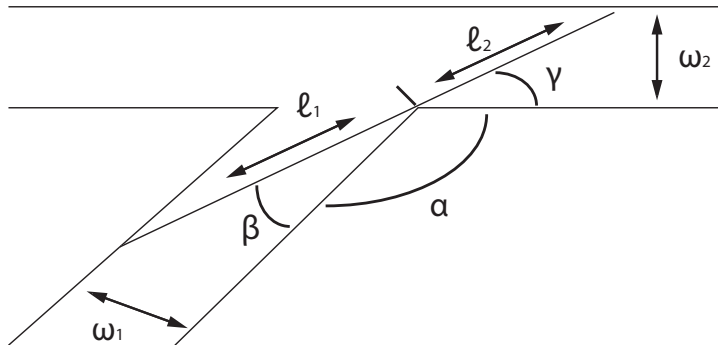


## Application Problem 1: Root Finding

As the construction in Olin Hall continues, we must think about the ability to set up our classrooms in a desired manner. For instance, we want chalkboards in the rooms. In order to get them there, we need the chalkboards to be able to be manuvuered through the hallways. There are two intersecting halls with width  $w_1 = 9$  feet and  $w_2 = 7$  feet. These two halls meet at an angle  $\alpha = 125^\circ$  as shown:



Assuming a two-dimensional situation, what is the longest board that can negotiate the turn? Ignore the thickness of the board. The relationship between the angles  $\theta$  and the length of the board  $\ell = \ell_1 + \ell_2$  is  $\ell_1 = w_1 \csc(\beta)$ ,  $\ell_2 = w_2 \csc(\gamma)$ ,  $\beta = \pi - \alpha - \gamma$ . The maximum length of the board that can make the turn is found by minimizing  $\ell$  as a function of  $\gamma$ . Hint: Think back to calculus, how do we find a minimum or maximum of a function? What is the longest board that can be installed in Olin if this corner must be negotiated during the installation?

**Rubric:** Each of the following categories will be classified as Achieved or Opportunity. All categories must earn an Achieved ranking in order for the Application Problem to earn an Achieved Ranking.

### Transforming the scenario into a mathematical problem.

- Recognizes information that is relevant to the scenario.
- Correctly relates relevant information.

### Correctly implementing a relevant numerical technique.

- Chooses and appropriate numerical technique for solving the problem.
- Correctly implements the chosen numerical technique for solving the problem.
- Gives appropriate explanation as to why technique was chosen.

### Clearly communicating your process and results.

- Provides necessary information to motivate and put the question in context.
- States the question and explains why it is important and interesting.
- Explanation of mathematical interpretation of problem.

- States what methods are used to arrive at the solution AND why they were chosen.
- States solution of the problem.
- Interprets meaning of the solution and puts it in context of the background information.
- Clear and concise.
- All variables are clearly defined.
- Units for all quantities are given.