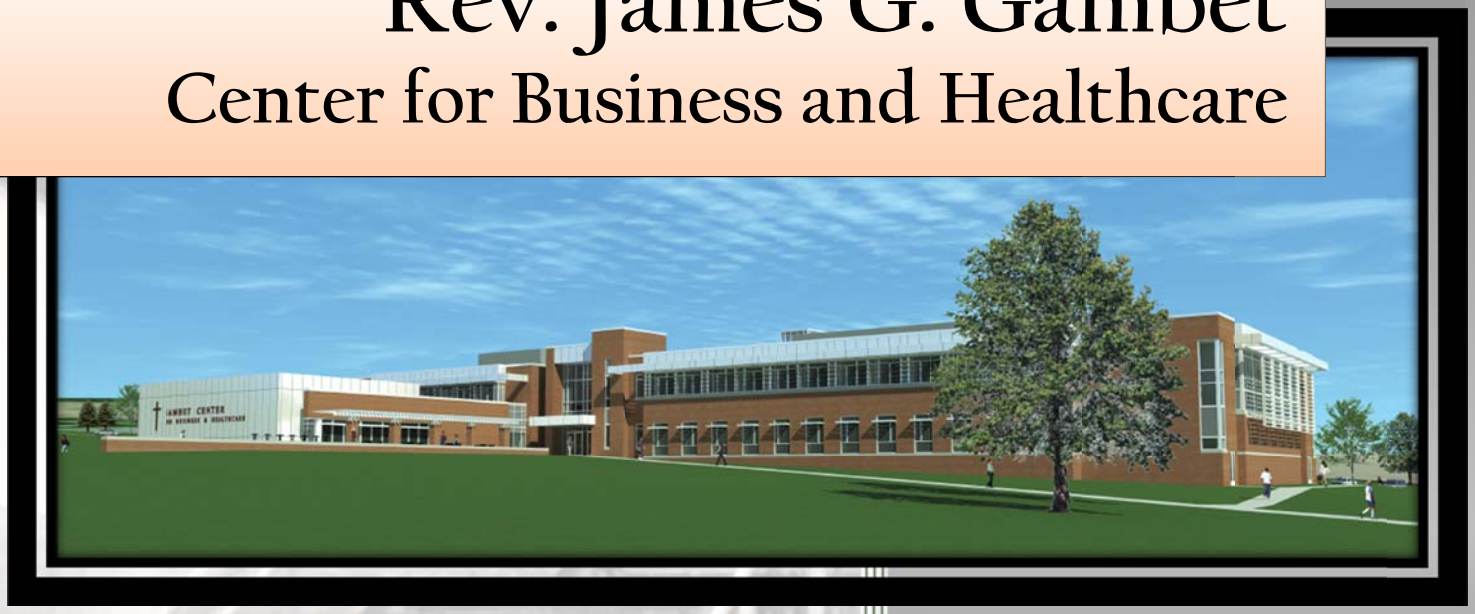
DeSales University

Thesis Proposal

Rev. James G. Gambet
Center for Business and Healthcare



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Executive Summary

The Reverend James G. Gambet Center for Business and Healthcare is the latest addition to the campus at DeSales University. The new $27 million facility, which is the new home of the Business, Nursing, and Physician Assistant Programs, will be state of the art and include technologically advanced labs and classrooms. DeSales' continual growth and ever increasing commitment to sustainability is reflected in the design of the facility, which is expected to achieve a LEED® Silver rating. The four analyses included in this proposal are to target specific ways in which to make the Gambet Center even more sustainable and able to upgrade the building to LEED® Gold classification.

Technical Analysis 1: Conceptual Energy Modeling
The first analysis aims to determine the advantages of incorporating the use of Building Information Modeling as a tool to aid in efficient conceptual design. With no BIM requirements set on the project, an analysis of how conceptual energy modeling could have been utilized during the design process to influence more sustainable systems and assemblies.

Technical Analysis 2: Implementation of a Green Roof
An alternate to the original design of the building included a large lecture hall that was eventually added to the scope of the project. A green roof structure for this part of the building will be considered to help offset the additional HVAC requirements. A mechanical breadth will be conducted analyzing the impact the green roof has on the mechanical system loads with the intention increasing the energy efficiency of the building. In addition, a structural breadth study will also be performed on the structural system of the Gambet Center to determine any changes necessary to support the added load of the green roof.

Technical Analysis 3: On-Site Renewable Energy
Without any on-site renewable energy on the project, a total of seven LEED® credits were not obtainable with the current design of the Gambet Center. This analysis will explore the feasibility of including photovoltaic panels on a significant portion of the roof surface of the building. Additional options such as parking lot structures will also be considered in order to maximize the on-site production of energy.

Technical Analysis 4: More Advanced Lighting Control System
The Gambet Center currently includes a basic lighting control system that only has the capability of switching lights on and off with switches, time clock controls, and occupancy sensors; however, there are no dimming capabilities, which require the light fixtures to use the maximum amount of energy when turned on. A system with dimming capabilities is expected to reduce energy consumption considerably.

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Project Background

The Reverend James G. Gambet Center for Business and Healthcare is the latest addition to the campus at DeSales University. The new $27 million facility, which is the new home of the Business, Nursing, and Physician Assistant Programs, will be state of the art and include technologically advanced labs and classrooms. DeSales' continual growth and ever increasing quality in education has caused these programs to reach their maximum potential in the current facilities. Construction of the 77,000 square foot building is managed by Alvin H. Butz, Inc., and is scheduled to complete in November 2012.

Within the last five years, DeSales University has made a major push into education students and facilitating sustainable practices. Through combining the business and healthcare departments into one building, they are exposing the medical students to the business side of their industry, while providing them all with a new building that promotes sustainability and healthy lifestyles. The Gambet Center is expected to obtain a certification of LEED® Silver.

Currently, the Gambet Center is eligible for 50 LEED® credits, the minimum amount necessary for a LEED® Silver rating. An additional 10 credits are required for the building to achieve an upgraded rating of LEED® Gold. Of the available credits that are applicable to the Gambet Center, a focus on the energy efficiency and consumption of the building is essential to discover techniques in which LEED® Gold can be attained. It is the intent of the following four technical analyses to propose options in which a Gold rating can be made possible.

Technical Analysis 1: Conceptual Energy Modeling

*Critical Industry Issue

Problem Identification

Although high sustainable performance was the a requirement to the design of the Gambet Center, the use of building information modeling (BIM) was limited to the architectural massing and rendered images. The mechanical contractor also created 3D models of the mechanical system for their own constructability review, and there was no coordination with other trades. Had the early conceptual design of the building been integrated with energy modeling software, there could have been opportunities to make smarter decisions relating to the energy efficiency of the building.

Background Research Performed

The BIM Execution Guide developed by Penn State details a variety of ways BIM can be employed. Although it is obviously not appropriate to incorporate every use into the Gambet Center, it can be beneficial to analyze a few. A list of various BIM uses from the Penn State BIM Execution Planning Guide are listed below:

BIM Uses:

Building Maintenance Scheduling	Digital Layouts
Building Systems Analysis	3D Coordination
Asset Management	Engineering Analysis
Space Management and Tracking	Facility Energy Analysis
Disaster Planning	Structural Analysis
Record Modeling	Sustainability Evaluation
Site Utilization Planning	Code Validation
Virtual Mockups	Cost Estimation
Digital Fabrication	Phase Planning
Programming	Design Reviews
Site Analysis	Existing Conditions Modeling

Again, it is not logical to incorporate all of these uses on every project, and final decisions rely on the uses providing the most benefit to the owner or project team.

Potential Solutions

The use of conceptual energy modeling is helpful in the early design process to discover inefficiencies in the design. Although the Gambet Center finished construction in early 2013, the current design can be analyzed and compared to alternative options with modifications of

various parameters. The creation of an energy model of the Gambet Center also aids in the completion of the other technical analyses by providing energy usage estimates that are difficult to obtain with the building not yet fully operational.

Discussion of energy usage and BIM at the 2012 PACE Roundtable provided insight into the problems of utilizing BIM for energy modeling. Research into what makes a valuable energy model and how to make the model work best for designers and facility managers and how to interface this information with the Building Automation System will be performed.

Methodology

- Choose energy modeling software to analyze the building
- Understand the application, features, and the limits of its functionality
- Create a conceptual model of the building and run an energy analysis
- Run additional analyses to compare with original design
- Suggest appropriate changes in design that improve energy usage

Expected Outcome

The LEED® Silver rating of the Gambet Center suggests a fairly high level of sustainable practices already integrated into the design. Explained in the LEED® Evaluation above, the Gambet Center performs poorly in the Sustainable Sites category. In order to reach the Silver rating, the other credits need to be achieved through other categories. This suggests that any improvements to the building will most likely be minimal, though it is expected that the results of this technical analysis will be able detail some improvement to the design.

Technical Analysis 2: Green Roof Implementation

Problem Identification

The Lecture Hall was initially an alternative option to the initial design of the Gambet Center that was eventually included in the project scope. This alternate requires two additional rooftop heat recovery units, the implementation of a green roof may allow for a reduction in the size of the mechanical system for the additional space.

Background Research Performed

Green roofs have become increasingly popular in green building design due to their exceptional performance as building insulation and can substantially reduce building loads. Green roofs consist of many layers and are partially covered with soil and small plant life. These layers include waterproofing, water drainage, soil retention, and soil among others. Other advantages to incorporating green roofs are for absorption/collection of rainwater, a small habitat for wildlife, and mitigation of the heat island effect. Although a higher initial cost and more difficult to construct, green roofs can provide durable roof membranes that can save the owner money in the long run.

Potential Solutions

While the addition of a green roof does not have a direct effect on helping the Gambet Center achieve a higher LEED® rating, it may have a significant reduction to the mechanical load of the building that, when paired with an alternative geothermal mechanical system, helps to optimize the energy performance of the building.

Methodology

- Research variations of green roofing systems to determine which types are most appropriate for the project
- Propose a design of the selected green roof system
- Structural breadth to analyze effect on the structural system, and determine what changes may be necessary
- Mechanical breadth to calculate reduction of HVAC load on the space
- Produce a cost estimate of the system and perform lifecycle cost analysis to determine payback period
- Determine effects on LEED® rating of the building
- Impact on schedule
- Provide recommendation to owner on appropriateness of considering the green roof

Expected Outcome

It is believed that the addition of a green roof system above the Lecture Hall will substantially reduce the heating/cooling load on the space, leading to a reduction of the mechanical equipment needed. This will lead to a higher energy performance for the building and help with the attainment of LEED® points to receive a Gold rating. After this analysis, it may be shown

that the incorporation of a green roof on the majority of the roof structure is more beneficial than a photovoltaic system application in terms of achieving LEED® points.

Technical Analysis 3: On-Site Renewable Energy

Problem Identification

DeSales University has made major strides in incorporating sustainable practices into their campus operations, most notably in the construction of their new buildings. The McShea Student Center was the first LEED® Accredited building on the campus, and is followed by the Gambet Center, both of which meet LEED® Silver requirements. Rewarded for leadership in sustainability, DeSales has the opportunity to take that role even farther by starting to incorporate energy independence into its practices. Photovoltaic and green technologies can be explored to help DeSales remain a leader in the area, while also showing a strong commitment to sustainability.

Background Research

Photovoltaic solar panels are the most popular way to produce electricity on site, and help offset energy use in buildings. In depth research will be required to discover cost effective technology that is appropriate for use on the Gambet Center. Additional ways of generating electricity, such as wind turbines and "stand-alone" PV panels, can also be evaluated. Lowering the amount of energy consumed by the Gambet Center is one of the best ways to make it more sustainable because it decreases the reliance on the utility, because generation of electricity is a major contributor to greenhouse gas emissions.

Potential Solutions

The installation of PV arrays on the roof of the Gambet Center will produce the most amount of electricity, but a cost to benefit analysis will need to be performed to determine how much of the roof area should be covered with solar panels, or if this type of system is feasible at all. A smaller application, such as small wind turbines on the tops of exterior light poles may also be a unique way to produce electricity on site.

Methodology

- Research photovoltaic systems suitable for the Gambet Center and their connection into the building
- Conduct a solar study to analyze optimal array position on the roof
- Calculate the total energy produced by the solar panel arrays
- Investigate alternative applications of on-site renewable energy
- Determine lifecycle cost and payback period of proposed system
- Compare the total building electricity usage to the generation capacity of the PV system
- Make final recommendation on including a PV system

Expected Outcome

It is expected that inclusion of a PV array on a significant portion of the roof area will be a viable application to reduce energy costs. The lifecycle analysis will detail the return on investment and be compared to the owner's expectations on what they are willing to invest to make a

recommendation whether or not this solution is appropriate to help gain LEED® points. Depending on the results from Technical Analysis 2, rooftop PV arrays may not be the most beneficial for gaining additional LEED® points, in which case other applications of on-site renewable energy will be explored.

Technical Analysis 4: Advanced Lighting Controls

Problem Identification

While the Gambet Center was specifically designed with sustainability in mind, the initial cost and payback period to the owner were major factors in deciding what types of systems to use on the project. A basic lighting control system was included to help reduce energy consumption. While this system was designed to be energy conscious, it is not the most efficient system that could have been chosen. The largest opportunity to gain additional LEED® points are available when optimizing the energy performance of the building, so a more advanced lighting control system can help to make this possible.

Background Research Performed

The current lighting control system is a Lutron Electronics computer processor based system known as Quantum. Quantum has the ability to become an advanced lighting control system, but as it is currently designed, the Gambet Center does not take advantage of this functionality. As an example, the lights can only be switched on and off, with no dimming capability built in. Without the ability to dim lights, they will be using more electricity than if they could be dimmed most of the time.

Potential Solutions

By upgrading some of the components of the Quantum light management system already in place in the Gambet Center, a considerable amount of energy can be saved by adding dimming and other automatic control capability.

Methodology

- Study current lighting control system to understand the setup, features, and areas for improvement
- Redesign system to include additional capabilities to decrease electrical requirements of the lighting system
- Calculate annual electrical consumption of the lighting system
- Find the energy savings of the system upgrade
- Provide lifecycle cost analysis for the upgrade
- Determine any gains in LEED® credits resulting from the redesign

Expected Outcome

It is believed that a more advanced lighting control system with efficient fixtures will benefit the Gambet Center in terms of sustainability. The energy savings of the upgraded Quantum system are expected to outweigh the higher initial costs. It is also thought the additional shading solution will help reduce the mechanical loads of the building, further increasing the efficiency.

Weight Matrix

Technical Analysis Weight Matrix for the Distribution of the Core Investigation Areas					
Description	Critical Industry Research	Value Engineering	Constructability Review	Schedule Reduction/ Acceleration	Total
Use of BIM	20%	-	5%	10%	**35%**
Green Roof		15%	10%	-	**25%**
On-Site Renewable Energy		10%	15%	-	**25%**
Advanced Lighting Controls		15%	-	-	**15%**
Total	**20%**	**40%**	**30%**	**10%**	**100%**

Conclusion

Upon completion of the four technical analyses described above, it will be determined if the implementations of sustainable concepts and systems will be enough for the Gambet Center to gain the additional 10 LEED® credits necessary for Gold rating. Technical Analysis 1 will explore how the facility can benefit through using a higher level of BIM in the project in regard to energy use modeling and tracking. Investigation of a green roof for the lecture hall to reduce mechanical loads will be conducted in Technical Analysis 2 with the intention of substantially reducing the size of rooftop HVAC equipment for the lecture hall. Technical Analysis 3 is expected to show that a small portion of the building's electrical consumption can come from on-site renewable energy in the form of photovoltaic panels on the roof. Finally, the redesigned lighting control system explored in Technical Analysis 4 is expected to considerably reduce the electric consumption of the lighting system. The combination of these four technical analyses is believed to make the difference between a LEED® Silver and Gold rating.

| Appendix A-1 |

Breadth Studies

Breadth Studies

Structural Breadth

The implementation of sustainable technologies into the Gambet Center includes the addition of a green roof system above the Lecture Hall, which is evaluated in Technical Analysis 2. The incorporation of a green roof imposes a significantly larger dead load on the structure, and a closer look must be taken into the effects on the structural system. It is expected that the structural system that is currently designed will not be adequate, and fail to resist the additional load from the green roof.

Depending on the outcome of the breadth analysis it will be apparent whether it is necessary to either increase or not change the size of the structural members. In the probable case the size of the structural system increases, the cost implications will be considered and compared to those of the rest of the system. While there are substantial costs associated with green roofs, the size of the mechanical system will decrease leading to cost savings on heating and cooling costs over time. A lifecycle cost analysis of adding the green roof will also be conducted to assess whether the payback period is within the expectations of the owner. Regardless of the cost of the system, any gains in building efficiency will help to achieve more LEED® points for obtaining Gold certification.

Mechanical Breadth

Also stemming from Technical Analysis 2, a mechanical breadth will also be performed to calculate the amount of energy saved from the addition of a green roof system above the Lecture Hall. As it is currently designed, the Lecture Hall requires two 2,850 CFM air-handling units for mechanical loads. Since green roofs are good for energy reduction, they can largely reduce the heating and cooling loads of the Lecture Hall.

The savings in cost could potentially come from a combination of using less natural gas through energy reduction and the need for smaller equipment. As stated above these savings will be compared to the additional costs of the green roof itself and the necessary upgrades to the structural system, and used to provide the owner with a complete lifecycle cost analysis of implementing a green roof.