A Handbook of Design Experiments

. . . in which are treated the process of observing the properties of Materials, the process of constructing working models and the significance of demonstration.

Materials and Assembly 48-215

College of Fine Arts, Carnegie Mellon University
Create Lab, Robotics Institute, Carnegie Mellon University
Pittsburgh, PA
2010

Supported by the equitable engagement of hand + mind.

In the beginning, there was a forest of plywood.

The trees blew freely in the wind, bending and twisting wildly. The depths of winter made its mark hard on the forest, bitter chills crackling and rupturing elasticity that once ruled over the land. By spring, the trees were dead. But something grew out of the destruction. A phoenix rising from the woodchip splilnters, the creature was unsightly and miss-proportioned. Its skin was a taut festering surface of peeling membrane - still laying in the wood shards, it was indistinguishable from its environment. As it emerged from its hole in the forest grave, naked legs were revealed. Thin and a little unstable, they wobbled around till they finally straightened for the first time. The creature tripped, bowed, its gangly limbs dancing lightly over the surface of the debris.

Its dry, crackling skin was draped over a gnarled set of bones, which occassionally protruded beyond its covering. And it was ugly. It continued to walk, meandering aimlessly from its birthplace. The dead forest became a bog, and the creature was stuck in the mud. The long legs pulled and pulled to no avail. It was not until a strong wind came through, lifting the creature up by its hairy armpits. The wind pulled so hard that the joints corkscrewed outwards, the creature filling with air and light. Suddenly shedding its scaly skin, the creature was petrified by its own sublimity, fossilized forever as an empty skeleton of the grotesque, layers of struggle embedded into the grain.

In the end, folding became joining
and pli became ply.

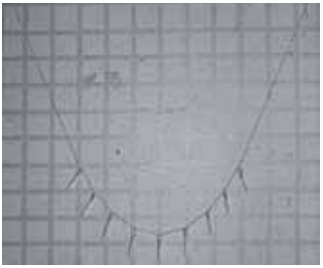
TEAM BUCCODIBEPPO

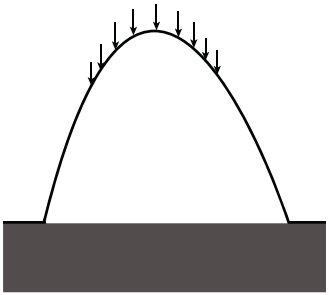
Team Members

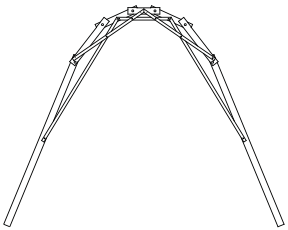
Eric Bruner	Talia Perry
Chris Buehler	Rebecca Peterkin
Wei-Li Cheng	Daniel Rapoport
Sarah Harkins	Medha Singh
Benjamin Howe	Zachary Weimer
Issac Kwon	Karno Widjaja

GEOMETRY

With the Gaudian caternary model and precedents in the Rainbow Bridge of China and other wooden-member vernacular architecture as a source of inspiration, the design utilizes individual members that interlock to form a continuous-span arch. In the model, weights were applied to strategic points on a hanging string, and a gridded system was used to record accurate observations as the system adjusted to varying forces throughout the testing process. After multiple iterations the group determined that nine weights implied an appropriate parabolic curve, and the segmented nature of the model directly informed the design process.

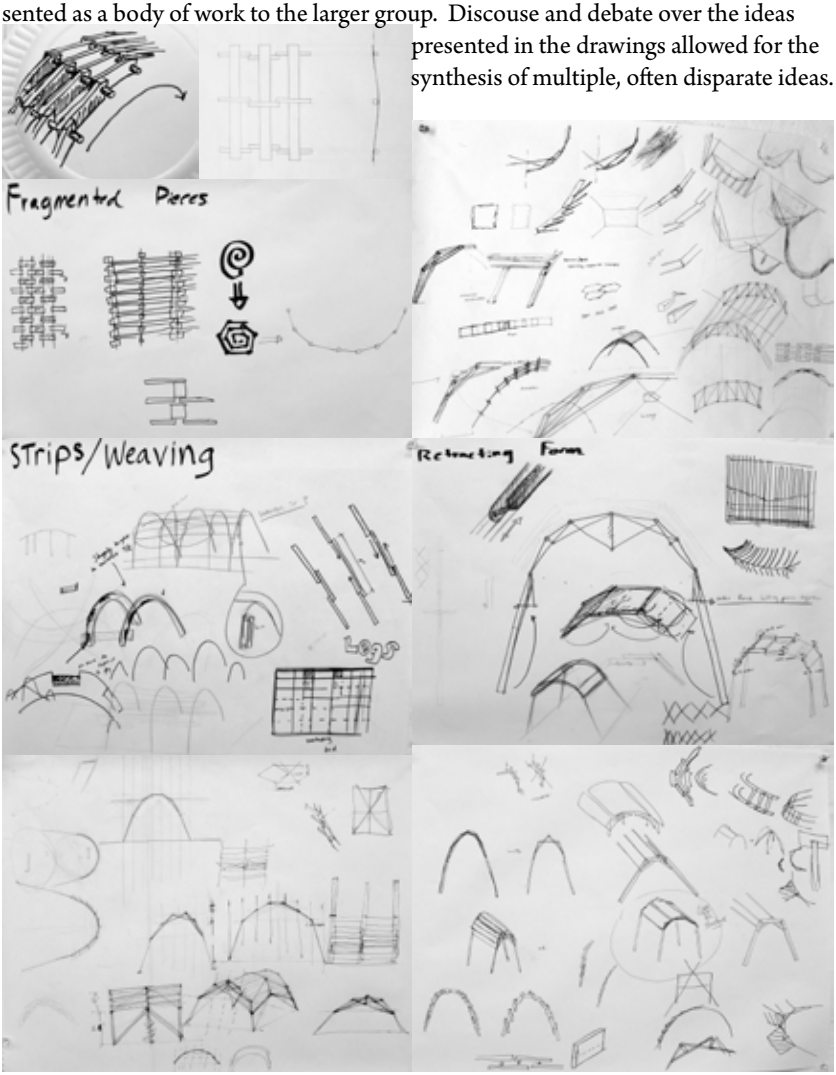




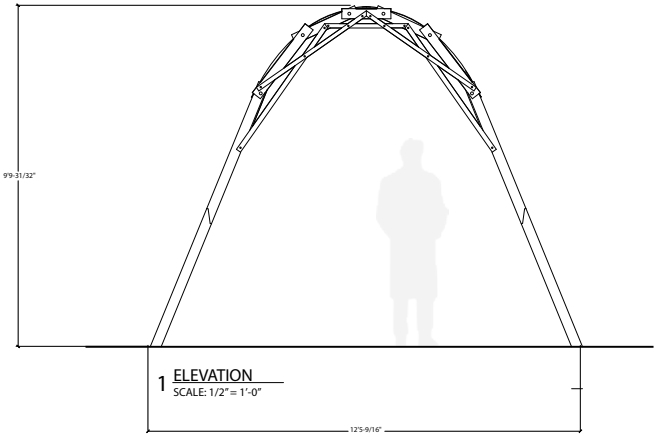


SKETCH

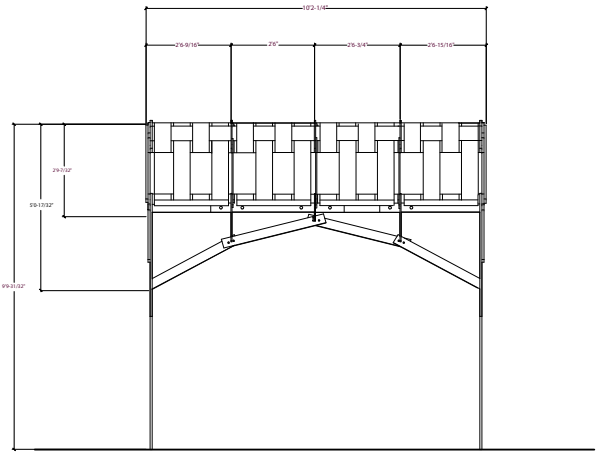
Our process was informed through the use of multiple iterations of gestural hand drawings. Dividing ourselves into small, exploratory groups, each team pursued different design strategies through multiple sketched drawing sets that were then presented as a body of work to the larger group. Discouse and debate over the ideas presented in the drawings allowed for the synthesis of multiple, often disparate ideas.



DRAWING



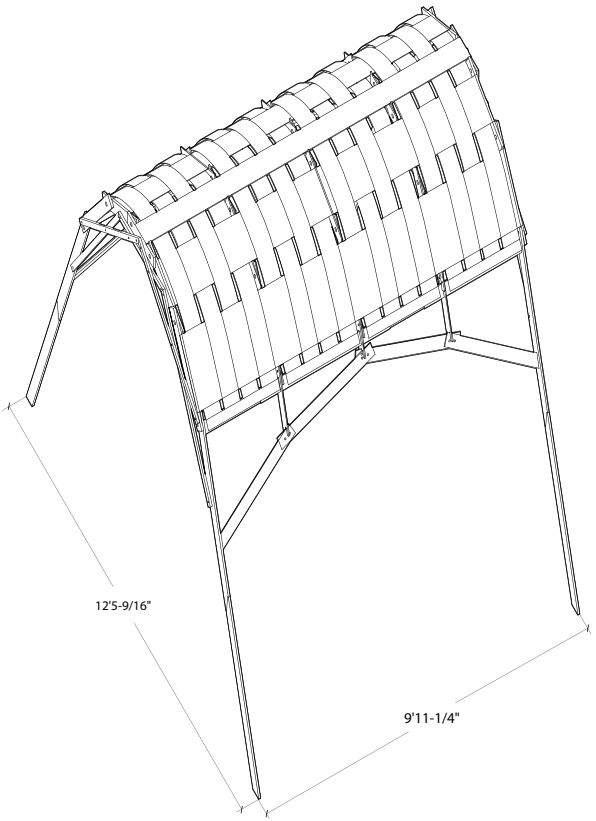
1 ELEVATION
SCALE: 1/2" = 1'-0"



1 ELEVATION
SCALE: 1/2" = 1'-0"

Figures not to scale.

DRAWING

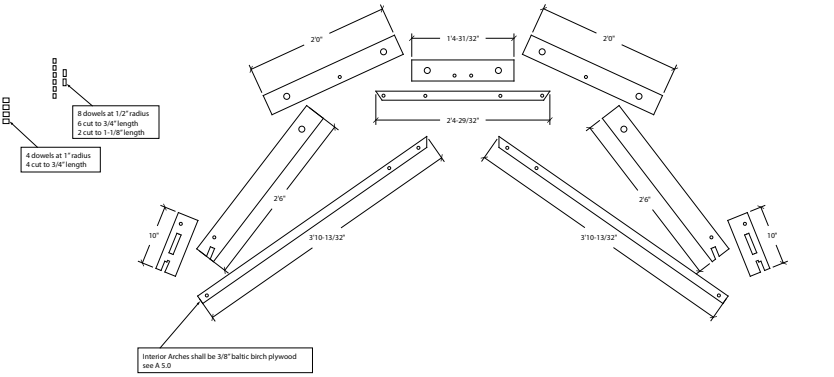


1 AXONOMETRIC
SCALE: 1/2" = 1'-0"

Figure not to scale.

DRAWING

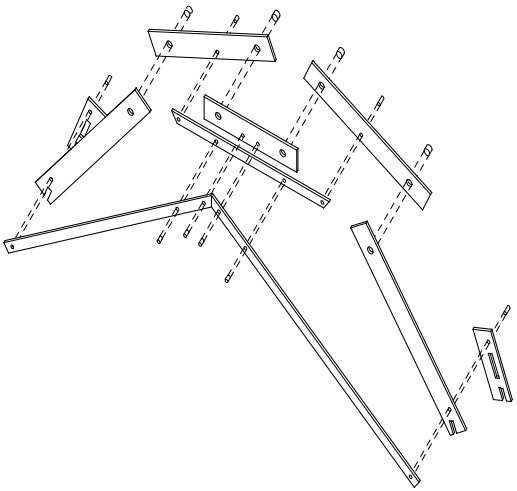
Our group felt that the use of dowels to hold all non moment connections together would express the structual aesthetic of the overall design. This would not only unify the type of connections used, but also allows for a visual blend of the overall material palette used for the construction of the project i.e. plywood.



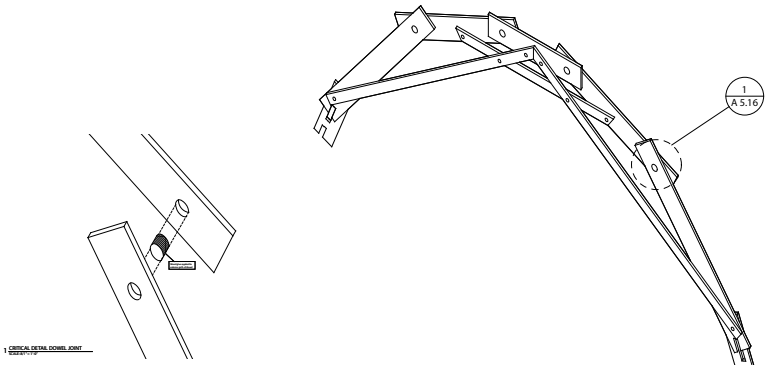
1 COMPONENT LAYOUT INTERIOR CENTER ARCH
SCALE: 1/1" = 1'-0"

Figures not to scale.

DRAWING



1 EXPLODED ASSEMBLY INTERIOR CENTER ARCH
SCALE: 1/1" = 1'-0"



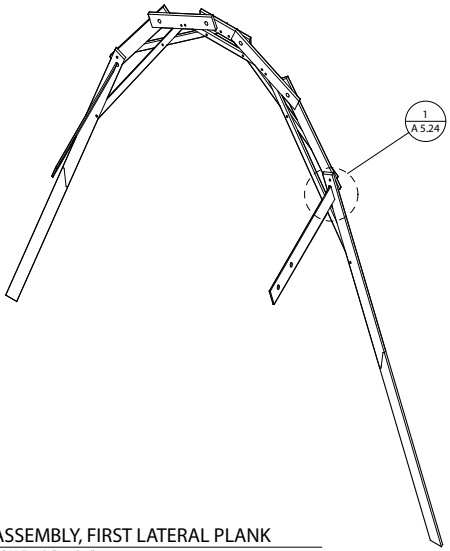
1 CRITICAL DETAIL DOWEL JOINT

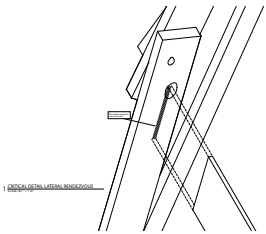
2 ASSEMBLED INTERIOR CENTER ARCH
SCALE: 1/1" = 1'-0"

Figures not to scale.

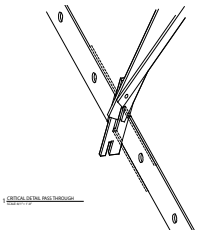
DRAWING

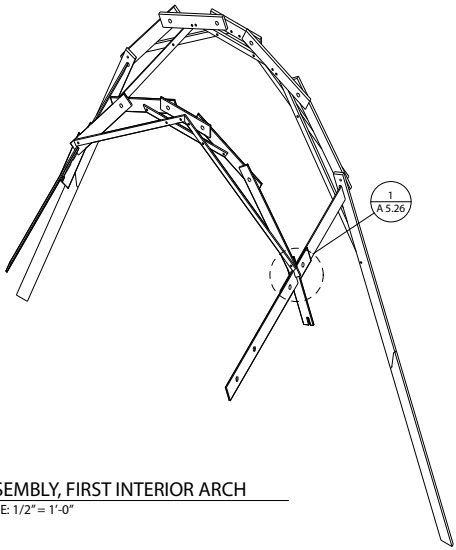
Moment joints were used to hold connections together where the dowels system proved ineffective. With the allowance of metal brackets to be used in the project, they were subsequently used at key moment joints as a stronger and more effective alternative.





1 ASSEMBLY, FIRST LATERAL PLANK
SCALE: 1/2" = 1'-0"

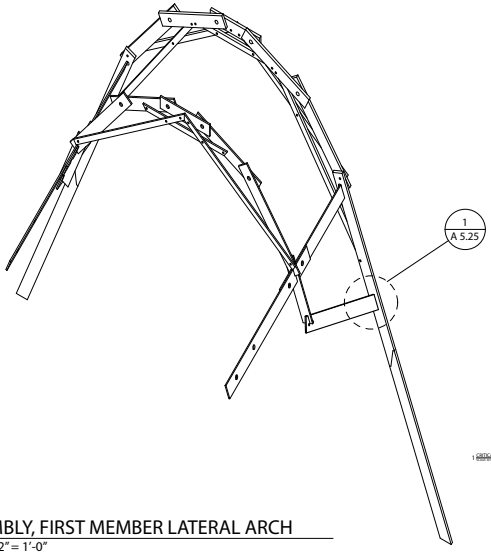


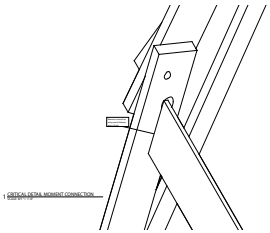


2 ASSEMBLY, FIRST INTERIOR ARCH
SCALE: 1/2" = 1'-0"

Figures not to scale.

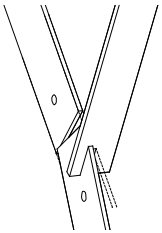
DRAWING



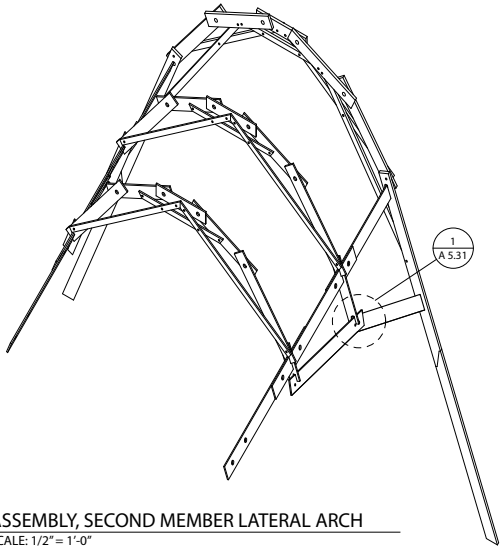


1 CRITICAL DETAIL MOMENT CONNECTION

1 ASSEMBLY, FIRST MEMBER LATERAL ARCH
SCALE: 1/2" = 1'-0"



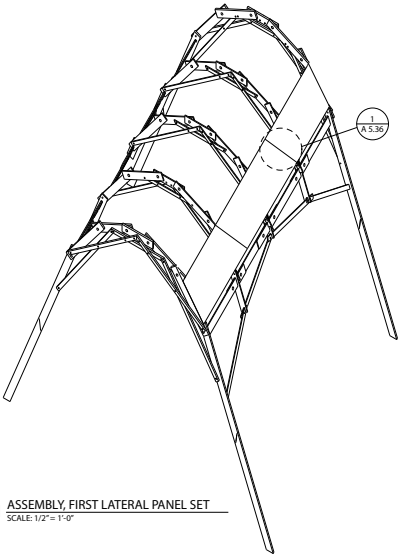
1 CRITICAL DETAIL GUIDE INTO NOTCH



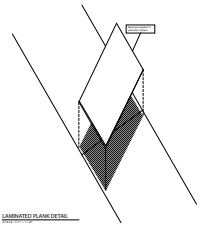
2 ASSEMBLY, SECOND MEMBER LATERAL ARCH
SCALE: 1/2" = 1'-0"

Figures not to scale.

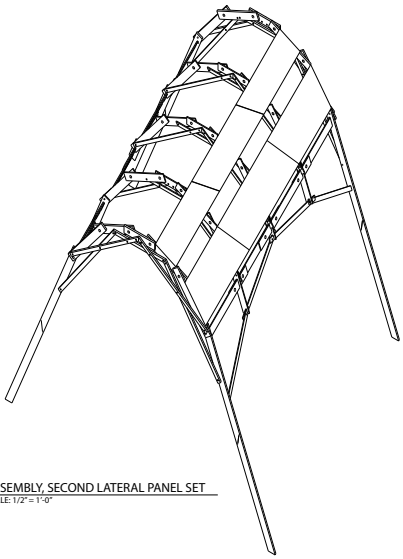
DRAWING



1 ASSEMBLY, FIRST LATERAL PANEL SET
SCALE: 1/2" = 1'-0"



1 LAMINATED PLANK DETAIL

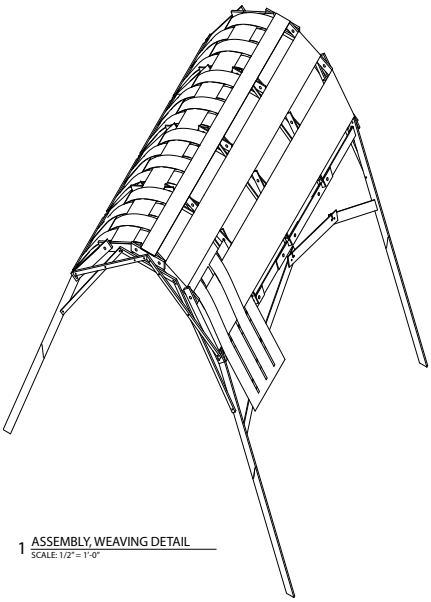


2 ASSEMBLY, SECOND LATERAL PANEL SET
SCALE: 1/2" = 1'-0"

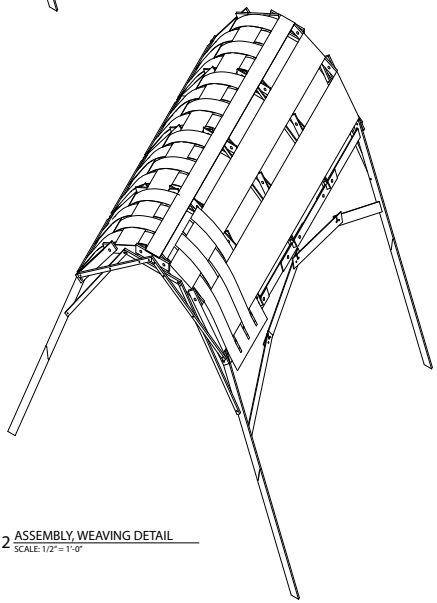
Figures not to scale.

DRAWING

The non structural and weaving panels were included not only as a rooftop addition to the vaulted structure, but also as an additional component of lateral stability. The combination of both systems were conceived from the earlier iterative models and sketches made by the group as an interesting and unique way to provide basic protection from the elements as compared to a typical roof.



1 ASSEMBLY, WEAVING DETAIL
SCALE: 1/2" = 1'-0"

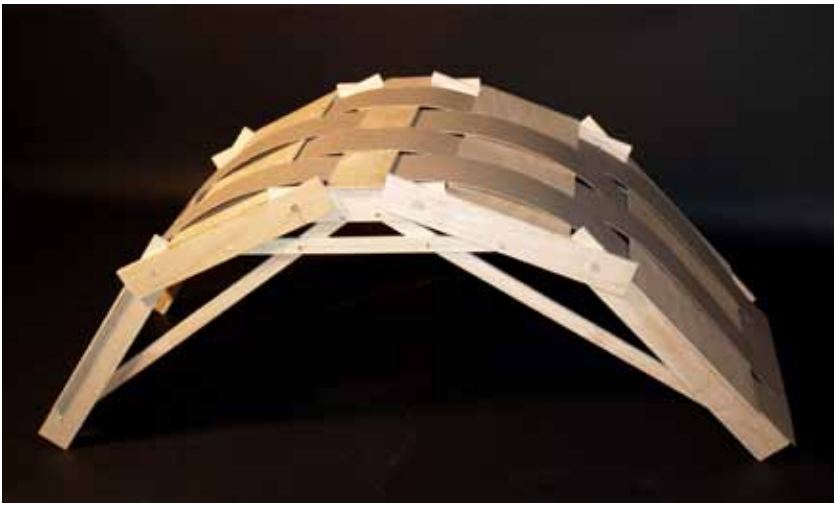


2 ASSEMBLY, WEAVING DETAIL
SCALE: 1/2" = 1'-0"

Figures not to scale.

MODELING

MODELING

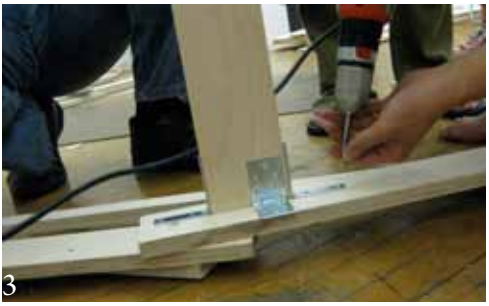


CONSTRUCTION

1| Marking the plywood pieces
2| Cutting out the plywood pieces on the table saw
3| Drilling the metal fasteners into the exterior arch to support the moment joint
4| Putting up the first exterior arch
5| Attaching the first interior arch to the exterior arch


1


2


3


4


5

CONSTRUCTION

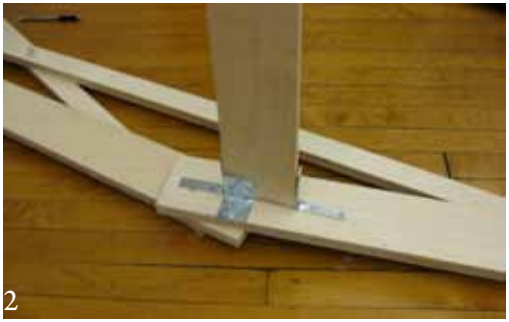
1| Laminating the planks

2| Using metal fasteners to create the moment joint

3| Attaching one exterior arch and two interior arches

4| Completed structural arch without planks and weaving


1


2


3


4

CONSTRUCTION


1

1| Structural pieces
2| Supporting an interior arch
3| Final assembly of structural arch
4| Final assembly of structural arch
5| Placing the center plank


2

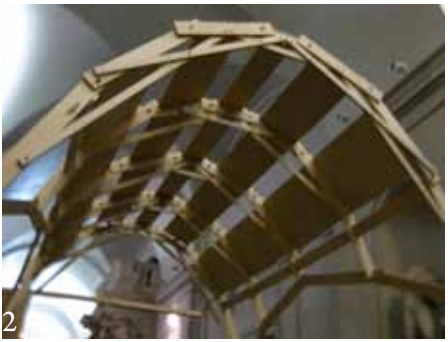

4


3


5

CONSTRUCTION

1



2

3

4

1| Close up of exterior arch

2| Structural arch with planking

3| Attempt to place weaving on the arch

4| Final arch