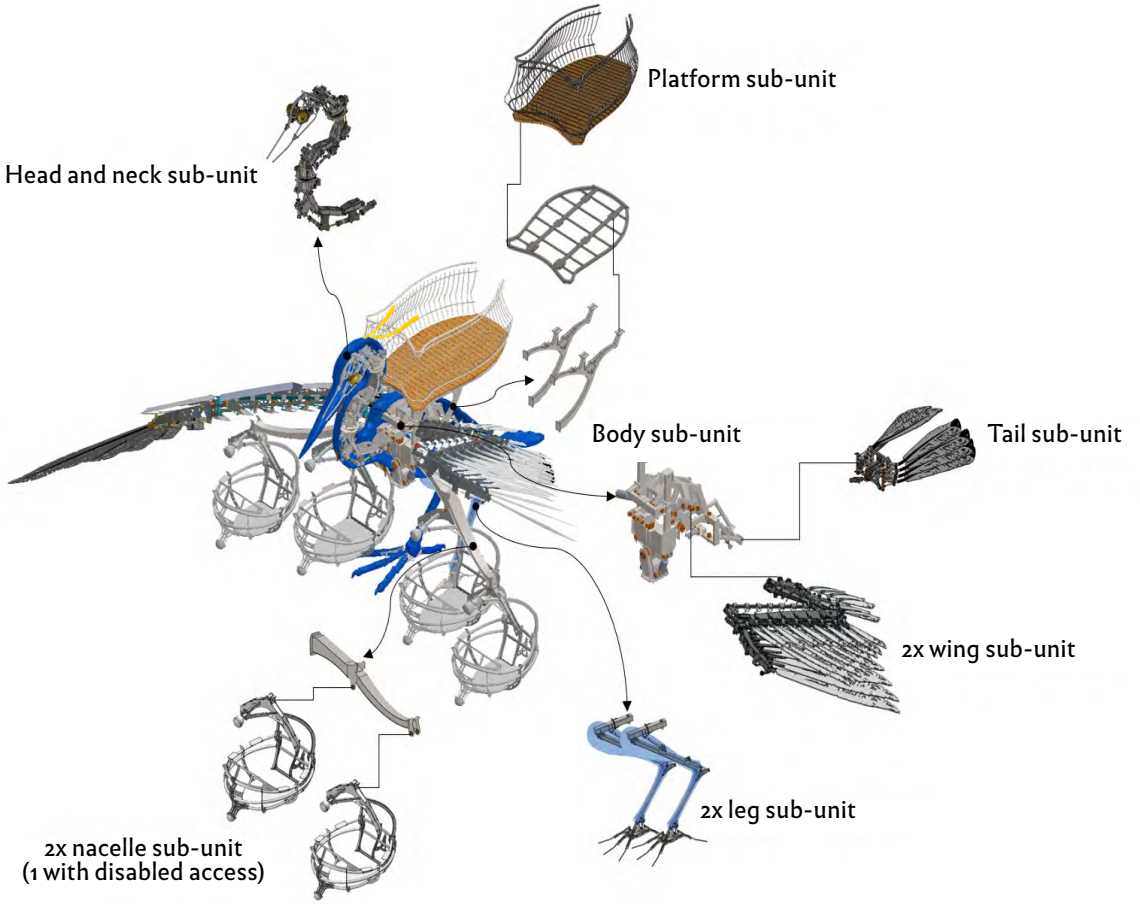
The Heron is the star of the project. It lives at the top of the Tree on platforms located 35 metres above ground. It is supported by a special lifting boom which makes the whole unit move. Its dimensions are impressive: it has a wingspan of 16.5 metres, stands 5.5 metres tall in take-off position (neck and legs tucked in) and weighs 35 tonnes fully laden with visitors, booms and counterweights.

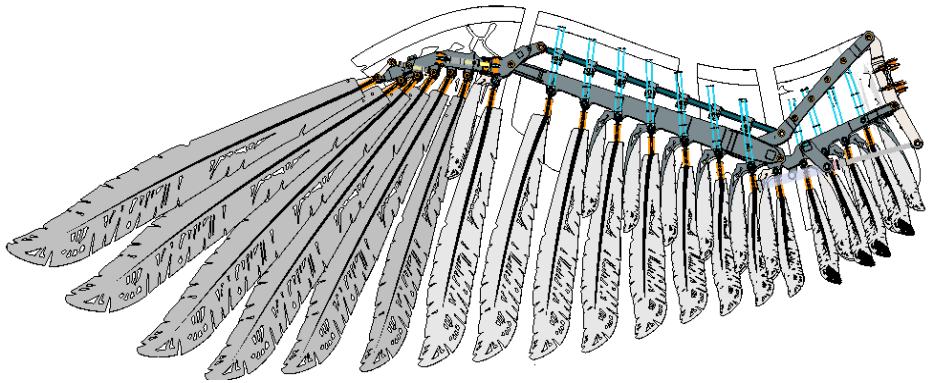


A Heron can carry 18 people: 12 in nacelles under its wings and 6 on its back. It can assume different poses via a combination of movements

.

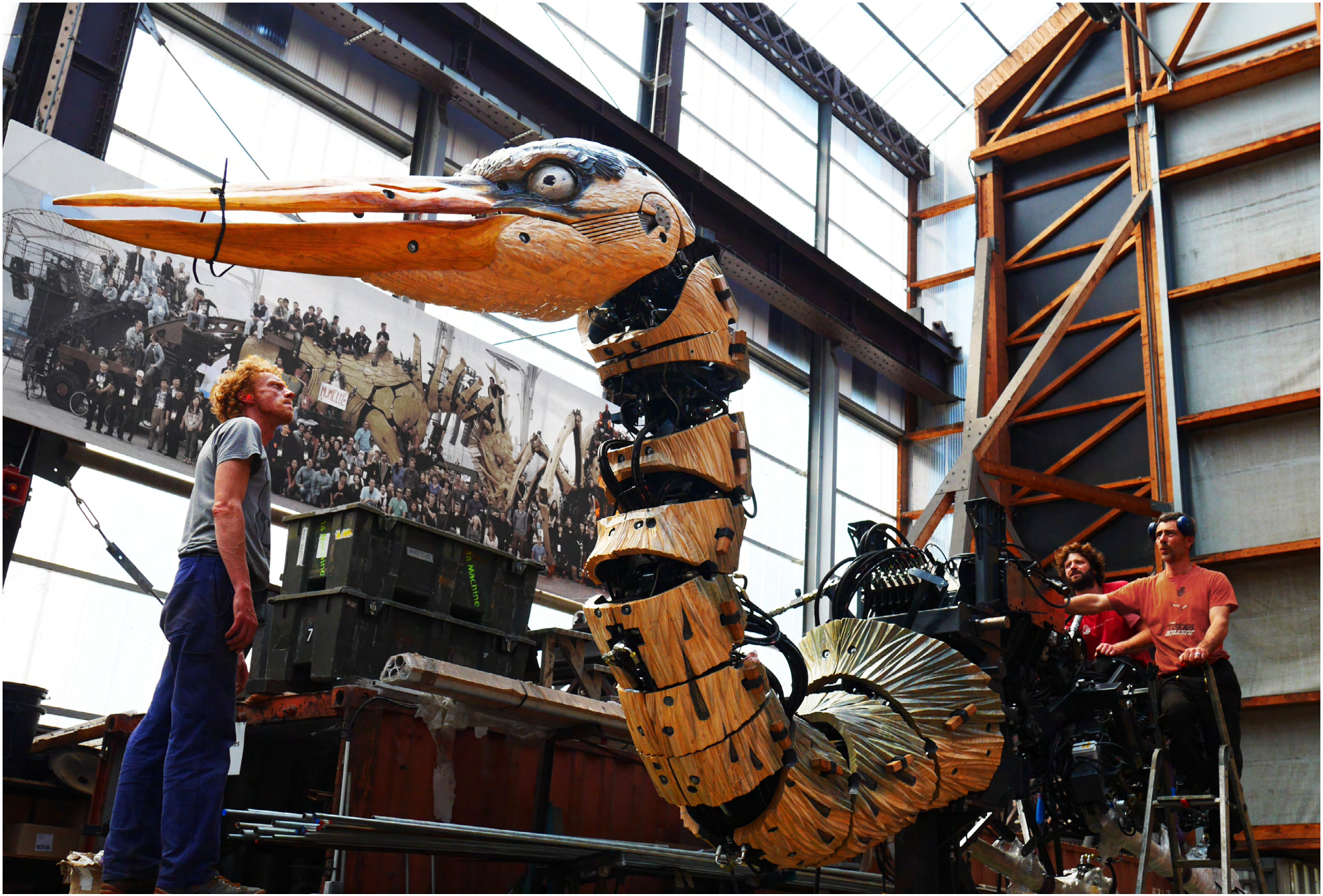
Each of the sub-units is made up of different limbs or vertebrae which replicate the real bird. All of these components are articulated using cylinders and slew rings to create the complex movements which bring the Heron to life. Structures are made from steel (or aluminium for the eyes) and are overlaid with carved wooden casing which is coloured and treated to create the external appearance of the Heron.
The whole structure is supported by two weight-bearing booms. The first allows the Heron to fly and the second is equipped with a counterweight to balance the strain exerted. This weight-bearing structure sits on a small tower equipped with a slew ring to enable the unit to rotate.



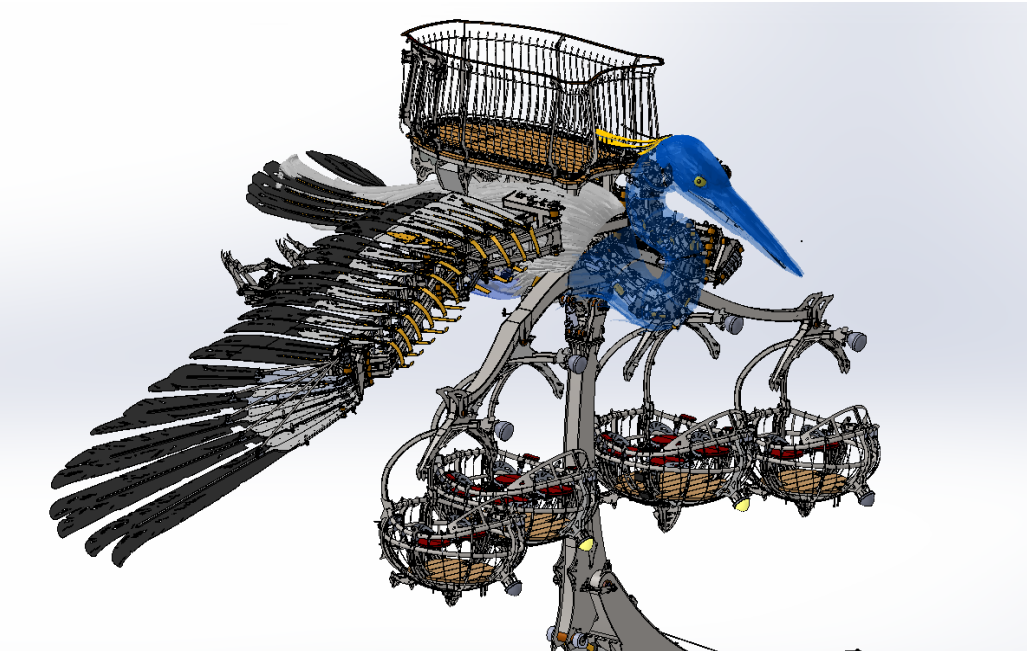


Feather research

Studies for a machine such as this involve integrating a multitude of technical parameters, and the design/construction of the Heron's feathers was one of the most difficult challenges to overcome. They had to be aesthetically pleasing, large, slender, light and, above all, strong, as they are very exposed to the wind. For example, the largest feather (approximately 3.6m in length) has to withstand over 125 kg of wind pressure in operation. The chosen solution involved using composite materials. The engineering company Daher created feather protypes which were made from "woven" recyclable carbon with a robotic arm.


PROMETHE

Once the safety mechanisms for take-off are engaged the Heron can begin its take-off in a realistic way. The first metre is vertical so that the boom clears the platform and then the giant Heron begins its rotation. When it lands, the last metre is vertical for the same reason. The flight lasts 5 minutes: 30 seconds for take-off, 4 minutes in flight, and 30 seconds for landing. The maximum altitude during flight is 5 metres above the boarding position or 40 metres above ground. The flying speed is slow and contemplative (1r/min or 1min/s). The trajectory is circular and varies in height, with wing flapping and gliding phases. The Heron can fly at a 10° angle. It assumes different poses during the flight and makes four complete rotations per cycle.
Its trajectory is monitored by an array of sensors.



Studies for the Giant Heron were carried out over a period of 18 months and construction began in June 2020 in the Cie La Machine workshop. The aim of the design was to create a heron which was morphologically lifelike both in terms of its wooden external "envelope" and its mechanical structures, which can adopt a number of realistic positions. The machine-animal marriage is a subtle combination and we are keen to showcase rather than hide this.

It is necessary to build a heron on the same scale as the Tree to address the technical challenges created by its installation 40 metres above ground. There are significant constraints due to the complexity of its movements, the size of the unit and its exposure to wind and bad weather. Materials and designs must be adjusted accordingly. The unit must be able to withstand winds of up to 26m/s (i.e.95km/h). The Herons must stop operating if winds exceed 15m/s (i.e. 54km/h), and in the event of a thunderstorm, in order to comply with legislation. Because visitors are present on the Heron, it must comply with a number of standards imposed by law. At every stage of the design, a member of staff responsible for calculations validated the strength of the materials, the diameter of the bolts and axes, stability and wind resistance standards, soldering standards and standards relating to hosting visitors. Throughout the entire design and construction process, NECS, a technical evaluation consultancy, has been providing advice and validating these calculations.

Before perching on the top of the Tree, the Giant Heron will be installed close to La Machine company's workshop in public space outside. The first Heron test flights will take place in 2021. These tests are an integral part of the studies for this machine. Just like biologists, the construction team will study the behaviour of the mechanical animal in minute detail.

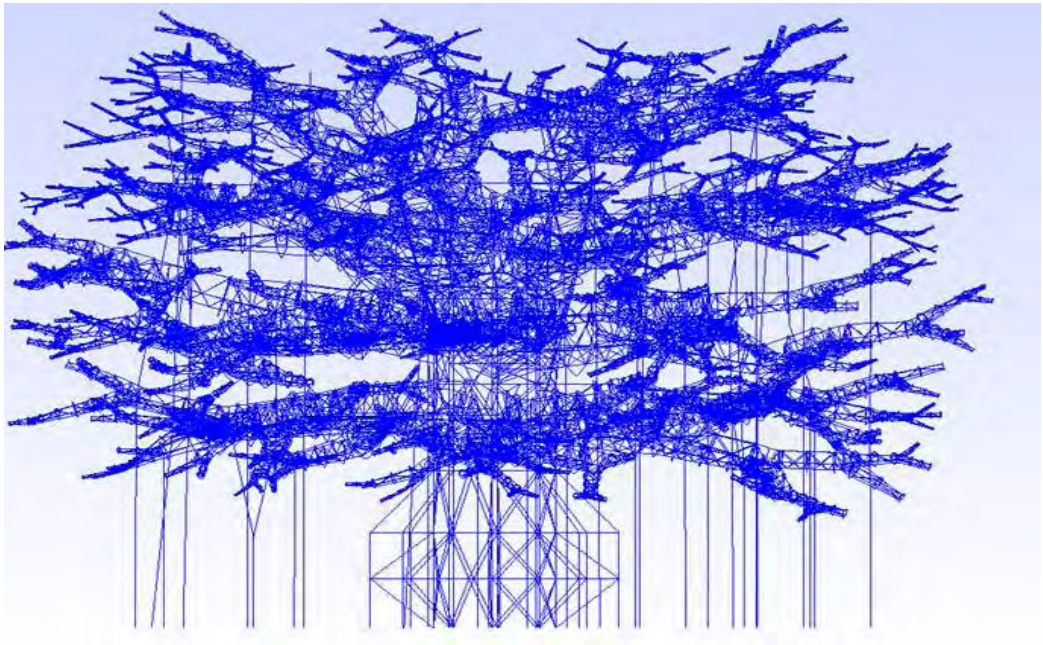
TECHNICAL STUDIES

The whole sculpture was modelled in 3D by La Machine's design office under the artistic supervision of its creators. Then, in order to ascertain the feasibility of this unique structure in the light of all the technical issues, La Machine put together a team of specialists made up of leading European and international design consultancies.

The structure was dimensioned and optimised by SIXENSE NECS, a structural design consultancy specialising in civil engineering projects and highly complex engineering structures (such as the Musée des Confluences in Lyon).

The foundations were studied by ARCADIS, a geotechnical specialist and international leader in sustainable design and engineering solutions, and consultancy relating to the natural and built environment.

Compliance with classification and regulatory standards was assessed by a group of two technical evaluation bodies. Firstly, TUV NORD, an international technical services provider which certifies the majority of European theme parks, and secondly, BUREAU VERITAS, a world leader in leader in testing, inspection and certification.
Fire safety was analysed by EFECTIS, a fire science consultancy with expertise in all the fire safety skills required for testing, engineering and modelling, certifications, inspections, training, and evaluation.
The effects of wind on the structure were analysed by CSTB, a French public institution and European leader in engineering evaluations in five areas, including wind. Wind studies were carried out at their premises in Nantes using their cutting-edge equipment, notably the climatic wind tunnel at the Jules Verne Institute for Technology Research.



Wireframe view of the structure

Structure

Given the complexity of the geometry of the Tree, structural studies were carried out using a 3D digital model known as a wireframe. It can be used to apply the various stresses to which the structure will be subjected (gravity, operational stress, wind, earthquakes, etc.), and to calculate its behaviour. This is a very complex digital model in which each structural element is represented by a simplified geometric element (a three-point arc, line, surface, etc.) with its section profile and name. The simplified version contains 82,000 structural elements. Once the whole structure has undergone geometric dimensioning, each sub-section can be defined and calculated at a local level with greater precision.

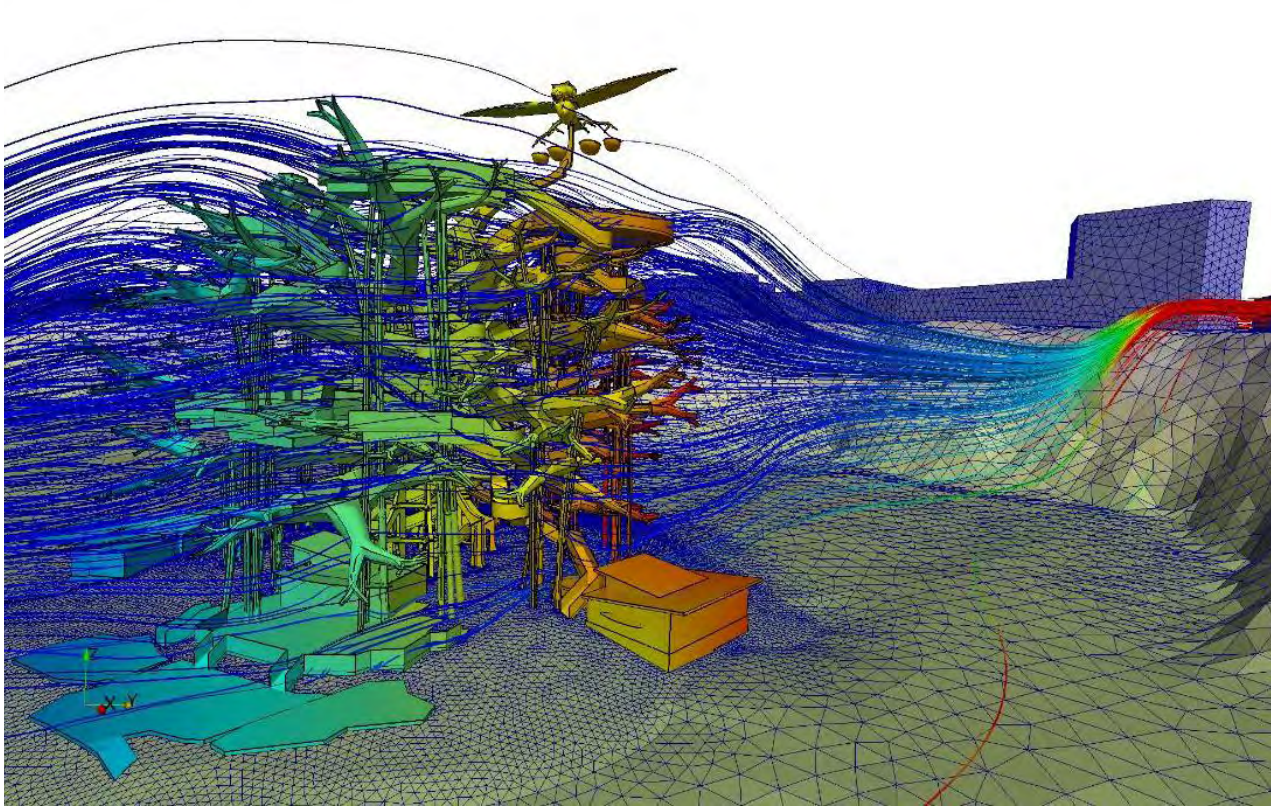
Wind

Wind is also an element which has an impact on the dimensions of the Tree structure and it is therefore crucial to understand it in detail. A specific study was carried out with CSTB, which uses a wind tunnel on elements of the Tree - plants, branches and scale models - to study their behaviour. This was involved two phases:

- Ascertaining wind characteristics in the Bas-Chantenay quarry
- Assessing the effects of wind on the Heron Tree

Wind characteristics onsite

A 40m measuring mast was installed in the exact centre of the future Tree in order to measure wind at 10, 25 and 40m. We also used it to measure temperature, as this provides valuable information about planting conditions in the Hanging Gardens.
A second measuring mast was installed on the roof of CAP 44, a building on the banks of the Loire which catches the prevailing south-west wind. The physical wind measurements in the quarry were compared with those at Bouguenais airport during the brief measurement period (a benchmark site which has measurements going back 30 years).
By extrapolation, we were able to identify wind characteristics in the quarry over a long period of time.
A digital simulation captured this data and simulated the demolition of the car park and the partial demolition of the CAP 44 building to identify wind characteristics on the Heron Tree in the future configuration of the site.



Assessing the effects of wind on the Heron Tree

This complex study involving 10 major phases was based on a blend of measurements applied to life-size and scale models using digital simulations. The measurements taken onsite and the simulations carried out in wind tunnels have shown that the quarry protects the Tree from prevailing Loire winds, but that the CAP 44 building has an accelerator effect, notably on the upper part of the structure. It was thought that the planting could create surfaces that increase wind resistance, but it was observed that it had no impact on the overall pressure exerted on the building. The construction principles employed in the Tree will allow it to withstand gusts in excess of 200Km/h.

0 m/s

15 m/s

40 m/s

Ageing of materials

The mechanical animals on the Heron Tree are subjected to bad weather all year round. Awnings will be installed to protect them but it is imperative that materials, assemblies, and treatments are adapted to climate conditions on the banks of the Loire. We have therefore built a small cage containing 2m by 1m samples, which is already in position at the foot of the future Tree in the Bas Chantenay quarry.

It contains a multitude of wood species, different treatments, varnishes oils and surface finishes. Wooden/metal assemblies are also being tested. Other materials will be added, such as textiles and leather.
Regular monitoring has been implemented to observe how these samples age over time and to find the best materials. This testing will be carried during the entire operation, i.e. over several years, and will ensure that the Tree retains its beautiful appearance and bright colours.

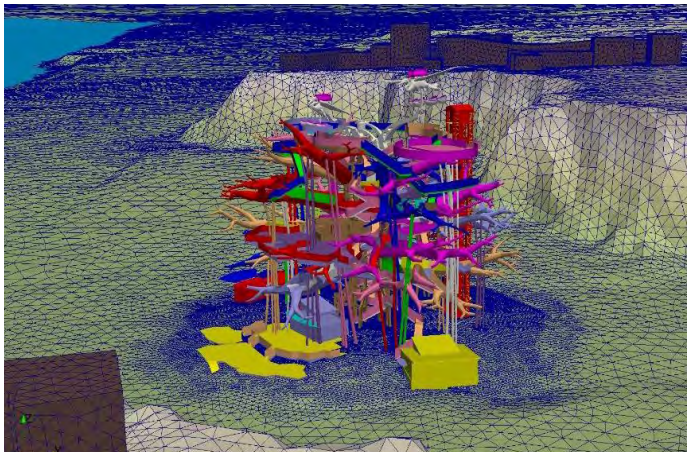
Lightning

Building a 1,5000-tonne structure exposed to bad weather obviously raises the issue of vulnerability to lightning. A risk assessment is underway and aims to identify and quantify the measures which need to be implemented. Planned solutions involve:

- Earthing the entire structure
- Suspending operations on the Heron Tree in the event of a thunderstorm
- Installing surge arrestors in all electrical cabinets

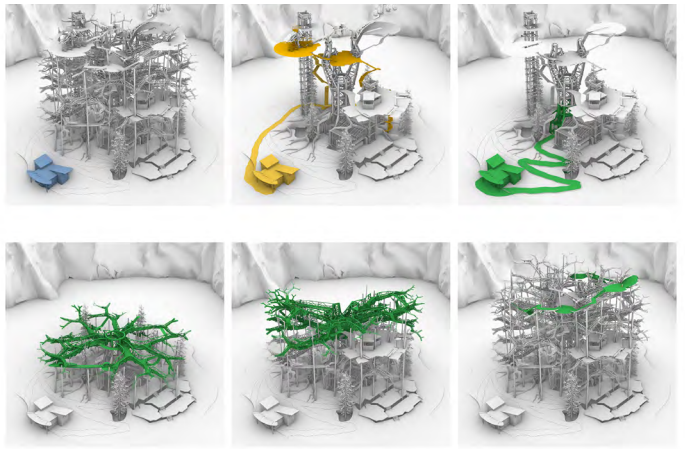
In addition

Supplementary studies have successfully addressed the following issues :



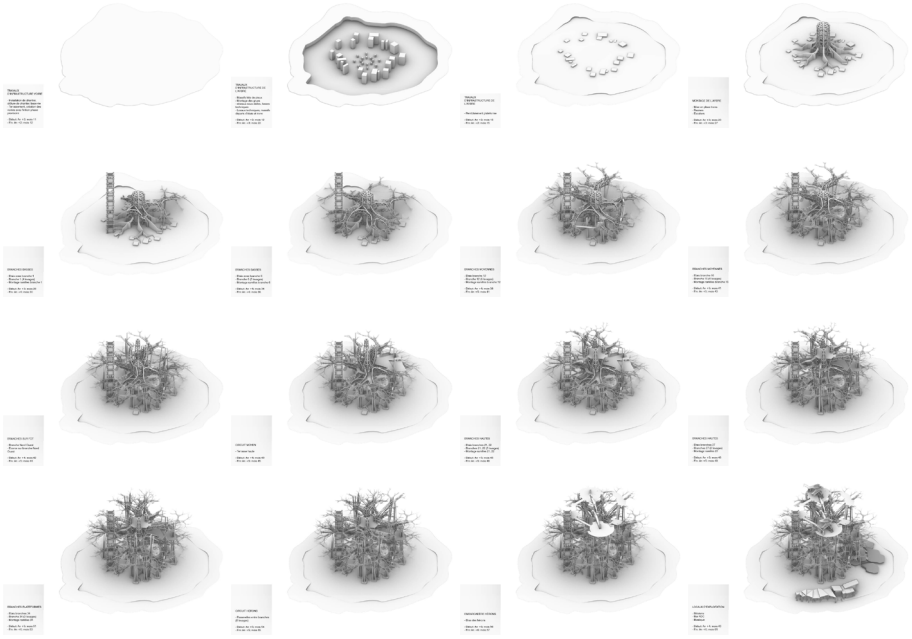
Maintenance of the structure of the Tree and its Bestiary.

Fire safety and visitor evacuation

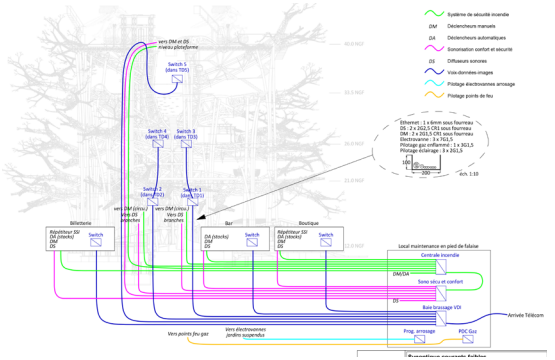


Operations, visitor hosting, and accessibility
Fire safety and visitor evacuation

Project timetable and optimisation



Gardening and protection from climate risks



Fluid installations (water, electricity, gas, hydraulics), network plans and energy consumption management

The economic component

Heron Tree figures :

- 2/3 of wages for construction services paid to local workers

- 90% of companies associated with construction are from the region

- A stimulus for post-Covid recovery

- 30 million euros of benefits for the local area

- 500,000 visitor admissions expected

- 160 full-time jobs and approximately one hundred jobs for students when Les Machines de l'île begins operating the Heron Tree.

86 people from the Compagnie La Machine were involved in studies for the Heron Tree. The detailed project study consisted of over 3,000 pages of data.

The study also offered an opportunity to share this extraordinary venture with numerous local stakeholders: 44 patrons provided in excess of 6 million euros; 5,511 private individuals donated €373,000 in two months; and the whole regional café, hospitality and catering sector was involved.

The Heron Tree

Co-Creators : François Delaroziere and Pierre Orefice

Design : Compagnie La Machine

www.lamachine.fr
arbreauxherons.fr

Press contact
Fredette Lampre I 06 87 77 28 71
fredette.lampre@lamachine.fr

Picture Credits :
Sketches : François Delaroziere
Photos and 3D images : Cie La Machine