

1 Assignment and final tasks.

The mathematical task is to match the graph of a function to a real arch of stone for example here in church architecture? You will explain a method to use math functions for real situations, a bit like the pictures frequently seen in video games and which can be moving on the screen later on and not in real.

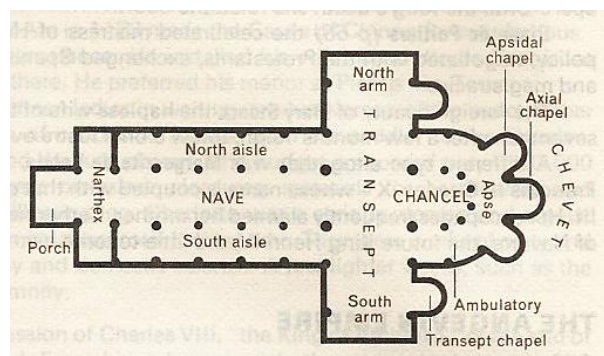
The communication task is a peer to peer students conference based on a self made poster to be given as experts in direction to visitors. All members of the team have to speak equally when presenting to the visitors.

The collaborative task is a team work in a foreign language and members are called below Alice, Bob, Charlie, David and Emmy. Feel free to share roles.

2 A human sized piecewise curve

1. Consider next to the narthex in the north aisle the baptist basin and look at its decoration on the body. One arch joining two columns is called *pointed arch* and consists of two intersecting circles arcs of equal radius. Alice chooses one such arch on this basin.
2. Using a measure tape Bob takes measurements of all dimensions and Charlie sketches a labelled diagram of this human size pointed arch. Keep it for the poster.
3. David chooses one of the pointed arches in the south arm of the transept. It looks as a rectangle topped with two pieces of intersecting semi circles.

Your task is to measure many heights to plot the curve of this arch and calculate if it is perfectly piecewise semicircular or not. The method given in the following is to turn a real solid situation into a mathematical curve, which can be deformed later as it is commonly done in video games for example. Thus, situations can be drawn (photographed?) on computer although they cannot be real.



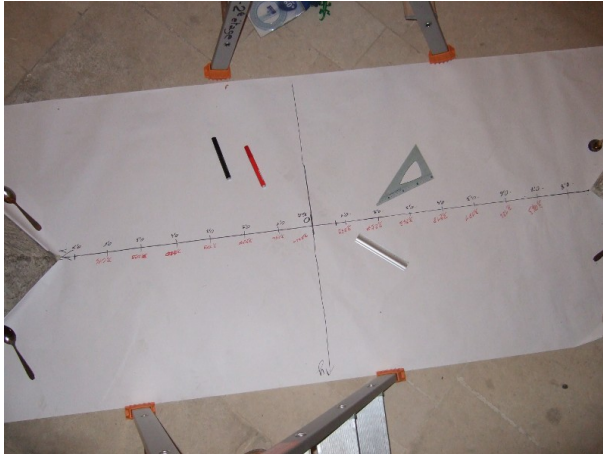


3 Measuring an inaccessible curve

Share roles in the following instructions.

1. Choose a much larger pointed arch in the south arm of the transept.





2. Lay the sheet of paper on the ground under the arch. The edge of the arch is the piecewise semicircular curve that has to be studied. Draw carefully onto the paper an axis where the projection of the keystone is the origin. This straight line segment is the vertical projection onto the ground of the arch curve. Give graduations every **10 cm**, orientate this axis. Secure the paper onto the ground to keep it fixed while measuring and taking notes. **FROM NOW ON THE PAPER SHOULD STAY UNREMOVED AT ALL TIMES DURING MEASUREMENTS!**
3. Measure carefully the height between the ground and the edge of the arch at all graduations. Use the grid given in the answer sheet to fill in your measurements.
4. Measure the height of the pile, the span and the rise of this arch. Fill in the answer sheet.

4 Plotting the curves based on the measurements

1. Ask the teacher for a computer and open an excel sheet. Insert in the excel sheet all measurements taken on the large pointed arch.
2. Plot the graph of these measurements. Is it what you expected it to be? Why or why not?
3. Ask the teacher to print the calculations and the graphs for the poster.

5 Approximating the graphs with the graph of a function

1. In the previously used window, plot the graph of the function $f(x) = \sqrt{1,79^2 - (x - 0,9)^2}$ for $-0,8 \leq x \leq 0$ and $f(x) = \sqrt{1,79^2 - (x + 0,9)^2}$ for $0 \leq x \leq +0,8$ where x is the coordinates on the axis drawn on the paper on the floor.
2. Is this theoretical graph a good approximation of the graph of the measurements? If not, you can adjust the constants given above to better ones if needed.
3. Ask the teacher to print the graphs for the poster.

6 Bibliography

Actes de la rencontre des IREM du Grand Ouest, 2009, "De l'architecture aux mathématiques : des lycéens sur le terrain", Pierre Ageron, Odile Jenvrin, Jean-Pierre Le Goff, page 15

7 Provided material

- a large sheet of paper to lay on the floor
- weights to secure the sheet of paper
- markers
- a laser measuring device (new batteries?)
- a craft worker's measure tape
- a level
- a plumbline
- answer sheet with grid for measurements
- a combined protractor square set ruler (a "Math en Main" present to each participant)
- blank sheets for further drawings to be glued onto the poster
- separate photos of places in the church and the church plan given in this assignment

**Answer sheet to fill in the measurements,
 for calculations and personal notes**

Name
Team

measurements	human sized round arch	large round arch in the nave
height of the pile		
span		
rise		

Measurements of the large arch in the transept

x in metres	h in metres
-1,2	
-1,1	
-1,0	
-0,9	
-0,8	
-0,7	
-0,6	
-0,5	
-0,4	
-0,3	
-0,2	
-0,1	
0	
+0,1	
+0,2	
+0,3	
+0,4	
+0,5	
+0,6	
+0,7	
+0,8	
+0,9	
+1,0	
+1,1	
+1,2	