



# Advanced Combustion: Hot Air Balloon-Engineering

## Background

This Advanced Combustion project stems from a graduate student's study of heat transfer that occurs inside a hot air balloon (HAB). However, little to no studies have been conducted to evaluate performance and efficiency of HAB burners.

## Project Goal

Design and construct a testing facility that mimics the conditions of a real hot air balloon, in which we are able to study the emissions and efficiency of an UltraMagic's 3.2MW MK-32 burner using a Enerac 700 gas analyzer. In addition, design and manufacture a field testing apparatus to place the gas analyzer's probe to collect data from an actual HAB.

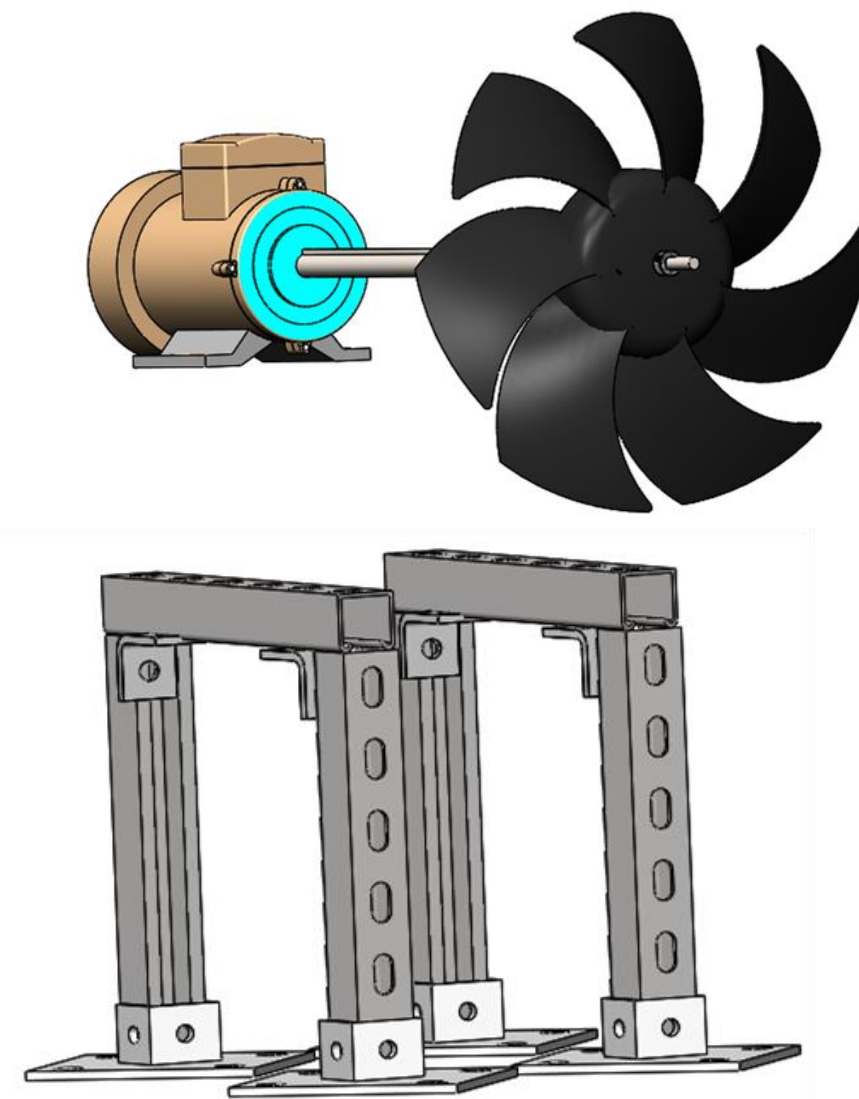
## Project Significance

- Provide a testing facility for HAB outside the field.
- Increase combustion efficiency to reduce HAB operation expenses & improve air quality by reducing emissions.
- Engage students in research in combustion, thermodynamics, and fluid mechanics.

## Testing Rig

### Ducting:

Designed with a 12in diameter to have to allow 200-500% excess air at a 2.28 m<sup>3</sup>/s to be drawn in by the motor.



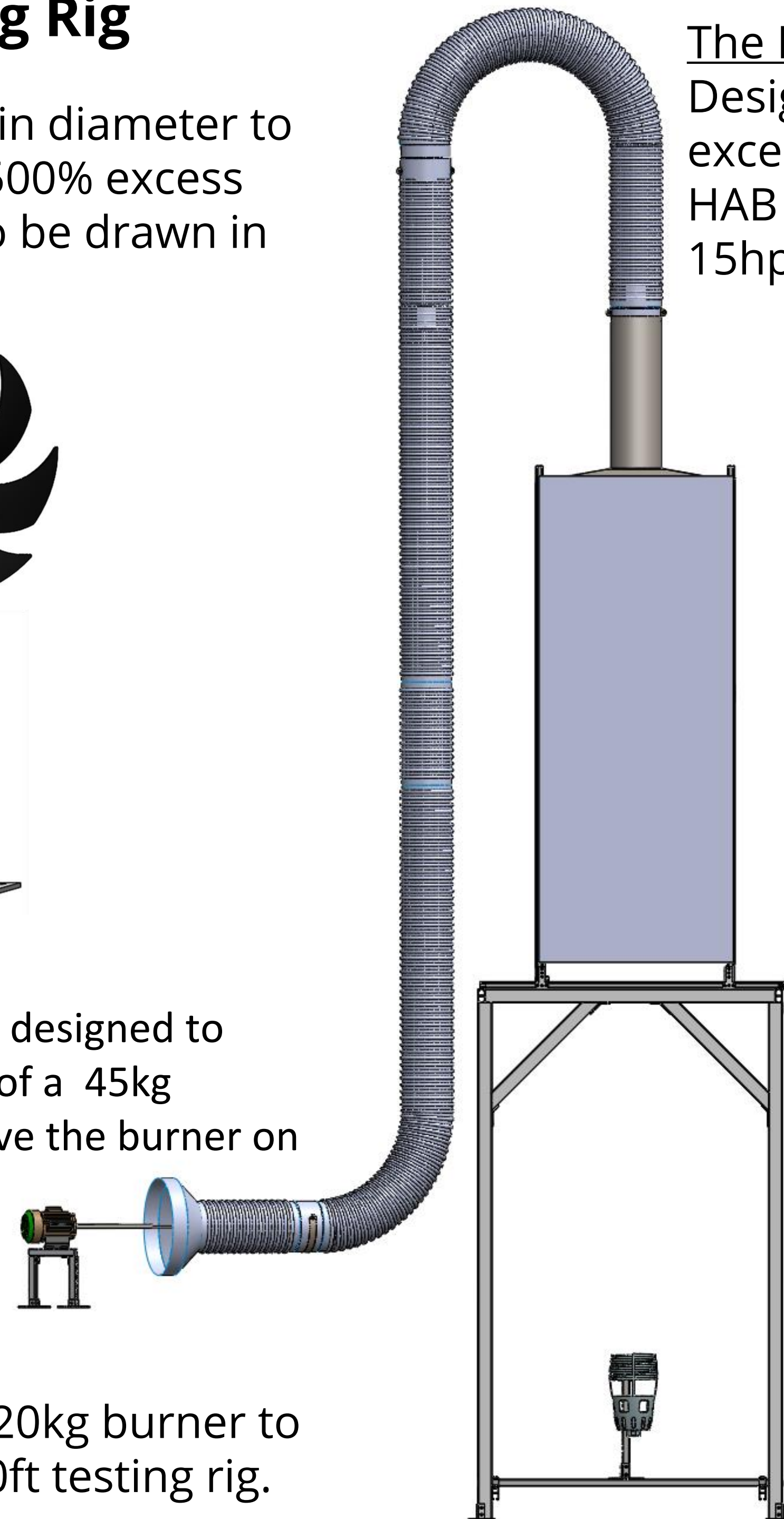
### The Motor Stand:

It is 12in in height and designed to withstand the weight of a 45kg motor, placed 4ft above the burner on the platform.

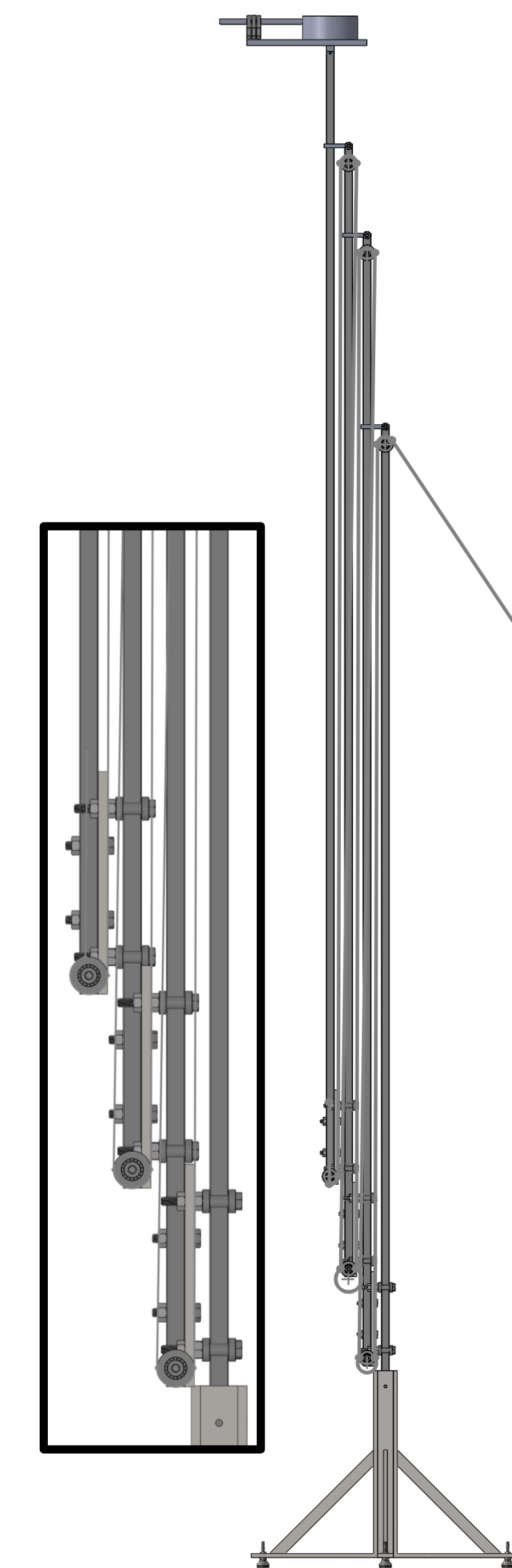
### The Burner Mount:

Vertically align our 20kg burner to directly center of 20ft testing rig.

The Fan Blades and Motor: Design to draw in 200-500% excess air that is similar to HAB field testing, using a 15hp motor.



## Field Testing Apparatus



In-Field Probe Extender  
A telescopic slider elevates the gas analyzer probe 15 ft to be in the flame stack. It is made out of steel to prevent melting at high temperatures.



## Accomplishments

- Creation of a telescopic design to extend the gas analyzer probe.
  - Design & Simulation of fan/ducting.
  - Completed design of burner mount to increase efficiency in mounting procedure.
  - Design of a stand to support the weight of the 45kg motor.
- Team Members: Lily Nguyen, Morgan Ericksen, Anthony Graback, Edwin Rivas

## Future Plans

- Manufacture the fan and ducting components that would allow us to mimic the conditions of a HAB.
- Look for methods to improve overall efficiency and reduce unwanted emissions.
- Manufacture a telescopic probe mounting device that will be used in-field testing.

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## Budget

