

Final Design Project

“The Turducken cooking challenge”

Report and Presentation Due: Monday, December 11th 6:00 pm

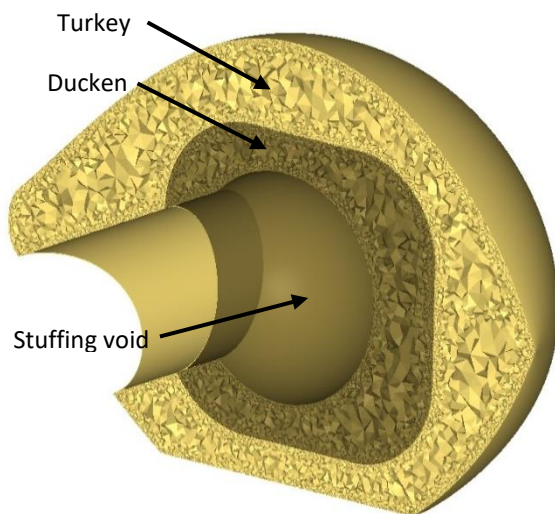
1 Overview

Cooking a thanksgiving turkey properly is a challenge, too much heat and it gets dried out, too little and your guests can get ill. A wealthy captain of industry who owns a turkey farm has put out a competition to help him design and then market a new concept in cooking his brand of turducken. The concept consists of cooking a turducken in a conventional oven, with the addition of electric resistance skewers which may be placed through the turkey. These help cook the inside of the turkey/duck and chicken while the outside is cooked more conventionally. The product, if properly design could potentially reduce the amount of cooking time, while more consistently maintaining even temperature throughout the bird. A void in the turkey will be used to fill the bird with stuffing during the cooking process.

Your task is to design these skewers for use in combination with a commercially available oven. Your goal is to design a system for cooking your client’s brand of turkeys with the skewers you design. Your aim is to produce the fastest cooking time yet maintain the most consistent cooking temperatures.

You are to use a combination of CAE tools, manual calculations as well as sound engineering judgment to design the product. To aid you in your work, your client has had one of his genetically engineered turkey breasts electronically scanned in 3d, showing the turkey, the ducken (chicken and duck) and the void where the stuffing will be placed. For this assignment you will work in groups of three.

<http://en.wikibooks.org/wiki/Cookbook:Turkey>



The 'large' scanned turducken as provided by your client



Turkey consumers

2 Design Responsibility

Your skewers will be electrically powered and use resistance heating. You are responsible to design their size, geometry and heating capacity. In addition you must specify for the potential customer where they are to be placed in the turkey, and under what settings the oven is to be set at.

You will not however be required to design the actual oven. You are also not required to determine methods of manufacturing or the cost of your design.

3 Performance Requirements

The design of the skewers and cooking method must ensure that the whole turkey is fully cooked. Your assumptions should include the following:

- Realistic properties for turkey meat as well as the ducken. The ducken is a homogeneous mixture of duck and chicken.
- Realistic properties for the stuffing that you recommend using.
- The turkey begins the cooking process as being fully refrigerated at 42°F.
- A fully cooked bird is defined when no temperature in the turkey is less than 185°F.
- An area of the turkey will be considered burned when its temperature reaches 265°F.
- The skewers must be designed to operate such that they reject a constant rate of heat; they may however be turned on or off once during the cooking process as long as when they are switched is specified to the customer.
- The skewers must be capable of being inserted into the turkey in a conventional home kitchen. They may be no bigger than 0.75" in any one dimension of the cross section and the cross section area must be less than 0.25 in². There is no limit on length for the skewers and the entire length of the skewers need not be actively heated or the same in cross section. You may use up to two skewers as part of your designed cooking process, but they must be identical.
- The oven in which you cook the turducken may operate between 350°F and 500°F. You are free to use up to two different temperature settings throughout the cooking process, as long as they are specified for the customer.

4 Deliverables

Your design needs to be presented in several ways and needs to fully convey the manner in which it works. These items should include the following:

- A report that summarizes the following:
 - Your skewer design assumptions, including all material properties and how they were arrived at.
 - Overview of your skewer design concept as well as how it is to be used in cooking the turducken.
 - Scaled sketches illustrating your skewer design and their placement in the turducken. These will be used for the customer directions sheet that is provided to the customer.
 - Graphical timeline diagram for cooking temperatures and skewer operation.
 - CAE simulations that demonstrate the following:
 - The total cooking time for your design.

- The simulated temperatures inside the turkey as a function of time, through each stage of your designed cooking process.
- The simulated maximum temperature locations of the turkey at the end of the cooking process.
- Simulations demonstrating the thermal gradient through the turkey at the end of the cooking process.
- The estimated mass/volume percentage of burned turducken.
- Documentation of all of your boundary conditions used in your CAE simulations.
- Hand verification calculations for the major elements of your design, including approximations for cooking time of the turkey given your heated skewers capacities, locations and oven operating assumptions.
- Design time estimate, cumulative number of hours spend developing your design.
- A final presentation showing the following:
 - The cooking time and process for your design.
 - Results of your cooking simulations.
 - Design time estimate.
 - Design benefits.

4.1 Report

The report should be typed and submitted on time by the final delivery date and time. Your report should be of a professional level meeting the standards discussed in class and listed on the syllabus and shall be submitted in paper and electronic form (PDF). In general color or black and white images are acceptable as long as they are legible and clearly demonstrate the results. Late documents will be penalized at a rate of 50% per day late (2% per hour).

4.2 Final Presentation

Your presentation should discuss the required items while keeping the audience engaged and interested. Your primary goal while giving the presentation is to show why your design is the best solution for the problem at hand and show the methodology for how you arrived at it. Presentations will be limited to 8 minutes each.