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IPRO 336 MIDTERM REPORT

Developing Innovative Design Concepts for Airflow, Energy Sustainability & Fire Protection Safety in Buildings

March 22, 2007

IPRO 336 It takes a team INTERPROFESSIONAL PROJECTS PROGRAM

1.0 Revised Objectives

IPRO 336's objectives have remained mostly unchanged. It should be noted, though, that originally the objectives were limited to performing an original experimental study that will help to determine the effects that stack effect phenomenon has on the distribution of the pressure and the airflow movements within high rise buildings, but since have been expanded to include the creation of a flow chart that depicts the basic design process that goes into the creation of smoke control systems within high rise buildings. This revision allowed much more of the research and work that team members were doing to be reflected in the final presentation, as well as creating a unique document that may one day be used by engineers to make the design process more straight forward. As a part of this project, the team is working towards:

- Quantify the effect of pressure variation due to stack effect on airflow diffusers
- Characterize the airflow diffuser
- Perform the air-tightness measurement of the building envelope
- Measure the airflow, pressure difference, temperature, relative humidity and air velocity in order to determine the thermal comfort indices (PMV, PPD and others)
- Deliver a descriptive report of effects that stack effect has in case of fire, and prescribe possible solutions
- Creating an original flow chart that follows the design process of smoke control systems based on interviews with experts in the field.

2.0 Results to Date

The main project team was broken into two smaller sub groups in order to more effectively allocate work and optimize time. These groups were based on the real world divisions in the smoke control process; the programming field, and the human knowledge spectrum. Those that set out to explore the human spectrum were directed to locate several practicing engineers and talk with them about their experience. This allowed the team to gain knowledge about the field from the experienced and compile the information together. The programming group was set out to research the current programs out on the market that are used by engineers when designing these safety systems, as well as, learning to use them. Within each of the two main groups several sub teams were established to focus on more specific portions of the groups objectives.

The human knowledge spectrum group was divided into 3 sub teams and they were to perform interviews with actual people working in the smoke control field. Since no books or other easy to reference documents exist on the actual design process of these safety systems, it was their job to gather as much information on that process as possible. This information is intended to document the design process so that in the future people can reference and use this "flow chart" to aid them in their design. Here are 3 of the reports so far:

Report 1

To begin with, smoke control or smoke management is an "iffy" science. In relation to the rest of the known sciences such as physics, chemistry, thermodynamics, and structures, the science of smoke control is an ever-changing science. It truly is difficult to be exact, and the majority of designing is based on good judgment. Like all other engineering, smoke control heavily depends on practical application of the known theoretical mathematics and physics involved. The reason why smoke control designing is constantly changing is due to the advancement of technology. With new technology created and new ideas to explore, smoke management engineers always have to apply different and newer methodologies to a project. Even if an engineer has done smoke control projects all his life, the design process is always different due to the many factors involved such as building layout, building occupancy, and building size.

There are 3 kinds of smoke control systems. The first system is to allow for a useable exit out of the building. In the case of smoke in a building, occupants need to be able to leave. The second kind of system is the need to evacuate smoke for fire fighting purposes. Fire fighters cannot enter the danger zone if they cannot see due to the thick smoke blinding one's vision. The third system of smoke control is to evacuate smoke to preserve, rescue, and the movement of people. Before people exit the building, people must first get to the exit path. This cannot be accomplished unless a suitable path to the exit has been established. For example, people must first get to the stairwell before they can actually get out of the building. The goal here is protect the life, the safety, and the survivability of people in a fire. This is paramount. For this to happen, good smoke management systems must be established and working. These systems are separate in design, but they must work together to preserve the lives of people. Remember, the building can be burnt down and reconstructed, but people cannot die and be brought back to life.

The need for smoke control is based off two things. The first is if there is some sort of legality issue or code requirement. If a building does not require it, then it will not be integrated into the building design. A developer will not spend extra money to install a smoke control system that is not required in the first place. Money is most of the time spent on the minimum needs. The second consideration is what there is to protect. This is also something to consider since most codes require smoke control rarely. For example, International Building Code only requires smoke management in an atrium or an underground building, nothing else. Chicago code only touches on smoke exhaust, and that is even just a couple of sentences. Really, it is left to judgment to find if there is a need to implement a smoke control system. Only certain buildings require smoke control, and even then some of those buildings don't really need it.

In designing smoke control, fire is a big part of the design. There are 4 kinds of fire situations to consider: axisymmetric, balcony spill plume, window spill plume, and corner plume. The International Building Code goes more into detail into each of those. There are conventions for each of the 4 kinds of situations. There are separate analysis criteria and design fire size. The code requires an analysis of each of the four. Afterwards, a building must be designed for the worst case. There are 2 kinds of fire, ventilation controlled or fuel controlled. Ventilation controlled is the instance where air is fanned or vented so that a fire can flourish. Fuel controlled is the instance where a material is being burned which acts as that fire's fuel. Most of the time, fires are ventilation controlled fires. A fire's intensity can be viewed as a bell curve, an upside down parabola. For example, a camp fire will start and burn logs. It will keep burning and rise in intensity, but it will eventually reach a peak. Then the fire will eventually die out due to the lack of fuel. Unless a fire is being fueled, it will last longer. Usually that is not the case in a fire in a building. The peak of the bell curve is the point of maximum heat release rate. It is at this point that the code requires the design to be applied. The code goes more in depth and can be used to make more sense of a design. However, this maximum point is merely a "snapshot" of the fire. Fires are in a sense unpredictable. Given all these programs and theory on fire dynamics, a fire is still a force of nature that could sometimes have an erratic path or unpredictable activity. This is a reason again why smoke control is an iffy science.

Fire and smoke codes can be said to be written in blood, meaning that people need to die in order for the world to realize the need to change the code. Before, Chicago did not consider any kinds of smoke or fire management. However, it took the death of people in a building fire for the city to implement code changes. Now the city requires all buildings to have sprinkler systems, but not smoke detectors or smoke control systems. It is sad to say, but another incident must occur before Chicago and other cities to enforce smoke management in all buildings. The question here is obligation. The world does not feel obligated to deal with smoke control unless it is needed, meaning that another major incident must happen. There are standards out there from certain organizations, but those standards are meaningless until they are adopted into a code.

Smoke control systems can either be joined with the HVAC design or can be stand alone. Having smoke control a part of the HVAC is a good idea since the HVAC system is always running. When it breaks, it will be shortly fixed. Having the smoke control being part of this system ensures that when in case of an emergency the smoke control system will work. This is a preferred design method since it gives the sense of security and knowing that smoke can be managed in case of an emergency. In actuality, this is the only way that HVAC relates to smoke control. HVAC is for comfort, not life safety. When HVAC fails, people get uncomfortable because of the temperature. When smoke control fails, people become dead because of the smoke seeping into their lungs and suffocating them. Joining the two systems together is definitely preferred, but it is not always practical or achievable. Think of the money wasted to supply a big enough generator to power a large fan when only one of the components will be used. It is more cost effective to have smaller fans powering different systems which will in turn save more money on electricity costs. The two systems can be separate sine smoke control does not affect HVAC. The problem with a stand alone smoke management is that the system will not run unless there is an emergency. So, the system really cannot be known if it will work or not. For the safety and protection of lives, smoke management systems should be tested weekly in order to insure proper mechanical operation. If the only time a smoke control system is tested is when it really is been used for the first time in an emergency and turns out to now function, then the occupants of a building will die.

The designing of a smoke control system is most of the time performed by the MEP engineer rather than a Fire Protection engineer. An MEP engineer is a Mechanical, Electrical, and Plumbing engineer that deals with the mechanical systems of a building, which in this case are HVAC or smoke control. A Fire Protection engineer really has nothing to with smoke control. They mostly deal with and design the sprinkler systems and exit paths. Fire Protection engineer deals with fire suppression and also life safety, but not smoke management.

Fire and smoke always occur together. When a fire starts, smoke will automatically be a product of this reaction. Naturally, one would think fire and smoke systems work together, but this is not the case. These are two independent systems. In a fire, sprinklers go off by zones, and each floor is a zone. The sprinkler heads are heat sensitive so only the ones nearest to the fire will be activated. An AHU, air handling unit, is thought of to help in a fire. This is not the case either. AHU is for comfort zoning, not smoke evacuation. A big floor needs a lot of air to be pushed. However, like stated earlier, the smoke control system can be a part of the HVAC. This too is a design consideration. In these systems, there is no real process to it. A fire starts and generates heat, and in turn sprinklers are set off and extinguish the fire. Smoke is released into the air and detected causing an alarm to trip, and then vents and exhausts are activated. If everything is designed correctly, smoke will leave the building. Sprinklers are temperature sensitive, but smoke can happen at any temperature. A building has to have smoke detectors for smoke and sprinklers for fire. Both systems should start so that life is preserved.

Stack effect is a phenomenon in buildings that is a result from the differences in temperature causing varying pressure gradients along the side of a building. For example, at the top of a building there is a lot of negative pressure causing air to be pulled towards the top. Moving down the building, pressure will become less negative until there is neutral pressure at the middle of the building. Here the air is not being pulled anywhere. Moving down the building there is a build up of positive pressure increasing until the ground floor. Here, air is being pulled from the building. Stack effect causes wind to flow around the building in different directions at speeds varying with height. To add to the complications, stack effect is reserved from winter to summer. Because of this, stack effect cannot be considered in a smoke management system. It is too difficult to understand the effect to really incorporate it into the design. So, the building is assumed to be sealed. The math is too complicated, even for a computer. The only way is to ignore stack effect and assume there is no stack effect in the envelope of the building. It is meaningless since there is stack affect along with the natural winds and the other effects from neighboring buildings. To consider stack affect is to only be aware of it and to use common sense in designing the smoke exhaust. It would be stupid and unwise to exhaust smoke on the windward side of a building.

Report 2:

When speaking with Mr. Schultz from the Fire Protection International Consortium, Inc. in correlation with Global Fire Protection Consulting, Inc. I was enthusiastic and amazed about the information obtained from him regarding the research assignment on the processes of HVAC & smoke control issues in buildings.

The objectives of a smoke control project are to simply comply with the code, Mr. Schultz explained. The whole concept of smoke control is self explained by its name, to control the direction of smoke by creating pressure differentials and limiting where the smoke is going. With his experience, smoke control is not something that someone elects to put in but rather that you’re putting in smoke control to simply comply with the IBC.

Some of the equipment used in smoke control is exhaust fans, draft curtains, and smoke and heat vents. Mr. Schultz explained that the simplest from of smoke control is the draft curtain, which will limit and retain the smoke in given area like filling an ice cube tray with water. Now ideally you would take the area between two draft curtains and place a vent in there for the smoke to be pulled or pushed out. It is also possible for piping to penetrate a draft curtain. Normally the hole for the pipe is not big enough to cause a concern, and if it is a concern you can just run a bead of caulk around it. A typical draft curtain is between three to six feet in deep and how much area that can be enclosed by the draft curtain is determined by the building code. When choosing between the different smoke control systems you need to evaluate what you’re trying to accomplish for the project, but Mr. Schultz states that: “the actual answer is that we try to go as cheep as we can, keep in mind that you’re putting this in because the code is making you. It’s not an elective system, so most designers just want to meet the code.”

Pressurization and depressurization can also be used to control smoke. This works by creating a positive pressure in the areas you don’t want the smoke to go, and then create a negative pressure in the area where we have the smoke. So when you have a fire in a given an area, this goes into exhaust mode, creating a negative pressured area by pulling the air out. While the adjacent areas stay in normal operation or go to supply mode, this creates a positive pressure which pushes and helps to move the smoke out of the area by creating a pressure differential. The pressurization values that need to be achieved for a specific project are found in the code based on the jobs parameters. For example when a fires occur in an Atrium area, you want to take this area to 100% exhaust and then take the adjacent areas to 100% supply to create a pressure differential. By creating this pressure differential you will move the smoke in the Atrium by pushing it out with the air in the occupied space of control.

When designing for a smoke control project, this is the one part of the field where the fire protection engineer will work closely with all of the project players. For example, you will be working with: the Architect to review the zonings and what type of barriers they will be providing, the Mechanical Engineer to make sure we are moving the correct amount of air, the Fire Alarm contractor to make sure that we are alarming correctly, and the sprinkler contractor to determine what zones we have and that they are enabled correctly. Therefore it takes the interaction between all features of the building to bring it all together. The coordination between the HVAC designer and the Fire Protection designer has to be close for any project. The Fire Protection Engineer needs to make sure that the HVAC designer understands what is trying to be accomplished and where they are trying to create the pressure differentials.

The codes that deal with smoke control are specifically found in the International Building Code along with the International Fire Code. Mr. Schultz explains that: “There is nothing out for a smoke control code so to speak, it’s either in the building code or in the fire code and may appear at times in the mechanical code, but Chicago just has the Chicago Building Code that covers everything.” Smoke control is usually taken care of by the MEP Designer with input from the FP Engineer; the FP Engineer does not design for the size of ducts and fans, but rather gives the MEP Designer their fire protection parameters and what they are trying to accomplish then the MEP Designer can correctly size everything from this.

When designing the zoning of sprinkler systems, you design for multiple zones for the purpose of control because if you make the zone to large you then defeat the whole concept of the system. The need for a large number of air handling units arises for the purpose to achieve the air turnover that the system is designed for, in addition to moving the smoke for the proper air exchanges that you’re looking for. The placement of exhaust systems is done by typically locating them at the highest point of the building where the smoke will naturally rise, but they need to be strong enough to pull the smoke up because the smoke is cooling and loosing its energy as it rises to the high point. It is possible at some point for the smoke to become stagnant and linger in a layer at some level where the buoyancy is lost and not reach the top.

Fire Dynamic Simulator (FDS) is the big software that everyone is using states Mr. Schultz. He also explains that FDS is a excellent program because it model a fire while giving you smoke develop, smoke layers, and show you what’s happening. You could print out a thousand pages of data or show a visual fire growth model, and the visual model impresses people more than the thousand pages of data, Mr. Schultz states. FDS is capable of being run on a PC, so that's another benefit of the program. The details of this program are unmatched, so far as Mr. Schultz states that they've put on fire models on Friday and have come back Monday and it's still running. As an example of the software's power after running all weekend, by Monday it has only modeled the first 15 minutes of the fire. Computational Fluid Dynamics (CFD) is also incorporated into the FDS type modeling which is the latest and greatest. The FDS model is based on CFD and examples of this can be viewed on NIFT.gov website. As for reliability of the program, "The program is reliable up to the point that the first sprinkler actuates and then there questions about it" Mr. Schultz go on to explain, "when the sprinkler actuates it creates more smoke, it cools the smoke, it pushes the smoke back down, it changes the whole dynamics of the fire that you were looking at before. So everything is different at that point."

Even though smoke control and natural ventilation are similar they are still different. Smoke control is considered to be taking an active roll by turning on and off fans while trying to manipulate the smoke. Now, natural ventilation is to model and watch where the smoke goes and see what's happening, because you will know that the smoke will go up and out this way and then place a roof vent at this location. Natural ventilation can be used to improve smoke control by taking it into consideration when designing. For example, if the building area will have open windows or if doors will constantly be open, these needs to be considered in the design because if the fire floor has been modeled with out natural ventilation and then someone opens a stair well door this will change everything. Thus evaluating for smoke control, natural ventilation needs to be taken into account for any project.

The smoke control design process, from detection to smoke exhaust begins by the sprinklers actuating in a zone. At this point the HVAC zone is designed to mirror the sprinkler zone by going into exhaust mode. Dampers could also be opened at this point, if provided. Now the rest of the HVAC system fans could either be left alone to operate normally or they could be switched to supply mode. Mr. Schultz explains that a problem that they run into is to discuss a relative issue about operating the smoke control zone from a fire alarm pull station, which is not the ideal method. The reason for this is that the pull station might not be at the exact zone of the fire. Someone could pull the switch at an exit on their way out of the building and they are outside of the smoke zone. This messes everything up because there is no correlation between where the pulled zone is to where the actual fire and smoke zone is. For that reason the smoke control is tied into the sprinkler activation or with a smoke detection system that would be unique to that specific zone.

The controversy related to the fire protection systems detection between the sprinklers or the smoke and heat vents going off first goes back many years. Mr. Schultz had explained that this is a big, big, big issue. He elaborated that when there were fire tests done during the 70's where they tried to simulate roof vents in a building by opening the buildings perimeter windows. So when they opened these windows the heat got pulled out through the windows. The problem was that when the heat was moving across the areas to the windows, it was setting off other sprinkler zones. This was setting off about 70% more of the sprinkler zones which had nothing to with the fire zone. The two views lie on a matter of preference. One view is that roof heat vents are great because it isolates the heat and allows it to flow out the vent. On the other hand if the roof heat vent isn't really where the fire is, then it's just bringing the heat over to itself and setting off sprinklers along the way that do not pertain to the fire area. Mr. Schultz also explains that people don't know how to respond to this controversy. He also states that; "the sprinkler comities response is: 'we really don't know, because we've never had full scale fire testing with roof vents', so until someone is willing to do that, our criteria is based on no roof vents being provided." Mr. Schultz also said that for this reason, nobody really knows because there is a lot of theory, and he could argue both sides of the story. Mr. Schultz also goes on to explain that the tests with the EFFR sprinkler and roof vents system have found problems that cause the system to fail due to skipping. The heat was getting pulled along and passed by the sprinklers not activated; then suddenly you're activating sprinklers that have nothing to do with the fire. IBC explains that if you put in an EFFR system, you don't have to put in roof vents in your building. Mr. Schultz laughs and states that for that reason everybody loves the EFFR system, because it eliminates roof vents. Another issue he explains is that; "Factory Mutual says if you put in roof vents, they should be rated 100 degrees above the sprinklers, where the building code says that you're required to have them. We have different code officials, different authorities having jurisdictions, requiring different things."

When asked if you have a checklist about smoke control, Mr. Schultz immediately said no. Everything is so project specific that he has really not tried to put one together and recognizes that he does not want to spend the time now to put one together, but when he gets the next job he would have liked to have one to use.

In conclusion the interview with Mr. Schultz was very useful for the information gathered for the research assignment on the processes of HVAC & smoke control issues in buildings. It takes a close correlation between the Fire Protection Engineer and the rest of the buildings contractors to make a successful smoke control project. Although different, natural ventilation must be taken into consideration when designing for smoke control because if overlooked this can cause a breakdown in the smoke control process in the event of a fire. When designing for a smoke control project it takes experience and knowledge of many different styles and combinations of systems to derive a design that is creditable, cost effective, and code compliant.

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Report 3:

All building which are currently under construction must address the issue of smoke control to some degree. Buildings which accommodate large amounts of people take special interest in extra precautions for smoke control. The most important aspect in creating a building which adequately addresses smoke control issues, is designing in systems to deal with the smoke if a problem should arise. This section focuses in depth the design process for smoke control in the new McCormick Place Convention Center and the systems which are utilized.

The main objective when designing any smoke control system is to keep the smoke away from the populated areas long enough for the people to leave the building. Because smoke control system is so important, its systems are integrated with the other systems in the building. Due to this integration the issue of smoke control is not only an issue for the Fire Protection Engineer by for many others involved in the design of the building. The most important system affecting smoke control in McCormick Place is the HVAC system. HVAC stands for Heating, Ventilation, and Air Conditioning which transfers air through out the building. During a fire the HVAC system can change the flow of air to suck out smoke from a specific area or replenish fresh air, or simply shut down. In case of a fire in any section of the building, a plan has already been created for what the HVAC systems in the rest of the building will do. The plan involves braking the building up into different Zone, which each zone having the ability to act in a different manor if a problem should arise. This plan is determined before had by the Fire Protection Engineer and HVAC Designer who follows a set of Codes determined by the City of Chicago. Most of the systems which are implemented follow the codes set by City of Chicago.

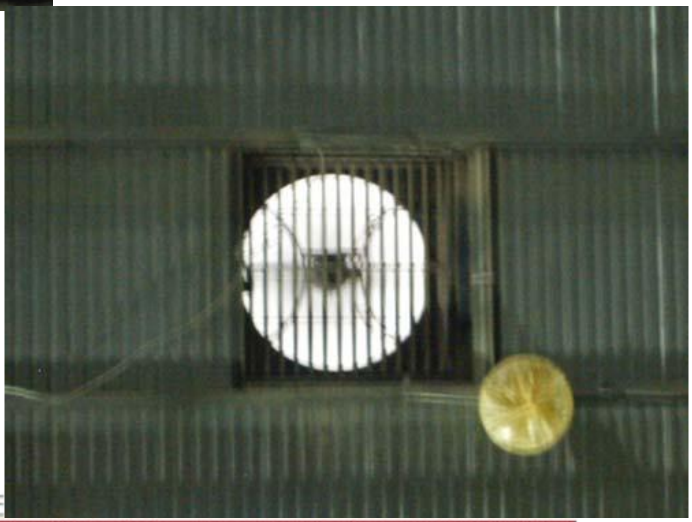
However some times unforeseen problems arise with the smoke control issue once construction is mostly complete. One major problem in McCormick Place was in the Ballroom, where a set of fake ceiling panels were placed approximately fifteen feet below the actual ceiling. The problem was that the Sprinkler system had to be placed within the false ceiling panels to be able to follow code, however the panel design included large holes for ascetic reasons. In the case of a fire the holes would allow smoke and heat to rise pass the false panels where the sprinkler system was located. The sprinkler system is activated by the trapped heat, therefore the sprinkler system would not function as planned during a fir because the heat would rise pass the

sprinkler system and not activate the sprinkler system. The Fire Protection need to come up with a solution to the problem to activate the sprinkler system if there was a fire but not disrupted the ascetics of the ballroom. The solution presented was to cover the whole in the false panels by a Plexiglas which would trap the heat but not affect the room's ascetics.

The atrium portion of the building connects the main exhibition arena with the ballroom and parking structure. Laser smoke detectors, shown just below, are used in this area because of the height of the ceiling and the inefficiency of placing traditional smoke detectors all over the ceiling. The laser smoke detectors are placed on either end of the atrium, towards the ceiling. If a fire broke out, the smoke would interfere with the laser and set off the alarms and sprinklers in much the same way that lasers at store entrances trigger a bell.

Smoke Curtains, seen below, were used in the Main Exhibition hall in McCormick Place to contain and channel smoke. A smoke curtain, similar to a large metal wall, hung down 10 feet from the ceiling, dividing the hall in half. Each half was then divided into smaller sections with 5 foot smoke curtains. Smoke is hotter then the air around it therefore it rises and gets trapped in the area just below the ceiling. These curtains serve the purpose of containing and directing smoke flow in the event of a fire in the exhibition arena by keeping the smoke isolated from the rest of the ceiling. These curtains also help to keep the smoke from interfering with other zones, which might force greater actions to be taken by the smoke control systems.

In addition the smoke curtains in the Main Exhibition hall there are also a pattern of vents in the ceiling. These vents are approximately 15'x15' and are shown to the left. There are several of these vents in each different zones in the Exhibition hall. The main purpose of the vents is to dissipate the smoke which collects on the ceiling, the smoke is simply vented out of the building through ceiling. The smoke continues rising through the vents, out



of the building, and up into the atmosphere away from the public.

A particularly interesting feature in McCormick Place is the emergency door to the parking structure. In the event of a fire or smoke, the metal door comes down from the ceiling, cutting off access to the parking structure. This serves to prevent both smoke from getting to the parking structure as well as the fire spreading to other areas. The emergency door must be able to last for more the four hours as stated by Chicago City code.

The programming group was also broken into 3 teams. The first team was to rework an old very simple program for finding the neutral axes caused by stack effect in high rise buildings, into a usable Matlab format in order to help in later experiments. The other two teams were to look in to the two main programs that deal with the design of smoke control and air flow within buildings, ASCOS and CONTAM. The first and older program is called ASCOS or (Analysis of Smoke Control Systems). It was designed to give steady air flow analysis for buildings given certain inputs, and was, for much of the 1980's and 90's the most used program in smoke control. It was prompt based, and very simplistic. It did not give the user much room to explore or design for very specific project cases and therefore was replaced by a newer program called CONTAM. Shortly after discovering that ASCOS was outdated and that CONTAM was the only current program for the analysis of air flow in buildings the two program teams reintegrated and began to compile information on CONTAM. The work they did is included below:

<u>Use of CONTAM to Analyze Stack Effect and Airflow in Buildings</u>

CONTAM is a multizone indoor air quality and ventilation analysis computer program developed by the National Institute of Standards and Technology (NIST). The program is used to determine airflows, contaminant concentrations, and personal exposure to contaminants in buildings. For this IPRO, CONTAM will be used to analyze stack effect and airflow in buildings. This information will be used to simulate the flow and concentration of smoke in buildings in case of a fire. In doing so we hope to develop innovative ideas for smoke control and building design.

Stack effect and contaminant flow in buildings were analyzed using two different models. A 30 story building located in Korea was used to analyze stack effect. This building was the subject of previous case studies which allowed a comparison between our CONTAM model and another model using a different program called COMIS. This helped ensure that our model was accurate and our data reliable. The height of the building also made pressure differences due to stack effect and the location of the neutral axis very clear. The second model, used to analyze contaminant flow, is the top floor of Alumni Hall. This building was chosen because it is the location of our experiment. Modeling the building in CONTAM before the experiment will help us locate and isolate, if necessary, certain flow paths to see how significant they are in determining the pressure differences within a room.

Korean high-rise

The 30 story building was simplified to 15 stories due to the large number of zones and interactions associated with 30 stories. The model consists of one lobby on the first floor and 14 residential stories above the lobby. Each floor is 3 meters high. All
residential floors consisted of four apartments. An example is shown in Figure 1.

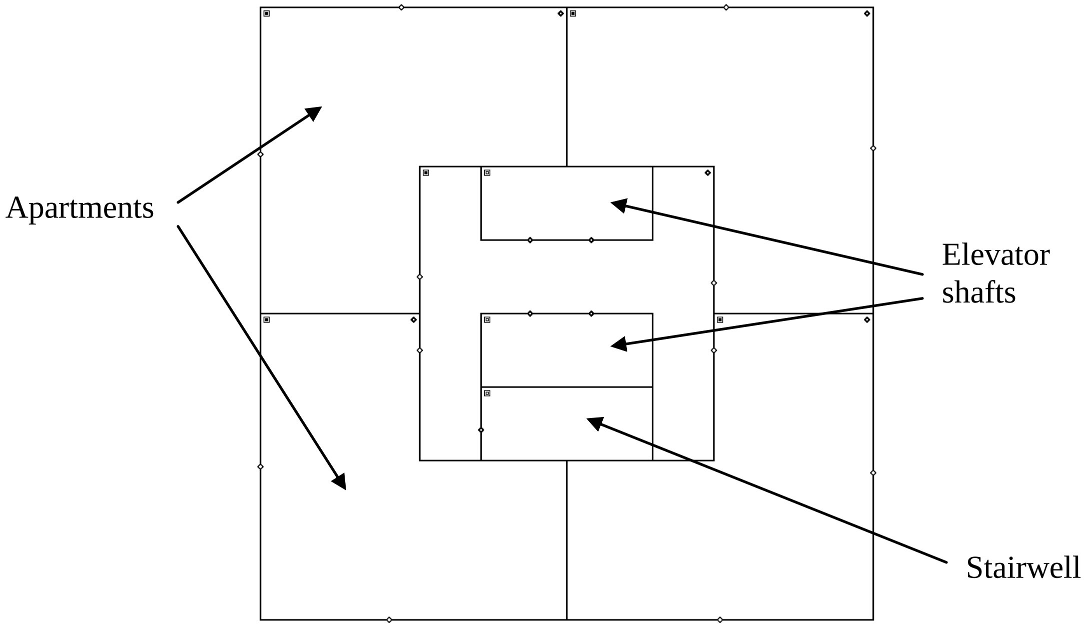


Figure 1

The building also had a five floor parking garage below ground but this was not modeled. The flow paths that were considered include exterior windows, interior and exterior doors, leaks between floors and the roof, and airflow through two elevator shafts and one stairwell. Once the building was modeled, temperature differences between zones and proper wind profiles for the exterior flow paths were defined. The simulation was then run and the airflow through the building was determined. Figure 2 shows how stack effect changes the pressure on the buildings exterior depending on height. The first floor lobby is shown in Figure 2. The pink lines show the pressure present on the wall. Pressure is always applied to the side of the flow path opposite the line. A pressure of 14.6 Pa is present on the outside of the exterior walls of Figure 2. The green lines represent the mass flow rate of air. A line that travels inward from the wall means that air is traveling from the outside of the building to the inside. Air always flows from the zone of higher pressure to a zone of lower pressure. Air is flowing into the lobby at an average of 4.2 kg/h through each flow path along the exterior wall.

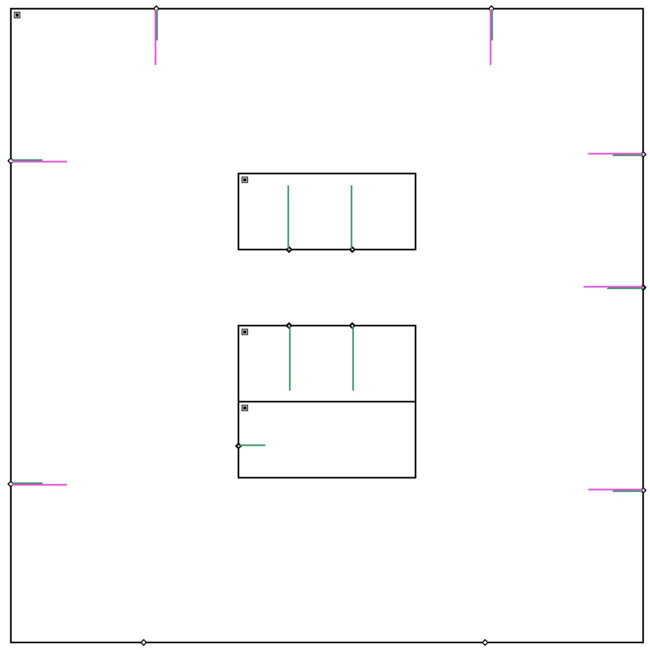


Figure 2

Figure 3 shows the location of the neutral axis. There is virtually no pressure or airflow on either side of the exterior wall. This occurs at approximately the eighth floor.

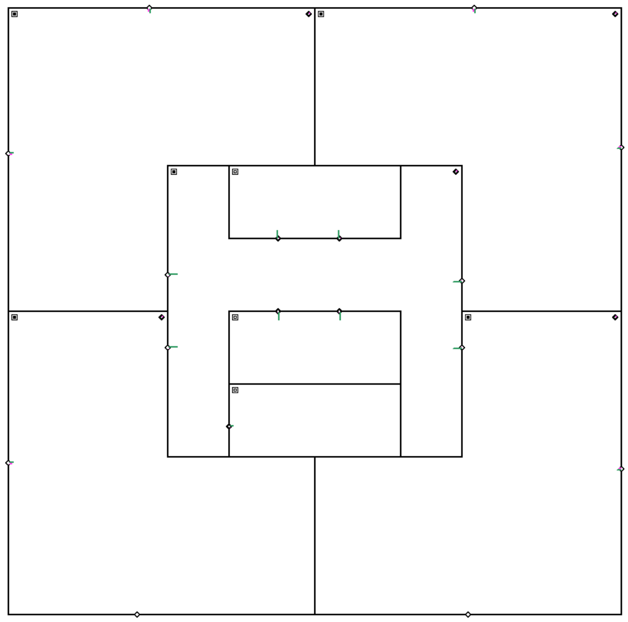


Figure 3

The topmost story is shown in Figure 4. The exterior wall has a pressure of 14.5 Pa along it. This time it is against the interior of the wall. On this level, air on the inside of the building is escaping to the outside. These values make sense because the distribution of pressure due to stack effect is linear. Because the neutral axis was located at approximately the halfway point of this building, the pressures at the bottom and the top should be almost equal- but in opposite directions.

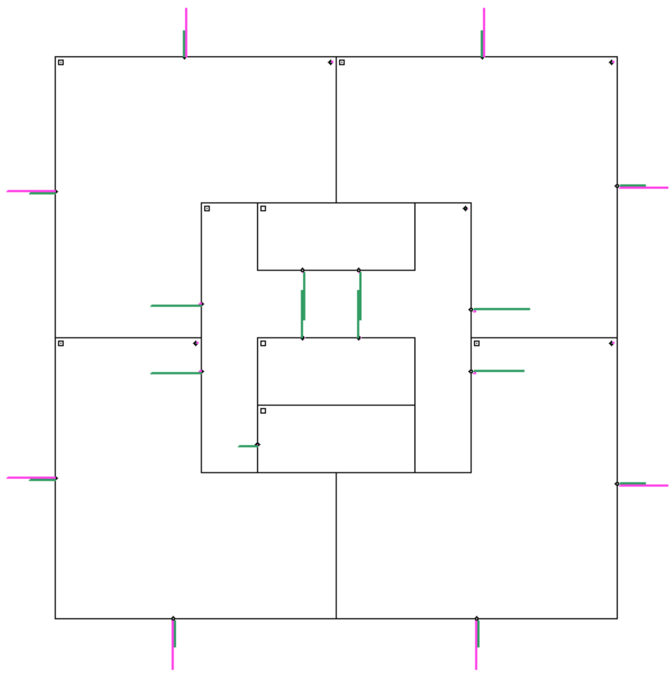


Figure 4

Alumni Hall

For the building airflow test of Alumni Hall, the building was constructed as shown below. The first floor structure was mainly ignored due to the fact the study will be conducted on the upper floor of the building.

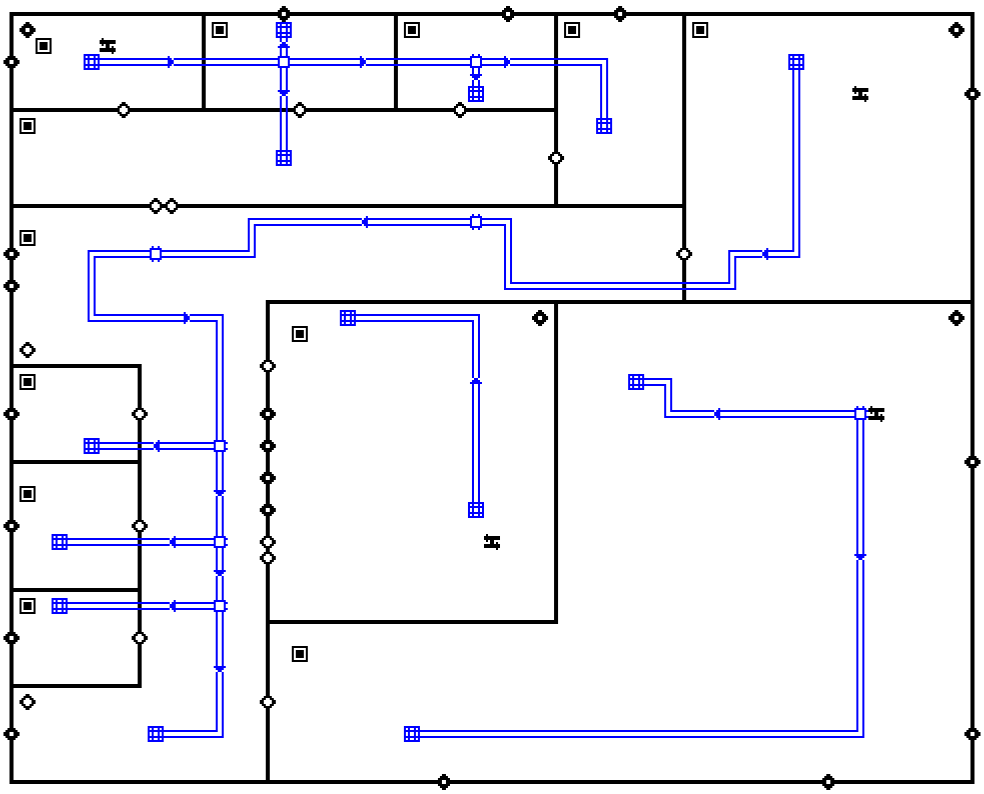


Figure 5: Mockup of Alumni Hall

Various considerations were made when making the mock-up of Alumni Hall. A small, basic ducting system was put into place as well as some air handling units. At each corner of the building, floor leakage was put into place to simulate the cracks that exist between each floor of the buildings. Windows were placed in accordance to the use (i.e. indoor windows or outdoor windows), as well as doors. This ensured that each element of the simulation was accurate depending on the various doors used in the building.

Since the ducting system of Alumni Hall is not know, the ducting system was taken to be a simple model of the one as shown above in Figure 5. Air handling units were placed in the most likely spots in Alumni Hall (i.e. the computer lab has its own, etc.). The connections from duct to duct were taken to be horizontally connected.

Ducting System		
	Roughness	.09mm
Shape		
	Rectangle	400x200mm
Leakage		
	Rate	0.01
	Pressure	4 Pa
	Class	4.06

Table 1: Ducting system parameters

The windows for the building came in two pairs, indoor and outdoor windows. The indoor windows were given shorter lengths for the cracks than the outdoor because the outdoor windows are generally bigger than the indoor ones. Also taken into consideration were the wind pressures on the various sides of the building. The values of the wind pressure were maximum for the side facing straight into the wind, but minimum for the opposite side. These values are given in the table below.

Windows		
Indoor		
	Length	.1m
	Width	2mm
Outdoor		
	Length	.5m
	Width	2mm
Wind Pressures		
	Front	7Pa
	Sides	3Pa
	Back	1Pa

Table 2: Parameters for the windows

For the doors, two different types of doors were used—indoors and outdoors. The main concern for this simulation is for the indoor doors because they are located on the section that we are studying. Because of this the outdoor doors were just treated as long cracks with the properties below. The indoor doors were simulated using the one-way power law flow in CONTAM with the parameters set as below.

Doors		
Indoors		
	Discharge Coefficient	1
	Flow Exponent	0.65
	Pressure Difference	4Pa
Outdoors		
	Crack Length	.5m
	Crack Width	2mm

Table 3: Parameters for the doors

A simulation is run using the concentration features of CONTAM are run simulating an excess amount of CO in the conference room. The result of the simulation on one room is given in the graph below.

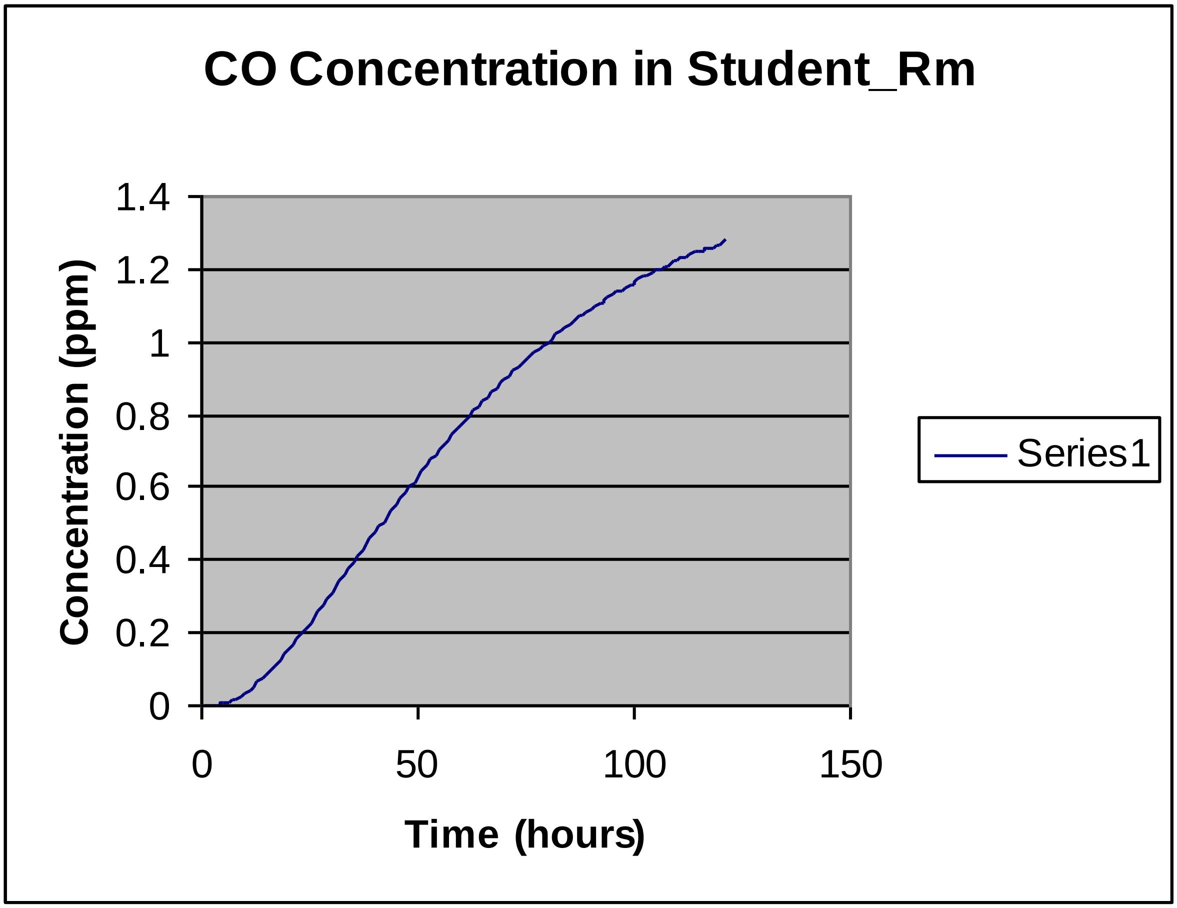


Figure 6: CO concentrations for student room based on other concentrations

The result for the airflow test for Alumni Hall is given below in the figure. The results were generated by using the "Building Airflow Test" feature of CONTAM. As is evident, the ducts and windows facing the wind pressure are subjected to an extreme amount of leaking inside, while the opposite will cause of loss of the air from the building.

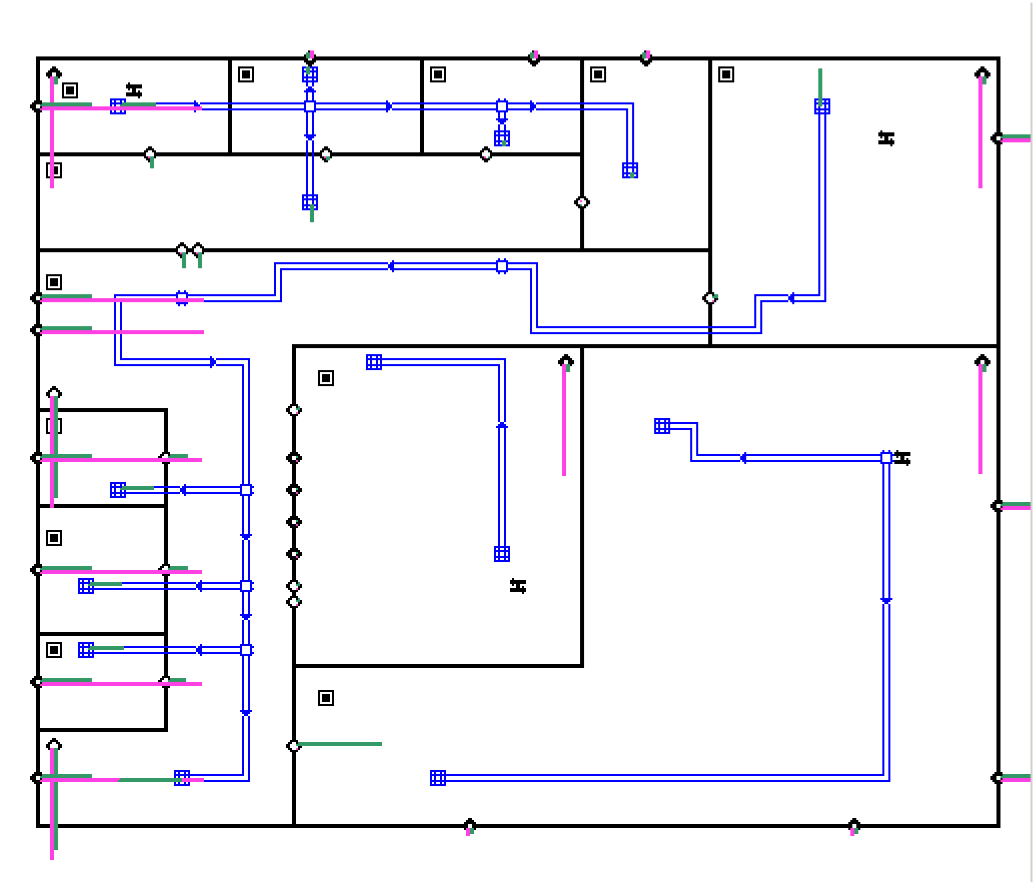


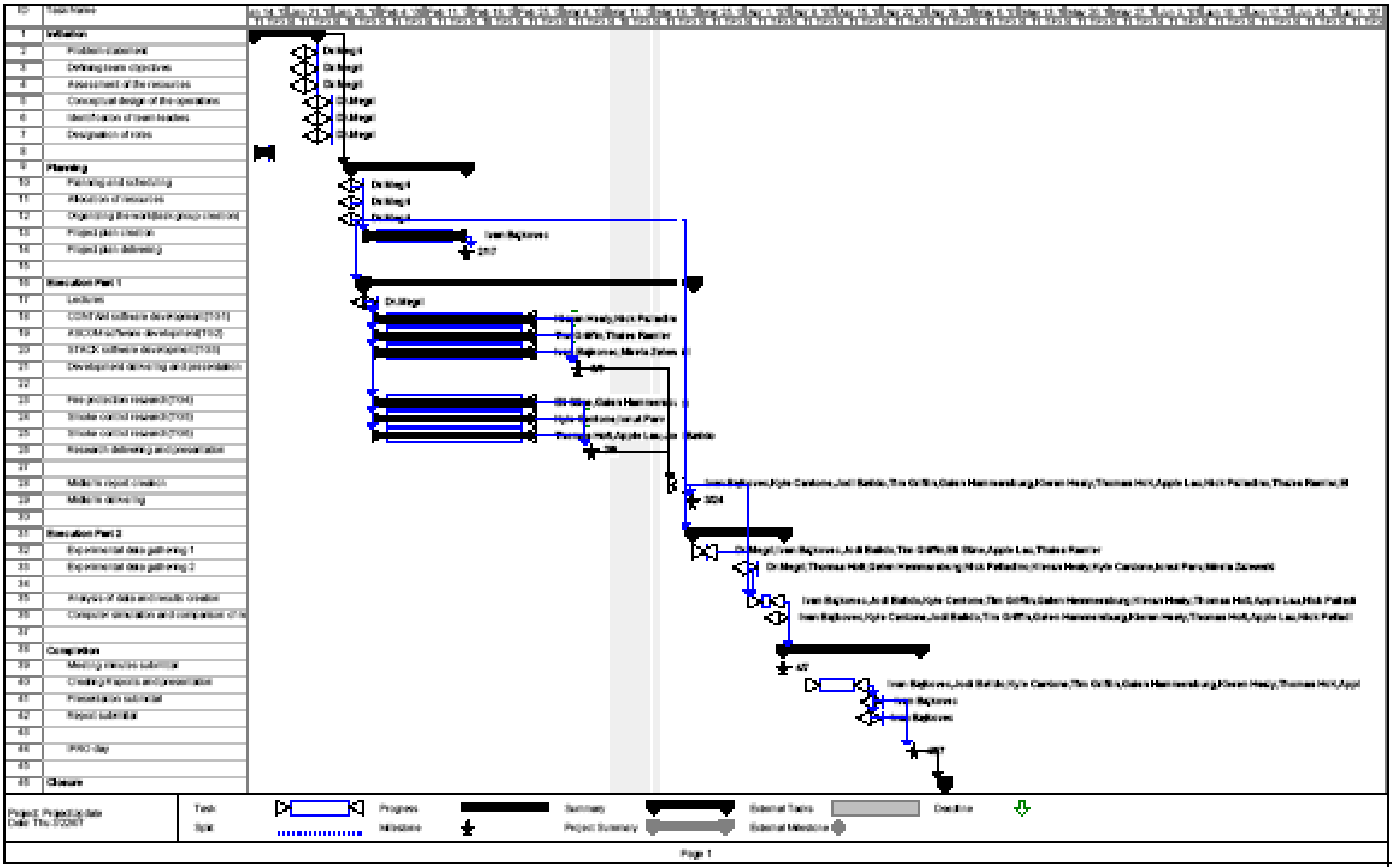
Figure 7: Building airflow test for 2^{nd} floor of Alumni Hall

It should be noted here that the previous reports are considered rough drafts and are not ready for final review. Dr. Megri is in the process of reading and critiquing them. The revised versions in addition to a few other interview reports will be included in the final report. The information gathered from them will be the basis for the design flow chart as well as aid in understanding of the experimental results (which are to be preformed in the near future).

3.0 Revised Task/ Event Schedule

The project has not deviated from the original structure the team decided on in the beginning of the project. The deliverables have been defined more explicitly since the project plan was written. This is due better understanding the team has after the research that was done from interviews, lectures given by Dr. Megri, and programs that were explored in the first half of the semester.

The Gantt chart describes tasks and milestone events of the project and has been updated to reflect dates that were changed . (Please refer to the attached MS Project file for complete examination):



The list of tasks that need to be performed with their duration, start and finish time, as well as predecessor activities are shown below. (Please refer to the attached MS Project file for complete examination):

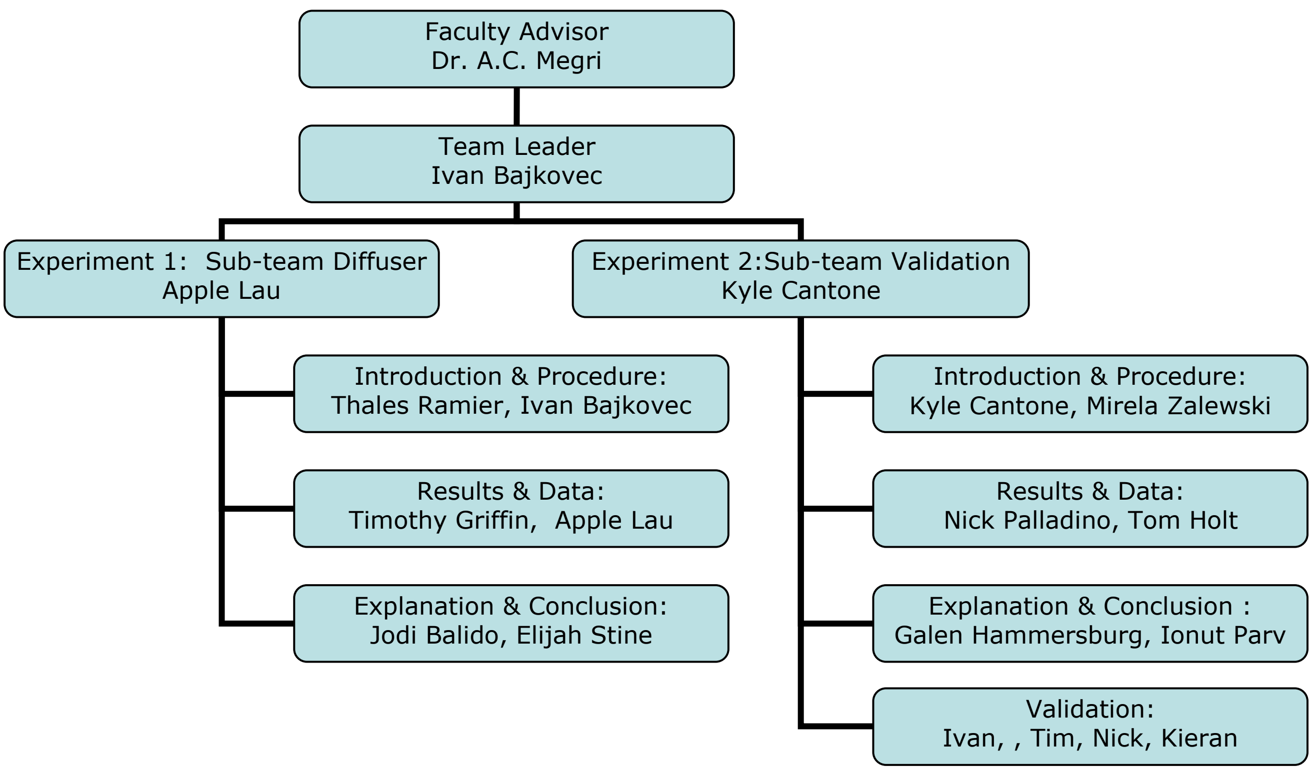
ID		Task Name	Duration	Start	Finish	Predecessors	Resource Names
1		**Initiation**	**3.63 days?**	**Tue 1/16/07**	**Thu 1/25/07**		
2		Problem statement	30 mins	Tue 1/23/07	Tue 1/23/07		Dr Megri
3		Defining team objectives	30 mins	Tue 1/23/07	Tue 1/23/07		Dr Megri
4		Assessment of the resources	30 mins	Tue 1/23/07	Tue 1/23/07		Dr Megri
5		Conceptual design of the operations	30 mins	Thu 1/25/07	Thu 1/25/07		Dr Megri
6		Identification of team leaders	30 mins	Thu 1/25/07	Thu 1/25/07		Dr Megri
7		Designation of roles	30 mins	Thu 1/25/07	Thu 1/25/07		Dr Megri
8			1 day?	Tue 1/16/07	Thu 1/18/07		
9		**Planning**	**5.75 days**	**Tue 1/30/07**	**Sat 2/17/07**	1	
10		Planning and scheduling	2 hrs	Tue 1/30/07	Tue 1/30/07		Dr Megri
11		Allocation of resources	2 hrs	Tue 1/30/07	Tue 1/30/07		Dr Megri
12		Organizing the work(task group creation)	2 hrs	Tue 1/30/07	Tue 1/30/07		Dr Megri
13		Project plan creation	20 hrs	Thu 2/1/07	Sat 2/17/07	10,11,12	Ivan Bajkovec
14		Project plan delivering	1 hr	Sat 2/17/07	Sat 2/17/07	13	Ivan Bajkovec
15							
16		**Execution Part 1**	**12.75 days**	**Thu 2/1/07**	**Sat 3/24/07**	13	
17		Lectures	2 hrs	Thu 2/1/07	Thu 2/1/07		Dr Megri
18		CONTAM software development(T01)	30 hrs	Sat 2/3/07	Tue 3/27/07	17	Kieran Healy,Nick Palladino
19		ASCOM software development(T02)	30 hrs	Sat 2/3/07	Tue 3/27/07	17	Tim Griffis,Thales Ramirez
20		STACK software development(T03)	30 hrs	Sat 2/3/07	Tue 3/27/07	17	Ivan Bajkovec,Mirela Zalewski
21		Development delivering and presentation	2 hrs	Tue 3/6/07	Tue 3/6/07	18,19,20	Kieran Healy,Nick Palladino,Tim Griffis,Thales Ramirez,Ivan Bajkovec,Mirela Zalewski
22							
23		Fire protection research(T04)	30 hrs	Sat 2/3/07	Tue 3/27/07	17	Eli Stone,Galen Hammersburg
24		Smoke control research(T05)	30 hrs	Sat 2/3/07	Tue 3/27/07	17	Kyle Cantone,Ionut Parv
25		Smoke control research(T06)	30 hrs	Sat 2/3/07	Tue 3/27/07	17	Thomas Holl,Apple Lau,Jodi Banks
26		Research delivering and presentation	2 hrs	Thu 3/8/07	Thu 3/8/07	23,24,25	Eli Stone,Kyle Cantone,Galen Hammersburg,Ionut Parv,Thomas Holl,Apple Lau,Jodi Banks
27							
28		Midterm report creation	4 hrs	Tue 3/20/07	Thu 3/22/07	26,21	Ivan Bajkovec,Kyle Cantone,Jodi Banks,Tim Griffis,Galen Hammersburg,Kieran Healy,Thomas Holl,Apple Lau,Nick Palladino,Thales Ramirez,Eli Stone,Mirela Zalewski,)
29		Midterm delivering	1 hr	Sat 3/24/07	Sat 3/24/07	28	Mirela Zalewski,Thales Ramirez
30							
31		**Execution Part 2**	**8 days**	**Sat 3/24/07**	**Fri 4/6/07**	13	
32		Experimental data gathering 1	1.14 days	Sat 3/24/07	Tue 3/27/07		Dr Megri,Ivan Bajkovec,Jodi Banks,Tim Griffis,Eli Stone,Apple Lau,Thales Ramirez
33		Experimental data gathering 2	0.83 days	Sun 4/1/07	Sun 4/1/07		Dr Megri,Thomas Holl,Galen Hammersburg,Nick Palladino,Kieran Healy,Kyle Cantone,Ionut Parv,Mirela Zalewski
34							
35		Analysis of data and results creation	18 hrs	Sun 4/1/07	Fri 4/6/07	32,33,28	Ivan Bajkovec,Jodi Banks,Kyle Cantone,Tim Griffis,Galen Hammersburg,Kieran Healy,Thomas Holl,Apple Lau,Nick Palladino,Thales Ramirez,Eli Stone,Mirela Zalewski,)
36		Computer simulation and comparison of re	4 hrs	Thu 4/5/07	Fri 4/6/07		Ivan Bajkovec,Kyle Cantone,Jodi Banks,Tim Griffis,Galen Hammersburg,Kieran Healy,Thomas Holl,Apple Lau,Nick Palladino,Thales Ramirez,Eli Stone,Mirela Zalewski,)
37							
38		**Completion**	**12 days**	**Sat 4/7/07**	**Fri 4/27/07**	36	
39		Meeting minutes submittal	1 hr	Sat 4/7/07	Sat 4/7/07		Mirela Zalewski
40		Creating Reports and presentation	12 hrs	Tue 4/10/07	Thu 4/19/07		Ivan Bajkovec,Jodi Banks,Kyle Cantone,Tim Griffis,Galen Hammersburg,Kieran Healy,Thomas Holl,Apple Lau,Nick Palladino,Thales Ramirez,Eli Stone,Mirela Zalewski,)
41		Presentation submittal	8 hrs	Fri 4/20/07	Fri 4/20/07	40	Ivan Bajkovec
42		Report submittal	1 hr	Fri 4/20/07	Fri 4/20/07	40	Ivan Bajkovec
43							
44		IPRO day	8 hrs	Fri 4/27/07	Fri 4/27/07	42,41	Ivan Bajkovec,Jodi Banks,Kyle Cantone,Tim Griffis,Galen Hammersburg,Kieran Healy,Thomas Holl,Apple Lau,Nick Palladino,Thales Ramirez,Eli Stone,Mirela Zalewski,)
45							
46		**Closure**	**3.5 days**	**Tue 5/1/07**	**Tue 5/1/07**	44	
47		Final briefing and disintegration	2 hrs	Tue 5/1/07	Tue 5/1/07		Dr Megri

4.0 Updated Assignments and Designation of Roles

The only change that have been made in this project is the dates of the experiments (which consequently pushed other tasks back). The reason for the change was due to conflicts in schedules which resulted in the inability for any 6 people to do the experiment on the scheduled date.

In addition to the changing of dates, the team has been reorganized into new sub-teams for the second part of the project (the experimentation). This reorganization was planned from the beginning but defined more accurately now. The reorganization is needed due to the necessary number of people to perform a single experiment. Therefore the team is subdivided into two groups, six people for each experiment.

A diagram showing the new breakdown of the team is shown below. It also includes parts assigned for the part of the final report that is to be completed after the experimentation. After the final report, all members contribute to the final deliverables that will be presented.



Individual Team Member Assignments

Individual assignments have not changed from those listed in the project plan and are as follows:

1 Ivan Bajkovec 110 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
13	Project plan creation	100%	20 hrs	0 days	Thu 2/1/07	Sat 2/17/07
20	STACK software development(TG3)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
21	Development delivering and presentation	100%	2 hrs	0 days	Tue 3/6/07	Tue 3/6/07
14	Project plan delivering	100%	1 hr	0 days	Sat 2/17/07	Sat 2/17/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
32	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/3/07	Sat 3/3/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
41	Presentation submittal	100%	1 hr	0 days	Wed 4/25/07	Wed 4/25/07
42	Report submittal	100%	1 hr	0 days	Thu 4/26/07	Thu 4/26/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

2 Dr.Megri 35 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
2	Problem statement	100%	0.5 hrs	0 days	Tue 1/23/07	Tue 1/23/07
3	Defining team objectives	100%	0.5 hrs	0 days	Tue 1/23/07	Tue 1/23/07
4	Assessment of the resources	100%	0.5 hrs	0 days	Tue 1/23/07	Tue 1/23/07
5	Conceptual design of the operations	100%	0.5 hrs	0 days	Thu 1/25/07	Thu 1/25/07
6	Identification of team leaders	100%	0.5 hrs	0 days	Thu 1/25/07	Thu 1/25/07
7	Designation of roles	100%	0.5 hrs	0 days	Thu 1/25/07	Thu 1/25/07
10	Planning and scheduling	100%	2 hrs	0 days	Tue 1/30/07	Tue 1/30/07
11	Allocation of resources	100%	2 hrs	0 days	Tue 1/30/07	Tue 1/30/07
12	Organizing the work(task group creation)	100%	2 hrs	0 days	Tue 1/30/07	Tue 1/30/07
17	Lectures	100%	2 hrs	0 days	Thu 2/1/07	Thu 2/1/07
32	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/3/07	Sat 3/3/07
33	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/24/07	Sat 3/24/07
47	Final briefing and disitntegration	100%	2 hrs	0 days	Tue 5/1/07	Tue 5/1/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07

3 Jodi Balido 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
25	Smoke control research(TG6)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
26	Research delivering and presentation	100%	2 hrs	0 days	Thu 3/8/07	Thu 3/8/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
32	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/3/07	Sat 3/3/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

4 Kyle Cantone 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
24	Smoke control research(TG5)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
26	Research delivering and presentation	100%	2 hrs	0 days	Thu 3/8/07	Thu 3/8/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
32	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/3/07	Sat 3/3/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

5 Tim Griffin 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
19	ASCOM software development(TG2)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
21	Development delivering and presentation	100%	2 hrs	0 days	Tue 3/6/07	Tue 3/6/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
32	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/3/07	Sat 3/3/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

6 Galen Hammersburg 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
23	Fire protection research(TG4)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
26	Research delivering and presentation	100%	2 hrs	0 days	Thu 3/8/07	Thu 3/8/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
32	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/3/07	Sat 3/3/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07

"Galen Hammersburg" continued

ID	Task Name	Units	Work	Delay	Start	Finish
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

7 Kieran Healy 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
18	CONTAM software development(TG1)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
21	Development delivering and presentation	100%	2 hrs	0 days	Tue 3/6/07	Tue 3/6/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
32	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/3/07	Sat 3/3/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

8 Thomas Holt 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
25	Smoke control research(TG6)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
26	Research delivering and presentation	100%	2 hrs	0 days	Thu 3/8/07	Thu 3/8/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
33	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/24/07	Sat 3/24/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

9 Apple Lau 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
25	Smoke control research(TG6)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
26	Research delivering and presentation	100%	2 hrs	0 days	Thu 3/8/07	Thu 3/8/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
33	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/24/07	Sat 3/24/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

10 Nick Palladino 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
18	CONTAM software development(TG1)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
21	Development delivering and presentation	100%	2 hrs	0 days	Tue 3/6/07	Tue 3/6/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
33	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/24/07	Sat 3/24/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

11 Thales Ramier 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
19	ASCOM software development(TG2)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
21	Development delivering and presentation	100%	2 hrs	0 days	Tue 3/6/07	Tue 3/6/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
33	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/24/07	Sat 3/24/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

12 Eli Stine 87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
23	Fire protection research(TG4)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
26	Research delivering and presentation	100%	2 hrs	0 days	Thu 3/8/07	Thu 3/8/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
33	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/24/07	Sat 3/24/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

13	Mirela Zalewski	88 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
20	STACK software development(TG3)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
21	Development delivering and presentation	100%	2 hrs	0 days	Tue 3/6/07	Tue 3/6/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
32	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/3/07	Sat 3/3/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
39	Meeting minutes submittal	100%	1 hr	0 days	Fri 4/6/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

14	Ionut Parv	87 hrs

ID	Task Name	Units	Work	Delay	Start	Finish
24	Smoke control research(TG5)	100%	30 hrs	0 days	Sat 2/3/07	Tue 2/27/07
26	Research delivering and presentation	100%	2 hrs	0 days	Thu 3/8/07	Thu 3/8/07
28	Midterm report creation	100%	4 hrs	0 days	Tue 3/20/07	Thu 3/22/07
33	Experimental data gathering 1	100%	4 hrs	0 days	Sat 3/24/07	Sat 3/24/07
35	Analysis of data and results creation	100%	10 hrs	0 days	Tue 3/27/07	Tue 4/3/07
36	Computer simulation and comparison of results	100%	4 hrs	0 days	Thu 4/5/07	Fri 4/6/07
40	Creating Reports and presentation	100%	25 hrs	0 days	Tue 4/10/07	Tue 4/24/07
44	IPRO day	100%	8 hrs	0 days	Fri 4/27/07	Fri 4/27/07

15		0 hrs

Designation of Roles

The designation of roles has not changed and is as follows:

Minute Taker (responsible for recording decisions made during meetings including task assignments or changes under consideration):
Mirela Zalewski

Agenda Maker (responsible for creating agendas for each team meeting):
Ivan Bajkovec

Time Keeper (responsible for making sure meetings go according to agendas):
Elijah Stine

Weekly Timesheet Collector/Summarizer (responsible for collecting weekly timesheets from each member of the team and updating everyone with summary report):
WingYin (Apple) Lau

Master Schedule Maker (responsible for collecting schedules from all the team members and developing a master schedule which tells the team when members are available and how to contact them):
Thomas Holt

iGROUPS Coordinator (responsible for organizing the teams iGROUPS and ensure that it is used properly):
Galen Hammersburg

5.0 Barriers and Obstacles

The single biggest obstacle of this IPRO project is that there is very little of the resources that can be researched on the subject of smoke control design. This obstacle has created other barriers during the project. The only real way to find out about smoke control design is to interview professionals who do it on a daily basis. It was hard to find professionals in this field and also difficult to schedule time to meet with them. When members of the group were able to talk to a professional, it was sometimes hard to get specific information out of them.

The other barrier we encountered, but was expected, was that no one on the team had any real background on smoke control. Smoke control design is not really taught as it maybe should be and it covers a variety of disciplines (knowledge of HVAC, physics, codes, experience and what is done in practice).

Dr. Megri was well aware of these obstacles and issues from the start. He made us aware of the lack of resources out there on the subject but the rest of the issues associated with the main this major obstacle the team became aware of as we started the project. Dr. Megri, an expert on the subject, had to have a few lectures in order acquaint us with smoke control. He also helped us find contacts in order to conduct our interviews to find more information on the subject, since he is in this field of work and is able to provide us with professionals he is acquainted with or is aware of. Basically, having an expert on hand, Dr. Megri, to guide this project was how these obstacles were able to be resolved or helped.

There were also some problems with the originally assigned roles. The main problem happened involved the programming group when research into ASCOS was ended and the group was folded into the CONTAM research team. In addition to that change some other problems occurred with overlapping work and redundant results with in the now larger CONTAM team. This was easily fixed by simply reorganizing the groups for the experimental work so that people were placed where they would be the most optimized; moving a member from the CONTAM group into the interviewing team where there was more work to be done.

These obstacles and issues have been helped or resolved well enough that they will not affect the project in a negative way. We were able to interview professionals, Dr. Megri has given us lectures as to the background of smoke control and code issues, and the programs have been developed or explored. The experimentation should validate all of the expected data and a design method will be reached from all the information we have gathered this semester. No other problems are foreseeable for this project at this time.