

**To:** David Trevas and Class Aids  
**From:** Bio-inspired design for energy Efficiency (BEE)  
**Date:** October 12, 2018  
**Subject:** Team Analysis Memo

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This memo is to inform clients and staff about the analyses that will be conducted on the Bio-Inspired Energy Efficiency team's proposed design. The design is a Solar Radiative Ventilation system/ array which will be adapted onto the heating ventilation and air conditioning (HVAC) system that is currently in the Social Behavioral Sciences West (SBS West) building on Northern Arizona University's campus. The purpose of this design is to bring SBS West up to ventilation codes, while increasing the energy efficiency of the building using ventilation and a solar panel array. Each member of the BEE team is responsible in conducting an analytical and economical analysis on an aspect of the proposed design. The major analyses which will be conducted are an analysis on the ventilation, done by Taylor Mellon, solar panel and solar array, done by Kyle Matsuoka, structure of the housing, done by Talon Mills, and heat exchanger, done by Hani Alharbi.

### **Ventilation - Taylor Mellon**

Ventilation is a key aspect in the design proposed by the team. Ventilation is to bring the building up to code and provide energy efficiency for the HVAC system. Taylor will be conducting the analysis of the ventilation of the system, focusing on one panel and then applying his findings to the array.

When analyzing the ventilation there are a multitude of aspects to consider and calculate. Taylor will address the ambient air temperatures throughout the day, week, month, season, and year. He will perform an analysis to observe how these impact the temperature within the building. While conducting his analysis, he will consider airflow, temperature gradients, and how building occupancy affect the ventilation of the system. Additionally, wind speeds and directions will be analyzed to calculate the efficiencies and energy reduction. In order for an accurate analysis, the areas in which the ventilation system can intake air will be addressed. The gradients of temperatures, airflow, and overall ventilation will be the main variables when conducting this analysis. Furthermore, when conducting the analysis the codes for ventilation within a commercial building and how occupancy of the building changes these regulations will be taken into consideration. He will then compare his findings for ventilation, energy reduction, and energy efficiency to the ventilation codes to ensure that the proposed design not only meets the ventilation requirements, but has an advantage over current ventilation systems. Once data is collected, it will be analyzed for the economical impact the system will have on SBS West. Although there will be a number of analyses done for the proposed ventilation system, there will be a need for more to be conducted. Taylor will analyze the aspects addressed in the above paragraph and will attempt to conduct further analysis. His findings will then be delivered

through documentation for the team, client, and staff to assess. Throughout this analysis, he will use any and all resources available to him, to ensure an accurate analysis was conducted.

### **Solar Panel and Array - Kyle Matsuoka**

Kyle will analyze the solar aspect of the system. This includes the type of solar panel that the team will use in the design along with the type of axis the panel will have; either a fixed panel or single axis panel. Along with the type of axis that will be used, an estimated cost and payback time of the solar panel will be included. This will be done using a System Advisor Model software that can simulate a solar panel with different variables. This software can take into account different parameters that can affect the energy production of the solar panel. For example the amount of shading and snow which can affect how much sun can reach the panel. Kyle will run multiple different simulations, each being different than the others, and analyzing each simulation to get the optimal solar panel and array for the system.

### **Heat Exchanger – Hani Alharbi**

Hani is analyzing the heat exchanger of our system. Heat exchanger is a device that allows the system to transfer the heat from point A to point B. The design of this heat exchanger varies from system to system, however, it is still doing the same job. It is mostly made of pipes which are connected to each other in order to create a path for the heat to go out of the system. There are three primary types of heat exchangers, they are a parallel flow, a cross flow, and a counter flow. From this analysis the team will use the most effective type of heat exchangers that will help our project to run without any issues.

### **Materials Selection, Structural, and Economic Analysis of Main Ventilation Ducting - Talon Mills**

In designing a new system a few key aspects need to be looked at and analyzed. The first of these is the structural analysis. The ventilation system needs to be designed in a way that there will not be a mechanical failure in the ventilation ducting itself. The vents, ducting, and fixation components will all have some force or stress applied to them that needs to be understood before the final selection of the parts that need to be purchased. Codependent with the structural analysis is the Material selection. Understanding what materials will prove to be the best suited for the project will be directly linked to the structural needs of the system. Once the structure is properly understood, materials selected, and the design is completed then the cost of the ventilation ducting will be estimated based on the current knowledge of the design.

### **Conclusion**

The BEE team has been tasked in increasing the energy efficiency of SBS west. In order for a design to be properly implemented, all aspects of the design need to be understood. The ventilation needs, solar array, heat exchanger, and ventilation ducting will all be analyzed for

desired aspects and then written in separate reports by the individuals who are incharge of each analysis as stated previously. The finding of these reports will then be used in finalizing a proposed design and the development of a prototype.