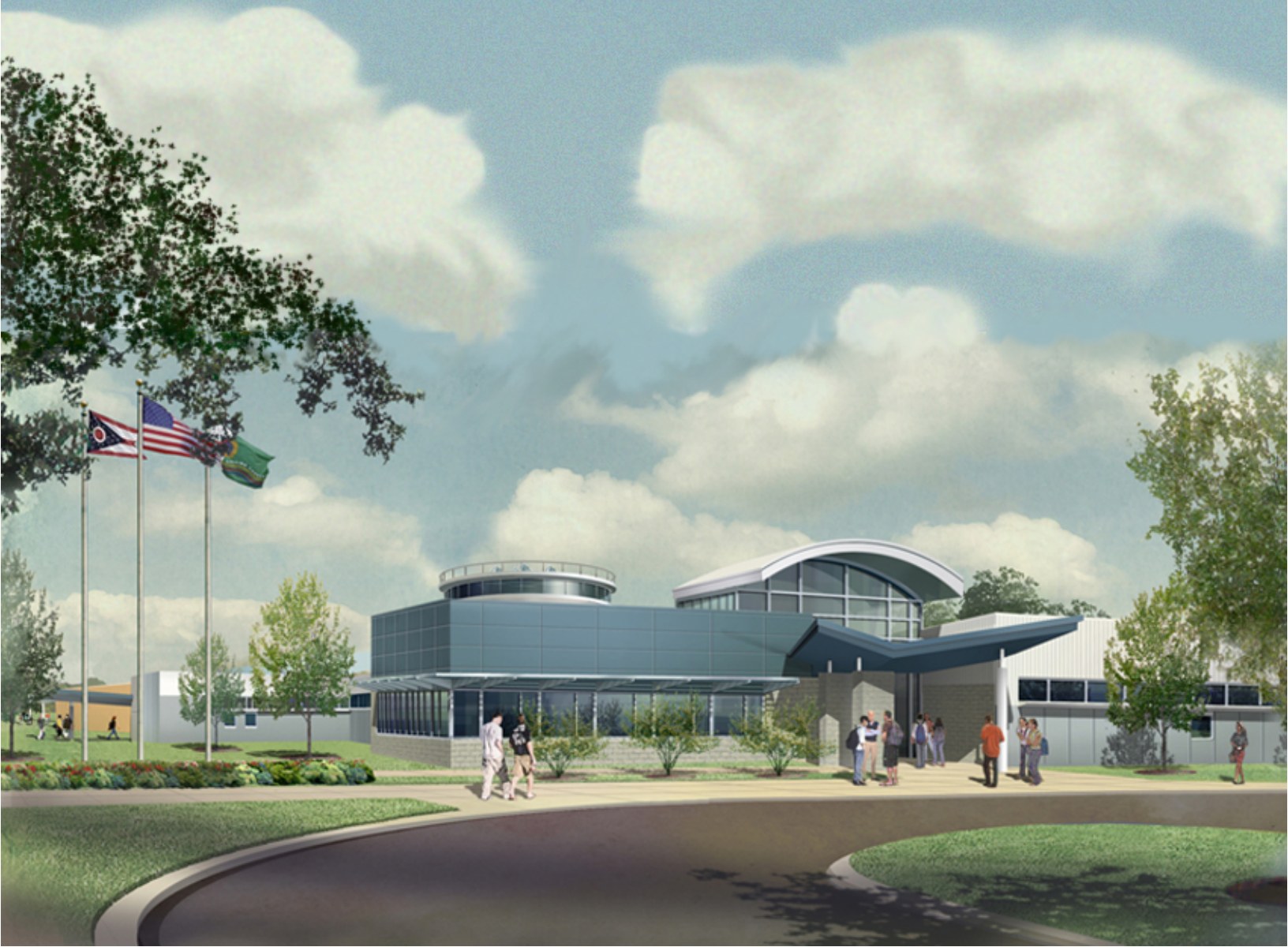


**CAREER AND TECHNOLOGY  
EDUCATION CENTERS  
LICKING COUNTY  
NEWARK, OHIO**

**SHANE A. SEMPLE**

SPRING 2004  
LIGHTING/ELECTRICAL OPTION  
FACULTY CONSULTANT: DR. MARTIN MOECK





# Table of Contents

<b>Executive Summary.....</b>	<b>2</b>
<b>Introduction.....</b>	<b>3</b>
<b>South Façade Lighting.....</b>	<b>6</b>
<b>Mall Court Lighting.....</b>	<b>12</b>
<b>Cosmetology Lab Lighting.....</b>	<b>25</b>
<b>Auditorium Lighting.....</b>	<b>32</b>
<b>Electrical Redesign.....</b>	<b>43</b>
<b>Acoustical Analysis.....</b>	<b>51</b>
<b>Mechanical Analysis.....</b>	<b>58</b>
<b>Final Conclusions.....</b>	<b>61</b>
<b>Acknowledgments.....</b>	<b>62</b>
<b>Appendix.....</b>	<b>63</b>



## Executive Summary

The following report is a culmination of two semester's analysis of the building systems of Career and Technology Education Centers Licking County (C-Tec). The report contains proposed redesigns for four lighting spaces, a significant alteration to the electrical distribution system, an analysis of the acoustics of the school auditorium, and the analysis of the impact that additional glazing will have on the mechanical systems.

The lighting redesign addresses four spaces, the South Façade, Mall Court, Cosmetology Lab, and Auditorium. Each of these spaces was redesigned in an effort to increase both the aesthetic quality of the lighting systems for the spaces as well as the energy efficiency of the systems. The redesign for the Cosmetology Lab includes the addition of glazing to the southeast wall, and an analysis of the effect of this glazing.

The electrical redesign for the school investigated the possibility of adding a photovoltaic array to the school to supplement the utility power. The investigation looked into several factors, including; available LEED credits, solar energy in Newark, Ohio, cost of the system, impact on the existing distribution system, and general pros and cons of photovoltaic technology. In addition to this analysis, a large mechanical panel in the building was analyzed on several criteria; to ensure that the panel met minimum criteria for over-current protection, that the feeder to the panel was sized properly, and that voltage drop from the panel to the farthest load was under 3%. A short circuit analysis was also carried out from the utility service entrance to this panel.

Breadth work was carried out in two disciplines, acoustics and mechanical analysis. The acoustical analysis addressed room acoustics for the auditorium. Ray diagrams were used to determine whether echoes would be a problem in the space, and reverberation time calculations were done to acoustically optimize the surface materials in the space. The mechanical analysis entailed comparing the solar load incident on the cosmetology lab with the addition of the new glazing to the original solar load. The increased load was then compared to the service for the space to ensure that the system would not need to be resized.



# Introduction

## Career and Technology Centers of Licking County (C-Tec) Newark, OH

### General Project Data

#### Building Occupant Name:

Licking County Joint Vocational School District

#### Building Functions:

The building will function as a vocational technical school for Licking County, OH. There will be classrooms varying from the basics of science and language arts, to cosmetology labs and a restaurant. There is also an auditorium in the building where shows may take place.

#### Size/Levels Above Grade:

~315,000 ft<sup>2</sup>/One level above grade

#### Primary Project Team:

General Contractor: Claggett & Sons

Architects and Engineers: [L. Robert Kimball Associates](#)

Owners: [Licking County Joint Vocational School District](#)

Electrical Contractor: Claypool Electric

Plumbing Contractor: Gutridge Plumbing

HVAC Contractor: General Temperature Controls



Career and Technology Education Centers  
Secondary Education Center

Kimball Associates, P.A.

#### Construction Dates:

Start: May 2004

Expected Completion:

December 2005

#### Cost Information:

Construction Cost:

\$32,000,000

Soft Costs: \$4,000,000



### **Building Description:**

C-TEC of Licking County is a vocational school located in a residential section of Newark, Ohio, that serves the needs of both high school aged and adult students. This project was a very large addition that roughly doubled the size of the school to 315,000 ft<sup>2</sup>. The new facilities will house classrooms for traditional classes such as science and language arts, as well as trade based classrooms and laboratories for cosmetology studies and auto body work. The new area of the school will also include a large auditorium that will be used for lectures, school assemblies, and more than likely community plays.

One of the most interesting aspects of this project is that upon completion C-TEC is expected to be LEED certified. This led to the building being very energy efficiently designed. As is the case with all LEED buildings, daylighting is used extensively throughout the building.

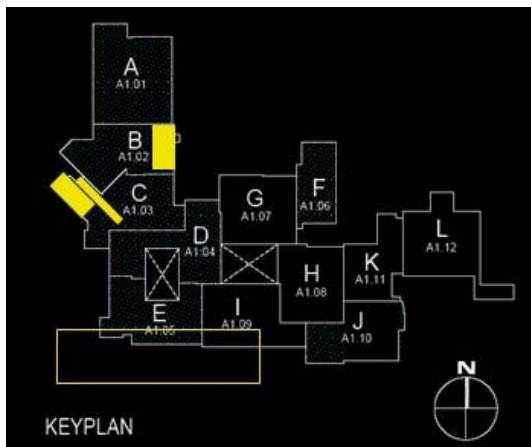


Career and Technology Education Centers  
Licking County  
Kinball Associates, P.A.

### **Project Description:**

This thesis assignment will address new lighting systems for four spaces in the building, the addition of a photovoltaic array to the electrical distribution system, an acoustical analysis of the auditorium, and a mechanical analysis for the addition of glazing in the Cosmetology Lab. The four lighting spaces that are redesigned are the South Façade (student entrance), Mall Court, Cosmetology Lab, and Auditorium. The new designs for these spaces will attempt to create

the most energy efficient system possible while retaining or improving upon the level of aesthetic appeal present in the rest of the school. In the picture to the left, the lighting spaces that are to be redesigned are shown in relation to one another. The rectangle in area B is the Auditorium, the long thin rectangle in area C is the Mall Court, the adjacent shorter rectangle is the Cosmetology Lab, and finally, the open rectangle in areas E and I is the South Façade.





### **Lighting Theme:**

Students who enroll in vocational schools tend to be those who did not find conventional education to be to their liking. Their start in a vocational school can be thought of as a new beginning for these students. This is reminiscent of the new beginning that nature receives every year in the spring. The second influence for the theme of the lighting design is the fact that the building is expected to be LEED certified. By being LEED certified this building is making a statement of efficiency and nature friendliness. A search was done to find images that brought about these feelings of spring, efficiency, and nature. The following painting, *Baume in Blute* by Claude Monet, stirred these feelings.



The new lighting systems for the school, while not trying to copy this image, certainly drew from the cool colors, simple brush strokes, and beautiful illustration of spring time in the painting for inspiration for the lighting designs.