Value Engineering Study

US Army Corps of Engineers®

Louisville District

Final Report

EISA Demonstration Project
Brigade Combat Team 3 Complex

Ft. Campbell, KY
PN 63641
P2 322296
Study No. 2011-11-M

~~October 2011~~ Implementation Results Corrected December 2011

Strategic Value Solutions, Inc.

Value Improvement Specialists

Value Engineering Study

US Army Corps of Engineers®

Louisville District

EISA Demonstration Project
Brigade Combat Team 3 Complex

Ft. Campbell, KY
PN 63641
P2 322296
Study No. 2011-11-M

October 2011

Strategic Value Solutions, Inc.

Value Improvement Specialists

Final

Value Engineering Study Report

for

EISA Demonstration Project
Brigade Combat Team 3 Complex

Ft. Campbell, KY

May 2011

Prepared for:

US Army Corps of Engineers, Louisville District
600 Dr. Martin Luther King Jr Place
Louisville, KY 40202

Prepared by:

Strategic Value Solutions, Inc.

19201 E. Valley View Pkwy, Suite H
Independence, MO 64055
816-795-0700

www.SVS-inc.net

Acknowledgements

Strategic Value Solutions, Inc. would like to express our appreciation to the US Army Corps of Engineers, Louisville District staff members and the Centers of Standardization with Fort Worth District and Savannah District who assisted us in the review of this project.

In addition, we would like to thank the members of the Fort Campbell Directorate of Public Works for sharing their knowledge about the Users' requirements as well as the specific needs of the Installation.

Particular thanks also to Ben Robertson for assisting in the coordination and management of this study.

Table of Contents

TABLE OF CONTENTS

SECTION 1 EXECUTIVE SUMMARY

SECTION 2 PROJECT DESCRIPTION

SECTION 3 VALUE STUDY PROCESS

SECTION 4 VALUE ALTERNATIVES

APPENDIX

SECTION 1

EXECUTIVE SUMMARY

SECTION 1
EXECUTIVE SUMMARY

This report presents the results of a Value Study conducted by Strategic Value Solutions, Inc. (SVS) on March 28-April 1, 2011 on the design of the EISA Demonstration Projects at Fort Campbell, KY for the US Army Corps of Engineers, Louisville District (District). This Value Study used the international standard Value Methodology established by SAVE International, the Value Society.

Design/Construction Strategy:	Design-Bid-Build
Level of Project Development:	35% design
Design Firm (Buildings):	Center of Standardization US Army Corps of Engineers, Savannah District US Army Corps of Engineers, Fort Worth District
Design Firm (Site):	US Army Corps of Engineers, Louisville District

Based on the team members' professional judgment and input from the District representatives, 25 ideas were developed into Value Alternatives and can be found in Table 1-1. The team also presents, in Table 1-3, the combination of alternatives that when combined, provides the greatest overall benefit to the project.

PROJECT DESCRIPTION SUMMARY

The US Army Corps of Engineers is using three FY13 projects to be constructed at Fort Campbell, KY to serve as demonstration projects for how to apply the objectives of the 2007 Energy Independence and Security Act (EISA) to the Army's standard designs.

This particular project will construct:

1. One brigade headquarters building, two battalion headquarters buildings, and a company operations facilities (COF) for 14 companies

2. Three small tactical equipment maintenance facilities (TEMF)

Two other projects were studied concurrently: three small TEMFs and one large TEMF, and the Barracks. However because the design on the barracks had not reached 35%, it was removed from the scope of the study.

Although some of the alternatives are applicable to the barracks, in some cases insufficient information exists to complete a thorough analysis. To the extent the information was available, analysis is provided in the alternative discussion.

These facility types are all based on standard designs developed by the Centers of Standardization (COS).

The demonstration project is to identify energy conservation and sustainable design solutions that could be incorporated into these standard designs as well as to identify sustainable site development alternatives.

The COSs were tasked with developing the facility designs. The Louisville District was responsible for the site designs as well as the EISA demonstration component of these projects.

WORKSHOP RESULTS

Risk Associated with Achieving EISA 2007

From the Value Team's understanding of the programmatic objectives and project management plan for these projects, the following risks and opportunities were identified.

- If the standard design "box" cannot be changed, this will limit the available solutions to achieve the requirements of EISA 2007. To maximize the opportunity to achieve these requirements, the building design needs to be flexible in configuration and adaptable to site specific conditions to take advantage of natural features as well as solar and wind exposures. This may require the development of a functional standard as opposed to a "hard-line" standard.

- The site selection process on military installations has largely been based on issues such as available land within the desired area of the installation. As we continue to develop on these installations, this approach will most likely conflict with the sustainability objectives of EISA 2007 by forcing a site design that accommodates the standard design but sacrifices the natural amenities and features of the site.

- Site selection and designs have been further constrained by anti-terrorism and force protection (ATFP) strategies that have been employed since 9/11. In particular, the setback requirements for buildings from roads and parking areas has substantially limited the buildable area on already limited site options. If we continue to allow ATFP requirements to trump all other site development considerations, we are not going to be able to take advantage of the most effective, most efficient, lowest cost, and most sustainable opportunities to achieve the requirements of EISA 2007 through building orientation and natural stormwater management practices.

- Military installations have historically required low rise development that has resulted in the Army's version of urban sprawl. Along with this sprawl comes large expanses of traditionally impermeable surfaces for parking. This sprawl approach was further encouraged by a long standing moratorium against building parking structures because of the per vehicle cost compared to surface parking. If we continue with this urban sprawl model, we are going to run out of land on our installations. More specific to EISA 2007, we are creating stormwater issues that are not environmentally or economically sustainable. To address these risks is going to require a new paradigm that incorporates higher density development using a vertical model that will incorporate mid to high rise structures and parking garages.

- EISA 2007 allows a 40-year life cycle analysis period to assess the economic feasibility of energy conserving and sustainable solutions. Due to the status of the emerging and evolving energy market sector, some energy conserving solutions and certainly renewable energy is still struggling to be cost effective even with the longer analysis period. The market demand has yet to really drive first cost considerations down. Further, many of the military installations, including Fort Campbell, are in relatively low energy cost locations. These two issues combine to make it difficult to demonstrate the cost effectiveness of these solutions based on current economic and financial models. If we do not change our paradigm for assessing the feasibility of energy conservation measures, such as renewables, then the objectives of EISA 2007 for energy independence and security will not be achieved by the 2030 mandate for this law. A holistic model needs to be developed that fully considers the national and global implications of reducing consumption of our natural resources and for reducing greenhouse gas emissions along with the associated costs from a social, environmental, and financial perspective.

Project Cost Analysis

The Value Team was not able to review the project's construction cost estimate in any detail to verify the estimated costs. The 35% design did not include a detailed cost estimate for the building designs. A parametric cost estimate was provided that only included costs for building systems on a square foot of building basis. Moreover, these estimates were based on standard design models and it was not discernible if these estimates had been fully adjusted based on current design considerations for EISA 2007 compliance. For example, it was not clear if the square foot costs included clerestories, triple pane windows, R-30 walls and R-46 roofs, etc. that were included in the 35% design drawings. All of these items, and more, represent significant cost additions above the standard design used for the parametric model.

A detailed and project specific cost estimate was provided for the site work for each of the project sites.

To compare costs for the Value Alternatives, the Value Team's cost estimators used the detailed site estimates for site issues; however, for building costs, estimates for components of the buildings were taken from R.S. Means, MCACES database, and from the experience of the team members. Further, since there were no usable estimates for the buildings, the Value Team had to estimate the cost of the original 35% design elements in addition to the cost of the proposed change in order to have a comparable cost difference for implementing the Value Alternative.

Energy Modeling

The energy savings requirements of EISA 2007 for federal buildings projects are unlike energy efficiency requirements of past legislation. For example, to demonstrate compliance with the EPAct of 2005 or with LEED Rating System requirements, project teams have been asked to create building energy models which compare the Proposed Building Design against a fictitious Baseline Building created in compliance with the requirements of ASHRAE Standard 90.1 Appendix G. In contrast, section 433 of EISA 2007 requires that new federal buildings and federal buildings undergoing major renovations shall be designed such that the fossil fuel-generated energy consumption of the buildings is reduced by 65% in FY2015 (ramping up to 100% by FY2030) as compared with a similar building in FY2003 from the Commercial Buildings Energy Consumption Survey (CBECS) database.

Meeting this section of EISA 2007 requires comparison against a database of actual building energy use intensities rather than comparison against a fictitious baseline building which is created to be minimally code-compliant. Certain simplifications of the building models are generally not a critical issue when comparing a proposed design against a fictitious baseline that includes the same simplifications, as the goal is comparison between these two models rather than comparison against actual measured data (i.e. for EPAct 2005 or LEED modeling). However, more rigorous modeling procedures for the proposed building designs may be necessary moving forward to demonstrate compliance with these aggressive fossil-fuel generated energy reduction targets. The government may consider developing detailed models of standardized building designs for distribution to design teams; these standard files could then be modified by the teams to reflect any site adaptations necessary but would then contain a standard level of detail across all projects. The drawback to this method would be limitation of the project teams to certain software packages, which is not necessarily recommended. Alternatively, the government may consider developing specific modeling protocol to ensure a certain level of detail in models created by design teams. Establishing a consistent "baseline" level of modeling for the purposes of comparing against CBECS data for EISA 2007 compliance should be a clear goal for federal building project stakeholders.

For this value engineering study, the evaluations of potential energy conservation measures were completed using the building energy model files provided by the COSs where available. These files were created using Trane Trace 700 software but were completed by various individuals; as a result, variations in modeling methodology and thus results output can be anticipated. As the files were not provided well in advance of our study, there was no opportunity for the team to complete a QC review of these models to gain an understanding of the assumptions made, level of detail provided, etc. Where building energy model files for the specific projects were not available from the design teams, Carrier HAP model files for similar buildings were provided by the Louisville District staff and used to estimate the magnitude of potential energy savings for various design options. As a result of all the variables noted above, the savings values determined via modeling during the study should be considered an order of magnitude estimate of the potential energy savings for a given design option. The modeling exercise performed was a useful means to compare the relative energy consumptions of multiple design options for a given project.

The COSs and the District have incorporated significant improvements to the energy consumption of these standard designs. Most of the “easy” solutions are in use. To achieve greater energy conservation is going to require solutions to squeeze out any possible BTU’s remaining. The current energy models are not capable of assessing the sometimes micro-level changes to obtain the additional energy savings. Therefore, consideration should be given to investing in a well-defined or more complex models that can provide a greater degree of accuracy and precision to validate the energy reduction from these smaller system level changes.

STUDY CONSIDERATIONS

The purpose of the workshop is to identify and develop alternative concepts that will improve the overall value of the project. In order to be successful at identifying alternatives, it is essential that the Value Team first understand the project objectives and the problems that must be solved. For this reason, the workshop began with presentations by the District’s project management to define the project objectives and to provide background information on the project. This was followed by a more detailed presentation of the project design by the project development team on how the design will accomplish the project's objectives.

This Information Phase of the workshop was followed by an in-depth analysis of the functional requirements of the project. A complete understanding of the basic functions that must be accomplished in order to successfully achieve the mission of the project is essential for the team to identify feasible alternatives to the current concept.

Using function analysis and Function Analysis System Technique (FAST) diagramming, the team concluded that the mission of these demonstration projects is to create a model for incorporating EISA 2007 strategies into the standard designs developed by the COSs. The basic function that must be accomplished in order to create this model is to demonstrate the feasibility of achieving EISA 2007. The feasibility will be demonstrated by maximizing the efficient use of our resources. When this feasibility is demonstrated it will showcase the Army as a leader in energy and sustainability. Key secondary functions that supported this basic function(s) included maximize resource efficiency, maximize use of renewable resources, reduce energy consumption, reduce energy demand, and conserve resources. Analysis of the functions intended to be performed by the project, helped the team focus on the mission of the project and, consequently, how to identify alternative concepts that would still meet the mission while exploring opportunities for value enhancement.

Through this function-based discussion it became evident that there were subtle, but important, differences in the understanding that individuals on the project development teams had about why we are doing this demonstration project. After a fairly length discussion, a general consensus was reached that we are driving towards a new standard design model for the Army, not just Fort Campbell, that is responsive to the requirements of EISA 2007. In order to create this model, we must be able to demonstrate that it is feasible to actually achieve these extraordinary goals.

With an understanding of the functional requirements, the Value Team transitions to the Creative Phase of the workshop and brainstormed on all of the possible ways to accomplish each of those functions. The team generated almost 300 ideas for potential changes to the current design.

This section describes some of the key considerations identified during the Value Study.

Critical Placed on the Design

Through the planning and design process, many assumptions have to be made in order to advance the project. The following were identified as some of the critical assumptions affecting the decision-making on this project.

- The Louisville District team was constrained by the COS to identify solutions within the standard design "box". In other words, the building configuration could not be changed.
- These facilities must be built on the specific sites selected by Fort Campbell DPW.

The Value Team accepted the site constraint and removed the building constraint.

Critical Constraints Placed on the Value Team

Often constraints or limits are imposed on the Value Study to define the boundaries between project aspects that the project stakeholders will consider changing and those that cannot be changed. These constraints may result from a variety of political, technical, schedule, or environmental causes. For this Value Study, no such constraints were placed on the team's ability to identify and pursue creative solutions for value improvements.

Value Alternatives

Table 1-1, at the end of this section, includes a complete list of all the Value Alternatives developed. This table shows the number and title of each alternative as well as a summary of the cost savings. These savings include the capital or first cost savings as well as the present worth value of the savings associated with the long term owning and operating costs over the economic life of the project. The first cost savings and the present worth savings on operations and maintenance (O&M) sum to give the overall life cycle cost savings for each Value Alternative.

It should be noted that Value Studies are working sessions for the purpose of developing and recommending alternative approaches to the current design. As such, the results presented are of a conceptual nature and are not intended as a final design. Detailed feasibility assessment and final design development of any of the alternatives or suggestions presented herein, should they be accepted, remain the responsibility of the District.

Due to the sheer number of documents provided, and the preliminary nature of the designs (even though they were represented to be 35% designs) some of the information required for development of the alternatives was either non-existent or was incomplete. In some cases, the Value Team resorted to use of information in the standard designs because it was more complete. In addition, much of the information was provided to the team just prior to the study with insufficient time to perform a thorough review prior to the workshop. As such, the quantities and development within the alternatives is conceptual and should be evaluated within the context of the entire scope of the projects and objectives of the workshop. Within this five day value workshop, the Value Team was tasked with reviewing six different building types (15 buildings) over 350,000 sf of building space spread over more than 14 acres, valued at more than $140 million. This does not include the barracks project which was included in some of the alternative(s) discussion but was not formally included.

Some alternatives presented in this report are variations of a common concept and others are alternatives to a specific aspect of the design. Thus, not necessarily all alternatives in this report can be implemented as selection of some may preclude or limit the use of others.

These potential savings do not reflect any costs for redesign, which must be considered. Moreover, the full benefit and impact of many of the alternatives goes beyond the cost savings to include improved project performance of required functions.

Optimum Combination of Alternatives

After completing the development of the Value Alternatives, the team reviewed the composite list of alternatives to identify what they believed to be the optimum combination of alternatives. This combination represents the best value solution for the project in the opinion of the Value

Team. The review concluded that the maximum project benefits would be realized by combining the alternatives as detailed in Table 1-3 – Optimum Combination.

Reviewed and Rejected Recommendations

RC-102 Recover heat from shower drain to heat cold water: the temperature of the water flowing through the drains is not warm enough to extract heat from.

CRD-1 Use big ass fans in Readiness Building: The intent of this recommendation is to augment the equipment in the buildings with large ceiling fans to provide comfort to the occupants and allow the ambient temperature to be raised. The readiness buildings are already designed with a climate range of 68 to 85 degrees F. The fans will consume more energy than they will save because the set points in these areas are very large. Because of the additional capital cost of the fans and low energy savings, this idea was rejected.

UR-1 Build a screen wall with integrated wind pods: After researching the wind data in the Ft Campbell area, wind pods are not a viable source of power.

IMPLEMENTATION RESULTS

The final phase of the VE process consisted of implementation decisions and actions by the District. The decisions and the rationale for the decisions, to the extent provided, are documented in Table 1-1.

Accepted Savings

Estimated net savings from the Value Alternatives accepted by the District for implementation are:

Capital Cost Savings	$ 33,000
Present Worth of O&M Cost Savings	$ 1,243,000
Life Cycle Cost Savings	$ 1,273,000

Additional Savings

Several alternatives were partially accepted by the District. The extent of acceptance was not provided for incorporation into this report. Implementing these recommendations could add additional savings up to:

Capital Cost Savings	($15,836,000)
Present Worth of O&M Cost Savings	$ 71,613,000
Life Cycle Cost Savings	$ 55,777,000

Total Potential Savings

If these additional alternatives are determined to be acceptable, then the total savings from this Value Study would increase the accepted savings stated above to:

Capital Cost Savings	($15,803,000)
Present Worth of O&M Cost Savings	$72,856,000
Life Cycle Cost Savings	$57,053,000

CONCLUSIONS

The PDT has done a good job trying to balance what at times seem to be conflicting requirements for the Army standard designs, Anti-Terrorism and Force Protection (ATFP), Fort Campbell Design Guides and preferences, and these relatively new requirements in EISA 2007. Through the efforts of the PDT, they were able to achieve a reduction in energy consumption to about 40% below the 2004 ASHRAE Standard 90.1. However, the goal for these projects is to try to achieve 65% reduction which is the requirement by 2015. It is important to note that these designs have not accounted for the new ASHRAE Standard 189.1 for high-performance green buildings, which will be applicable to the FY2013 projects. HQUSACE has estimated that these new requirements may add 10% to the project cost.

Through the efforts of the COSs and the District significant improvements have been made to the energy consumption of these standard designs. Most of the “easy” and cost effective solutions have already been incorporated in the 35% design. To achieve greater energy conservation is going to require solutions that are targeted to reduce or eliminate the last remaining BTU’s. As with any such effort, we have reached the point of diminishing returns with a conventional financial payback model. We are at the point with these projects that we have to make a decision on whether we are putting our priority on money or energy. Not an easy decision considering our national economic situation combined with the global threats to energy resources.

Our current financial and economic models make it difficult to achieve a beneficial life cycle cost (LCC), even with the 40 year analysis period allowed by EISA 2007. At Fort Campbell, the low energy rates compound the difficulty in achieving LCC savings. As was said earlier, the more cost effective solutions have been implemented leaving additional energy savings solutions that are relatively expensive for the energy savings achieved. We are now at a point where we need to develop a holistic approach to capture the true savings related to reducing energy consumption and conversion to renewable energy. We are going to have to also consider the true cost of the economic externalities associated with the consumption of our finite natural resources, creation of greenhouse gases, and other unintended consequences from our designs.

In order to make inroads in meeting EISA 2007, consideration must be given for each building, its location, including economic factors, as well as operations. The “one size fits all” or “cookie-cutter” mentality can no longer be applied if we are to be successful in achieving independence from fossil fuels.

To achieve EISA 2007 compliance is going to take a paradigm change in how we plan, design, and construct our facilities as well as what we are willing to pay for our energy independence and security. For example:

- It will take more than minor tweaks to the building systems to achieve any further reduction in consumption

- It will require site specific building designs that will likely challenge the current standard design approach.

- The suite of solutions used needs to consider where the greatest opportunities are for reducing energy consumption. At Fort Campbell, there should be a higher priority to heating energy reductions than cooling energy reductions since there are a greater number of heating degree days in the year than cooling degree days.

- Meeting the objectives of EISA will require a planning and design strategy that begins with site selection

- We are going to have to move away from a horizontal low-rise design mentality and transition to a higher density model that consolidates facilities and functions in mid to high rise facilities. This new model should also include a transition from acres of surface parking lots to centralized parking garages serving multiple facilities. This will reduce energy consumption and will reduce our hydrologic footprint.

It is important to recognize that at least initially, meeting these requirements is going to require a higher capital expenditure in order to:

1. Reduce energy consumption

2. Reduce dependency on fossil fuels

3. Increase energy security

Once the Federal Government becomes a significant consumer for these products and solutions, the cost will come down. This may be a situation where the government is going to have to take the lead to make energy conservation, renewable energy, and other sustainable solutions affordable for the rest of the nation.

Table 1-1 Summary of Alternatives
Brigade Combat Team 3 Complex, PN 63641, P2 322296

Alt. No.	Description	First Cost Savings	Present Worth O&M Savings	Life Cycle Cost Savings	Decision	Remarks
Reconfigure Site						
HRC-7	Combine the two Battalion Headquarters into one building	$562,000	$128,000	$690,000	R	
HRC-8	Combine the two Battalion Headquarters and the Brigade Headquarters into one building	$1,754,000	$990,000	$2,744,000	R	
CR-4	Replace most of the surface parking with a parking garage	($3,320,000)	$3,728,000	$408,000	R	
CRC-4	Combine all COFs into one building	$3,685,000	$1,089,000	$4,774,000	R	Will affect deployment time
HCR-1	Move Battalion HQ to PT site and move PT site to tree covered site	$53,000	$4,000	$57,000	R	
Site						
CR-1	Maintain natural vegetative cover over soils (minimize disturbance)	No Costs Developed			P	Will incorporate to the greatest extent possible
CR-2	Reduce vehicle parking by 20%	$436,000	$275,000	$711,000	R	
CR-20	Infiltrate rainfall close to where it falls	($130,000)	$0	($130,000)	P	Will incorporate to the greatest extent possible
CR-32	Use vegetation and trees to reduce the heat island effect around the buildings	($222,000)	$367,000	$145,000	R	

Alt. No.	Description	First Cost Savings	Present Worth O&M Savings	Life Cycle Cost Savings	Decision	Remarks
Building Architecture						
RC-13	Use flat roofs to facilitate solar; combined with pre-stressed concrete slabs	$90,000	$903,000	$993000	A	
RC-53	Use modular construction systems for interior	$702,000	$0	$702,000	R	
Mechanical						
RC-51	Optimize face velocity on AHU's	$27,000	$25,000	$52,000	R	See email attachments in back of report.
RC-56	Provide bypasses for ERV when free cooling	($10,000)	$122,000	$112,000	A	Code Requirement See email attachments in back of report.
RC-89	Use hot/cold aisles in server rooms	$0	$61,000	$61,000	R	
RC-109	Provide a central plant	($77,000)	$476,000	$399,000	R	Project moved to FY 15; no longer concurrent with Barracks construction
HRC-40	Use district energy system	No Costs Developed			R	Project moved to FY 15; no longer concurrent with Barracks construction
Electrical						
RC-31	Reduce lighting power density	Design Not Sufficiently Developed			R	
CCR-1	Consolidate electrical service to COFs	$379,000	$78,000	$457,000	R	Project moved to FY 15; no longer concurrent with Barracks construction

Alt. No.	Description	First Cost Savings	Present Worth O&M Savings	Life Cycle Cost Savings	Decision	Remarks
Operations						
RC-67	Provide building dashboards for occupants	($57,000)	$170,000	$113,000	A	Ft Campbell to monitor and maintain
RC-99	Create incentive program to encourage energy reduction (energy smack down)	$0	$170,000	$170,000	A	Ft Campbell to monitor and maintain
RD-6	Expand thermal comfort zones	$0	$150,000	$150,000	P	Design parameters will not change; thermostats to be adjusted by troops
Alternative Energy						
UR-4	Use a solar collector field to serve buildings	($15,966,000)	$71,463,000	$55,437,000	P	Installation investigating installing solar fields on landfills
UR-16	Use small modular nuclear reactors	($179,295,000)	$432,065,000	$252,770,000	R	
UR-20	Use a public-private partnership to finance a large scale program for renewable energy	No Costs Developed			P	Installation investigating as a source of capital for solar field
UR-36	Use solar powered site and street lighting	$213,000	$261,250	$475,000	R	

DECISION KEY:
A = Accepted **A/M** = Accepted with Modifications **P** = Partially Accepted **FS** = Further Study Required **R** = Rejected

Table 1-2 Non-monetary benefits
Brigade Combat Team 3 Complex, PN 63641, P2 322296

Alt. No.	Description	Increases Green Space	Reduces Real Estate	Reduces stormwater impact	Increased use of Renewable Energy	Reduces Peak Energy Usage	Reduces Overall Energy Consumption	Reduces heat island effect	Reduces Carbon foot print
Reconfigure Site									
HRC-7	Combine the two Battalion Headquarters into one building	Yes	Yes	Yes			Yes	Yes	Yes
HRC-8	Combine the two Battalion Headquarters and the Brigade Headquarters into one building	Yes	Yes	Yes			Yes	Yes	Yes
CR-4	Replace most of the surface parking with a parking garage	Yes	Yes	Yes				Yes	
CRC-4	Combine all COFs into one building	Yes	Yes	Yes		Yes	Yes		
HCR-1	Move Battalion HQ to PT site and move PT site to tree covered site	Yes							
Site									
CR-1	Maintain natural vegetative cover over soils (minimize disturbance)			Yes					

Alt. No.	Description	Increases Green Space	Reduces Real Estate	Reduces stormwater impact	Increased use of Renewable Energy	Reduces Peak Energy Usage	Reduces Overall Energy Consumption	Reduces heat island effect	Reduces Carbon foot print
CR-2	Reduce vehicle parking by 20%	Yes	Yes	Yes				Yes	
CR-20	Infiltrate rainfall close to where it falls			Yes					
CR-32	Use vegetation and trees to reduce the heat island effect around the buildings			Yes				Yes	
Building Architecture									
RC-13	Use flat roofs to facilitate solar; combined with pre-stressed concrete slabs								Yes
RC-53	Use modular and construction systems for interior								Yes
Mechanical									
RC-51	Optimize face velocity on AHU's					Yes	Yes		Yes
RC-56	Provide an ERV for bypass when free cooling						Yes		Yes
RC-89	Use hot/cold aisles in server rooms					Yes	Yes		Yes
RC-109	Provide a central plant		Yes				Yes		Yes
HRC-40	Use district energy system					Yes	Yes		Yes

Alt. No.	Description	Increases Green Space	Reduces Real Estate	Reduces stormwater impact	Increased use of Renewable Energy	Reduces Peak Energy Usage	Reduces Overall Energy Consumption	Reduces heat island effect	Reduces Carbon foot print
Electrical									
RC-31	Reduce lighting power density					Yes	Yes		Yes
CCR-1	Consolidate electrical service to COFs					Yes	Yes		Yes
Operations									
RC-67	Provide building dashboards for occupants					Yes	Yes		Yes
RC-99	Create incentive program to encourage energy reduction (energy smack down)					Yes	Yes		Yes
Alternative Energy									
UR-4	Use a solar collector field for multiple buildings				Yes				Yes
UR-16	Use small modular nuclear reactors				Yes				
UR-20	Use a public-private partnership to finance a large scale program renewable energy				Yes				
UR-36	Use solar powered site & street lighting				Yes		Yes		Yes

Table 1-3 Optimum Combination of Alternatives
Brigade Combat Team 3 Complex, PN 63641, P2 322296

Alt. No.	Description	First Cost Savings	Present Worth O&M Savings	Life Cycle Cost Savings
Site				
HRC-8	Combine the two Battalion Headquarters and the Brigade Headquarters into one building	$1,754,000	$990,000	$2,744,000
Building Architecture				
RC-13	Use climate responsive envelope design	$90,000	$0	$90,000
RC-53	Use modular and construction systems for interior	$ 702,000	$0	$702,000
Mechanical				
RC-56	Provide bypasses for ERV's when free cooling	($10,000)	$122,000	$112,000
Electrical				
CCR-1	Consolidate electrical service to COFs	$379,000	$78,000	$457,000
Operations				
RC-67	Provide building dashboards for occupants	($57,000)	$170,000	$113,000
RC-99	Create incentive program to encourage energy reduction (energy smack down)	$0	$170,000	$170,000
RD-6	Expand thermal comfort zones	$0	$121,000	$121,000
Alternative Energy				
UR-4	Use a solar collector field to serve buildings	($15,996,000)	$71,463,000	$55,467,000
	Totals	($13,138,000)	$73,114,000	$60,006,000

SECTION 2

PROJECT DESCRIPTION

SECTION 2
PROJECT DESCRIPTION

This FY2013 project was selected as a demonstration on how the Energy Independence and Security Act of 2007 (EISA 2007) could be applied to these Army standard designs and to the specific site adaptations of these designs at Fort Campbell, KY.

OVERVIEW OF EISA 2007

The EISA 2007 in some cases reaffirmed goals set in the Energy Policy Act of 2005 and in other cases expanded previous goals. The focus of this value engineering effort was on the Subtitle C, High-Performance Federal Buildings portion of EISA 2007.

The following provides a breakdown and further definition of the requirements for achieving High-Performance Federal Buildings.

Section 431 requires that total energy use in federal buildings, relative to the 2005 level, be reduced 30% by 2015. In 2005, the energy consumption requirement for Army facilities was to be 30% below the energy consumption levels established by 2004 ASHRAE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential.

Section 432 directs that federal energy managers conduct a comprehensive energy and water evaluation for each facility at least once every four years.

For new federal buildings and major renovations Section 433 requires buildings be designed to reduce fossil fuel-generated energy consumption as compared to FY 2003 (as measured by CBECS or RECS data). 55% reduction by 2010, 65% by 2015, 80% by 2020, 90% by 2025, and 100% by 2030. CBECS is the Commercial Buildings Energy Consumption Survey; RECS is the Residential Buildings Energy Consumption Survey.

Section 434 requires that each federal agency ensure that major replacements of installed equipment (such as heating and cooling systems), or renovation or expansion of existing space, employ the most energy efficient designs, systems, equipment, and controls that are life-cycle cost effective.

Section 435 prohibits federal agencies from leasing buildings that have not earned an EPA Energy Star label.

Section 436 requires GSA to establish an Office of Federal High-Performance Green Buildings to coordinate green building information and activities within GSA and with other federal agencies. The Office must also develop standards for federal facilities, establish green practices, review budget and life-cycle costing issues, and promote demonstration of innovative technologies.

Section 437 directs the Government Accountability Office (GAO) to audit the implementation of activities required under this subtitle. The audit must cover budget, life-cycle costing, contracting, best practices, and agency coordination.

Section 438 requires federal facility development projects with a footprint exceeding 5,000 square feet to use site planning, design, construction, and maintenance strategies to control stormwater runoff.

Section 439 directs GSA to review the current use of, and design a strategy for increased use of, cost-effective lighting, ground source heat pumps, and other technologies in GSA facilities.

Section 440 authorizes $4 million per year over five years to support work under sections 434-439 and 482.

For the purpose of conducting life-cycle cost calculations, Section 441 increases the analysis period from 25 years, in prior law, to 40 years.

DEMONSTRATION PROJECTS

The Army selected this project at Fort Campbell to be a demonstration for implementing the requirements of EISA 2007 into the Army standard design for the following building types:

Brigade Headquarters

Battalion Headquarters

Company Operations Facility

Tactical Equipment Maintenance Facility

Barracks

These demonstration projects were developed jointly by Fort Campbell, Louisville District, and the Centers of Standardization (COS) for each of the respective building types. Savannah District is the COS for the Brigade Headquarters, Battalion Headquarters, Company Operations Facility, and Tactical Equipment Maintenance Facility. Fort Worth District is the COS for the Barracks.

Louisville District took the lead on identifying energy reduction and sustainability opportunities for both the buildings and the sites. The COSs were responsible for incorporating these opportunities into the standard designs for the buildings while Louisville District was responsible for the site designs. The general EISA 2007 strategies that were employed included:

- Establishing a 15 to 30 degree orientation of the buildings for optimal solar exposure
- Maximizing R-values in the roof and walls
- Using triple pane windows
- Use of solar shading
- Increasing the natural lighting through the addition of clerestories (brigade and battalion headquarters only) and light shelves at the windows

- Maximizing the use of high efficiency HVAC equipment
- Maximizing the use of high efficiency lighting
- Using on-site stormwater retention for the 95 percentile storm through bio-swales, below grade detention, and porous pavement designs
- Using some photovoltaic panels mounted on the roofs

Through these energy and sustainability strategies, the COS was able to achieve nominally a 40% reduction in energy consumption for the headquarters facilities over the 2004 ASHRAE Standard 90.1. However, it is important to note that this design has not taken into consideration the implementation of ASHRAE Standard 189.1 Standard for the Design of High-Performance, Green Buildings, Except Low-Rise Residential. This new standard will be applicable to FY2013 projects. This new standard uses the CBECS database with actual building energy consumption for comparison of energy reduction instead of the fictitious building design used in ASHRAE Standard 90.1. Therefore, the estimated energy savings based on the ASHRAE Standard 90.1 may be different with the new standard is applied.

SECTION 3

VALUE STUDY PROCESS

SECTION 3
VALUE STUDY PROCESS

This section describes the process used to conduct this Value Study and the significant findings of the Value Team. This Value Study used the international standard Value Methodology established by SAVE International, the Value Society. The standard establishes the specific 6-Phase, sequential process, and the objectives of each of those phases, but does not standardize the specific activities in each phase.

Value Methodology (VM) is the general term that describes the structure and process for executing the Value Workshop. This systematic process was used with a multidisciplinary team to improve the value of the project through the analysis of functions and the identification of targets of opportunity for value improvement.

The **VM Job Plan** provides the structure for the activities associated with the Value Study. These activities are further organized into three major stages:

1. Pre-Workshop preparation
2. VM Workshop
3. Post-Workshop documentation and implementation

Figure 3-2 at the end of this section shows a diagram of the VM Job Plan used for this Value Study.

DEFINING VALUE

Within the context of VM, Value is commonly represented by the following relationship:

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

In this expression, functions are measured by the performance requirements of the customer, such as mission objectives, risk reduction and quality improvements. Resources are measured in materials, labor, price, time, etc. required to accomplish the specific function. VM focuses on improving Value by identifying the most resource efficient way to reliably accomplish a function that meets the performance expectations of the customer.

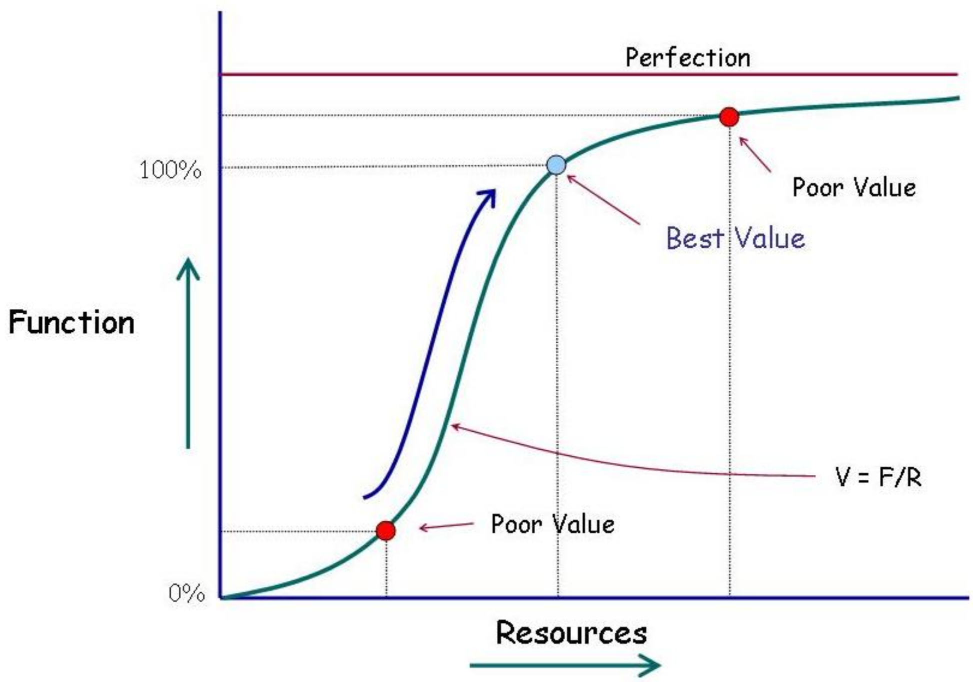
It can be seen from this relationship that Value is improved or increased by:

1. Increasing function without increasing resource consumption. Some increase in resources is acceptable as long as there is a greater increase in function performance.
2. Decreasing resources without decreasing function. Again, some decrease in function may be acceptable if the corresponding decrease in resources is significant enough.

Ideally, the Value Team looks for opportunities to increase function and concurrently decrease resource requirements. This will achieve the best value solution.

This Value concept is illustrated in the Figure 3-1, The Value Curve. This figure shows a hypothetical curve from plotting the value expression above. This curve will asymptotically approach perfection. The best value solution for a given project or project element will be found at the knee of the curve. At this point the required function or functions have been achieved to 100% of the required level with a corresponding minimum resource commitment. To attempt to increase the function performance beyond this level will result in a resource consumption that has a higher worth than the marginal increase in function. This results in a poor value solution. Conversely, a poor value solution can also be the result of not achieving the function to 100% of the requirement. In this case, an incremental increase in resources delivers significant increase in function performance. The Value Methodology is used to identify the poor value decisions in a project and then develop alternative solutions to better align the project along this curve to achieve a best value solution.

Figure 3-1
The Value Curve™



This understanding of how Value is affected by changes in function or resources provides the foundation for all SVS Value Studies. The following paragraphs describe the process we used to understand the functional requirements and how we identified value improvement alternatives.

PRE-WORKSHOP

Prior to the start of the workshop, the team was tasked with reviewing the most current documentation on the project development. This was done to familiarize them with the project design and to prepare them for asking questions of the project stakeholders during the project presentations at the beginning of the workshop. Much of the background information for this study was generated by the District in-house staff and COSs. Other pre-workshop activities included:

- Coordinating workshop logistics and communicating those to the various participants
- Providing guidance to the presenters on their presentation content for the project introduction
- Scheduling workshop participants and assigning tasks to ensure the team is prepared for the workshop
- Gathering necessary background information on the project and making sure project documentation is distributed to the team members

Materials furnished to the team by the District are listed in the Appendix.

VM WORKSHOP

The VM workshop was an intensive session during which the project design was analyzed to optimize the balance between functional requirements and resource commitments (primarily capital and O&M costs).

The VM Job Plan used by SVS includes the execution of the following phases during the workshop:

1. Information Phase
2. Function Analysis Phase
3. Creative Phase
4. Evaluation Phase
5. Development Phase
6. Presentation Phase

Information Phase

At the beginning of the workshop, it was important to understand the background of the project from which the design was developed. This background was provided in an oral overview by the District. The overview and subsequent project analysis provided information on the following topics:

- Rationale why this project is necessary
- Project objectives that have governed the proposed design
- Rationale for the proposed design configuration
- Explanation of design features, criteria, and assumptions
- Value Study constraints
- Project cost

The District project management presentation provided the team with an overview of the goals, issues, and expectations for the project. The District and the Value Team also finalized the Value Study constraints. This was followed by the project development team's more detailed presentation on the project design and an explanation of the rationale behind key design decisions. Further, this gave the project development team an opportunity to share their issues and concerns about the project from their perspective.

Project Cost Analysis

The Value Team was not able to review the project's construction cost estimate in any detail to verify the estimated costs. The 35% design did not include a detailed cost estimate for the building designs. A parametric cost estimate was provided that only included costs for building systems on a square foot of building basis. Moreover, these estimates were based on standard design models and it was not discernable if these estimates had been fully adjusted based on current design considerations for EISA 2007 compliance. For example, it was not clear if the square foot costs included clerestories, triple pane windows, R-30 walls and R-46 roofs, etc. that were included in the 35% design drawings. All of these items, and more, represent significant cost additions above the standard design used for the parametric model. Therefore, the building cost estimates are really of little value since they do not reflect the actual anticipated cost of the buildings as designed.

A detailed and project specific cost estimate was provided for the site work for each of the project sites.

To compare costs for the Value Alternatives, the Value Team's cost estimators used the detailed site estimates for site issues; however, for building costs, estimates for components of the buildings were taken from R.S. Means, MCACES database, and from the experience of the team members. Further, since there were no usable estimates for the buildings, the Value Team had to estimate the cost of the original 35% design elements in addition to the cost of the proposed change in order to have a comparable cost difference for implementing the Value Alternative.

Economic Data for Life Cycle Cost Analysis

To express life cycle costs, the Value Alternatives have been presented based on discounted present worth cost. The economic criteria used by the team were as follows:

Year of Analysis: 2011

Analysis Period: ....40 years

Gross Discount Rate: ....7% per year

Inflation Rate:..3% per year

Net Discount Rate: ....4% per year

Present Worth Factors:

Annual:...15.622

Power Cost: $0.067/kWh

Natural Gas Cost:...$2.04/therm

Labor:

Operations (fully burdened): $75/hr

Maintenance (fully burdened): $75/hr

Function Analysis Phase

Function Analysis is the heart of the VM process and is the key activity that differentiates the VM process from other problem solving or improvement practices. During the Function Analysis Phase of the VM Job Plan, functions are identified that describe the expected outcomes of the project under study. Function Analysis also defines how those outcomes are expected to be accomplished by the design. These functions are described using a two-word, active verb and measurable noun pairing.

This identification and naming convention of project functions enables a more precise understanding by limiting the description of a function to an *active verb* that operates on a *measurable noun* to communicate what work an item or activity performs. This naming convention also helps multidisciplinary teams to build a shared understanding of the functional

FAST Diagram

Function analysis was enhanced by using a graphical mapping tool known as the *Function Analysis System Technique* (FAST), which allows team members to understand how the functions of a project relate to each other. The resulting FAST Diagram allowed quick visualization of the logical relationship between project functions and the project as a whole. The FAST diagram is in the Function Analysis section of the Appendix.

The FAST Diagram is structured such that moving to the right of any function answers the question, “How are we accomplishing this function?” Moving to the left of any function answers the question, “Why are we accomplishing this function?” Elements that are vertically connected occur “When” or as a consequence of the function it is connected to on the horizontal path.

The diagram shows on the far left that the ultimate function or the mission that must be accomplished by the EISA requirements of this project is to demonstrate EISA feasibility and showcase the army. This is accomplished by conserving resource, reducing energy demand, reducing energy consumption, maximizing resources efficiency, and maximizing the use of renewable energy.

The functions between the two dashed lines, called Scope Lines, represent the functional elements of the project which are within the scope of the Value Study. The first column of functions (basic functions) within the left Scope Line represents the functions that must occur in order for this project to successfully accomplish its mission. The remaining functions (secondary or support functions) represent how the current design has chosen to accomplish those basic functions.

Creative Phase

This step in the VM process involved generating ideas using creativity techniques. The team recorded all ideas regardless of their feasibility. In order to maximize the Value Team's creativity, evaluation of the ideas was not allowed during the creative phase. The team's effort was directed toward a large quantity of ideas. These ideas were later screened in the Evaluation Phase of the workshop.

The creative ideas generated by the team are included in the Appendix. The list also includes ratings for each idea based on the Evaluation Phase of the workshop. These lists should be carefully reviewed, as there may be other good ideas not developed by the team because of time constraints. These should be further evaluated or modified to gain the maximum benefit for the project.

Evaluation Phase

In this phase of the workshop, the team selected the ideas with the most merit for further development.

After an initial vote, the Value Team Leader assessed how many ideas could be developed into Value Alternatives within the remaining duration of the workshop. From this assessment, all ideas with a certain number of votes were selected for development. However, prior to the final selection, the results were revisited collectively by the Value Team to ensure that those selected by the voting process truly represented the best ideas for development. This gave the team the opportunity to down-rate some ideas and to up-rate other ideas based upon team discussion of the ideas.

The criteria used for selection were:

1. The inherent value, benefit and technical appropriateness of the idea

2. The expected magnitude of the potential cost savings, both capital and life cycle

3. The potential for the District acceptance of the idea

Not all ideas were developed. This evaluation process is designed to identify those ideas with the greatest potential for value improvement that can be developed into Value Alternatives within the time constraints of the workshop and the production capacity of the team. The remaining ideas were eliminated from further consideration by the team; however, the ideas not developed should also be reviewed, as there may still be other good ideas not developed by the team because of time constraints or other factors. These could be further evaluated or modified to gain the maximum benefit for the project.

Development Phase

During the Development Phase of the workshop, each idea was expanded into a workable alternative to the original project concept. Development consisted of preparing a description of the value alternative, evaluating advantages and disadvantages, and making cost comparisons.

Each alternative is presented with a brief narrative to compare the original concept and the alternative concept. Sketches and brief calculations were also developed, if needed, to clarify and support the alternative. The value alternatives developed during the workshop are presented in Section 4 – Value Improvement Alternatives.

The Value Team Leader and, to the extent possible, other team members reviewed each alternative to improve completeness and accuracy.

Redesign costs are not included in the cost comparison of alternatives. The District will be responsible for determining these costs.

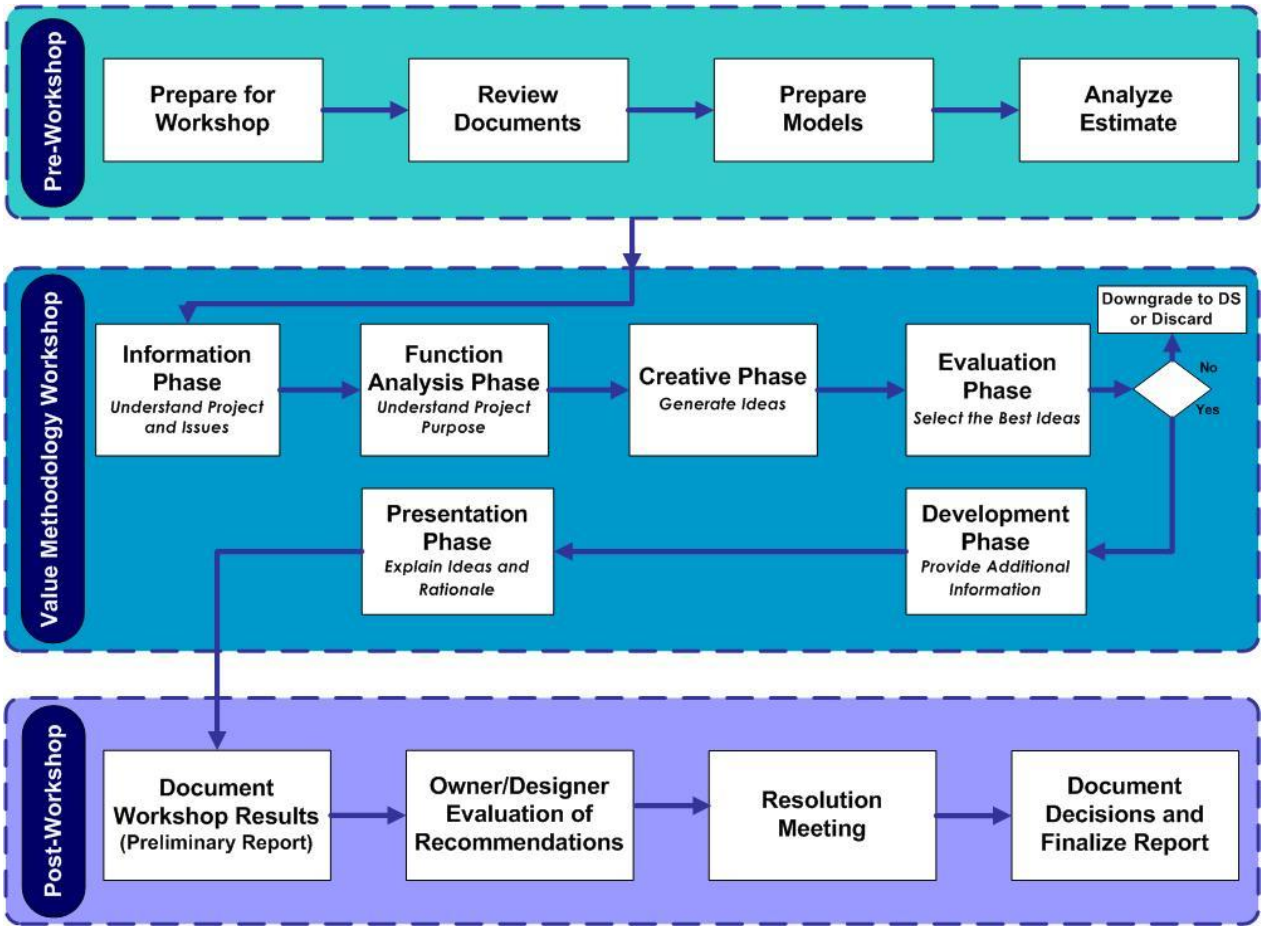
Presentation Phase

The last phase of this workshop was the presentation of the Value Alternatives. The presentation was made by the Value Team on April 26, 2011 to representatives of the District's project team including the COS and Ft. Campbell. The Value Team described each Value Alternative and the rationale that went into the development. This was followed by answering the audience's questions. The acceptability of the Value Alternatives was deferred pending the District's review of our Preliminary Report.

POST-WORKSHOP

The Post-Workshop activities of this Value Study consisted of preparing the Value Study Reports. Shortly after the conclusion of the workshop, our Preliminary Report was submitted to the District for review. This report contained the raw workshop product. This Final Value Study Report includes documentation of the Value process, as well as, the Value Alternatives developed during the workshop. The decisions regarding implementation of the alternatives are documented in the Executive Summary of this report.

Figure 3-2
Value Engineering Process Diagram



SECTION 4

VALUE ALTERNATIVES

SECTION 4
VALUE ALTERNATIVES

The results of this Value Study represent the value improvement opportunities that can be realized on this project. They are presented as individual alternatives for specific changes to the current design.

Each alternative includes:

- A summary of the original concept
- A description of the alternative concept
- A brief narrative comparing the original design and the recommended change
- Sketches, where appropriate, to further explain the alternative
- Calculations, where appropriate, to support the technical adequacy of the alternative
- A capital cost comparison
- And a life cycle cost analysis, if appropriate

Cost was the primary resource that was compared to the functions being accomplished in the project. To ensure that costs were compatible within the Value Alternatives proposed by the team, the US Army Corps of Engineers' M-II cost estimating database and other industry standard cost data were used as the basis of cost.

EVALUATING THE VALUE ALTERNATIVES

Each part of a Value Alternative should be evaluated on its own merit, rather than discarding an entire Value Alternative because of concern over a particular aspect of the proposed change. Furthermore, the District is encouraged to review all of the ideas shown in the creative idea listing in the Appendix. Since the Value Team was constrained by a finite duration for the workshop and the production capacity of the team not all ideas were developed. Therefore there may be other ideas in that list that would provide additional value improvement opportunities for the project.

ORGANIZATION OF ALTERNATIVES

The alternatives presented on the following pages are organized by project or functional categories, and then numerically within each of those categories. The divisions used for brainstorming the alternatives are as follows:

Reduce Consumption - All Buildings (RC)

Reduce Consumption - COF's (CRC)

Reduce Consumption - HQ’s (HRC)

Reduce Demand - All Buildings (RD)

Conserve Resources - All Buildings (CR)

Conserve Resources - COF’s (CCR)

Conserve Resources – HQ (HCR)

Use Renewable - All Buildings (UR)

These designations have been used throughout the VE process to organize the ideas.

The alternatives have been organized in the report as follows:

Reconfigure Site

Site

Building Architecture

Mechanical

Electrical

Operations

Alternative Energy

RECONFIGURE SITE

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Fort Campbell, KY

Alternative No:
HRC-7

Title:
Combine the two Battalion Headquarters into one building

Description of Original Concept:

The original concept is to construct two separate but adjacent Battalion HQ buildings on adjacent sites.

Description of Alternative Concept:

The alternative concept is to combine these two facilities into a single facility on the same site area currently utilized, and to locate this combined facility on the western end of the site.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 562,000
O&M Savings:	$ 128,000
Life Cycle Cost Savings:	$ 690,000

Advantages/Disadvantages

Alternative No.: HRC-7

Advantages of Alternative Concept

- Uses centralized mechanical, electrical and telecom rooms to serve both battalions
- Increased energy efficiency
- Economies of scale for sizing of equipment to service the combined facility
- Reduced disturbances to the surrounding site as a result of a tighter overall building footprint and associated building setbacks around the perimeter of the facility
- Maintains more green space to enhance sustainability
- Reduces long-term maintenance efforts for a single facility's compared to multiple facilities
- Reserves a greater amount of existing valuable real estate for potential future needs
- Reduces the number of external access points and stair towers
- Reduces the roofing area thereby reducing the stormwater retention requirements

Disadvantages of Alternative Concept

- Does not meet the standard design
- Could require reprogramming
- Redesign efforts may impact schedule

Discussion

Alternative No.: HRC-7

Combining the two battalion HQ facilities will provide opportunities to achieve efficiencies including initial costs, reduced square footage, reduced site size and development costs, preserving real estate for future use, preserving green space for improved stormwater management, and to achieve significant reductions in ongoing energy consumption and future maintenance costs.

There is also the possibility of reducing the number of classrooms since they are located on the same site and scheduling of rooms will be enhanced. This alternative does not consider a reduction in the number of classrooms, but does consider the reduced area required for mechanical, electrical and telecom.

Currently, each of the two battalion headquarters buildings occupies a building footprint of 13,539 SF and includes a partial second floor. The brigade headquarters occupies a building footprint of 21,681 SF and has a full second floor.

Similar combined battalion facilities have been used elsewhere, and it would seem possible to draw from those facilities and adapt them to this site.

Some site adjustment will be required as a result of this consolidation, and site parking will require some modification.

This concept combines the two buildings on one site with the buildings placed, effectively, end to end on the western end of the site. This reduces the real estate required by eliminating the required AT/FP setbacks for one building.

Sketch

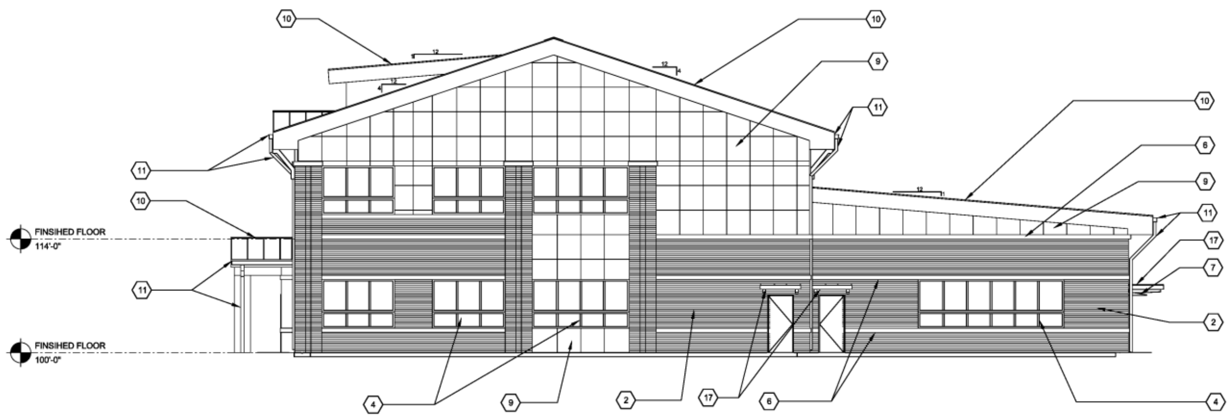
Alternative No.: HRC-7

☑ Original ☐ Alternative

Sketch

Alternative No.: HRC-7

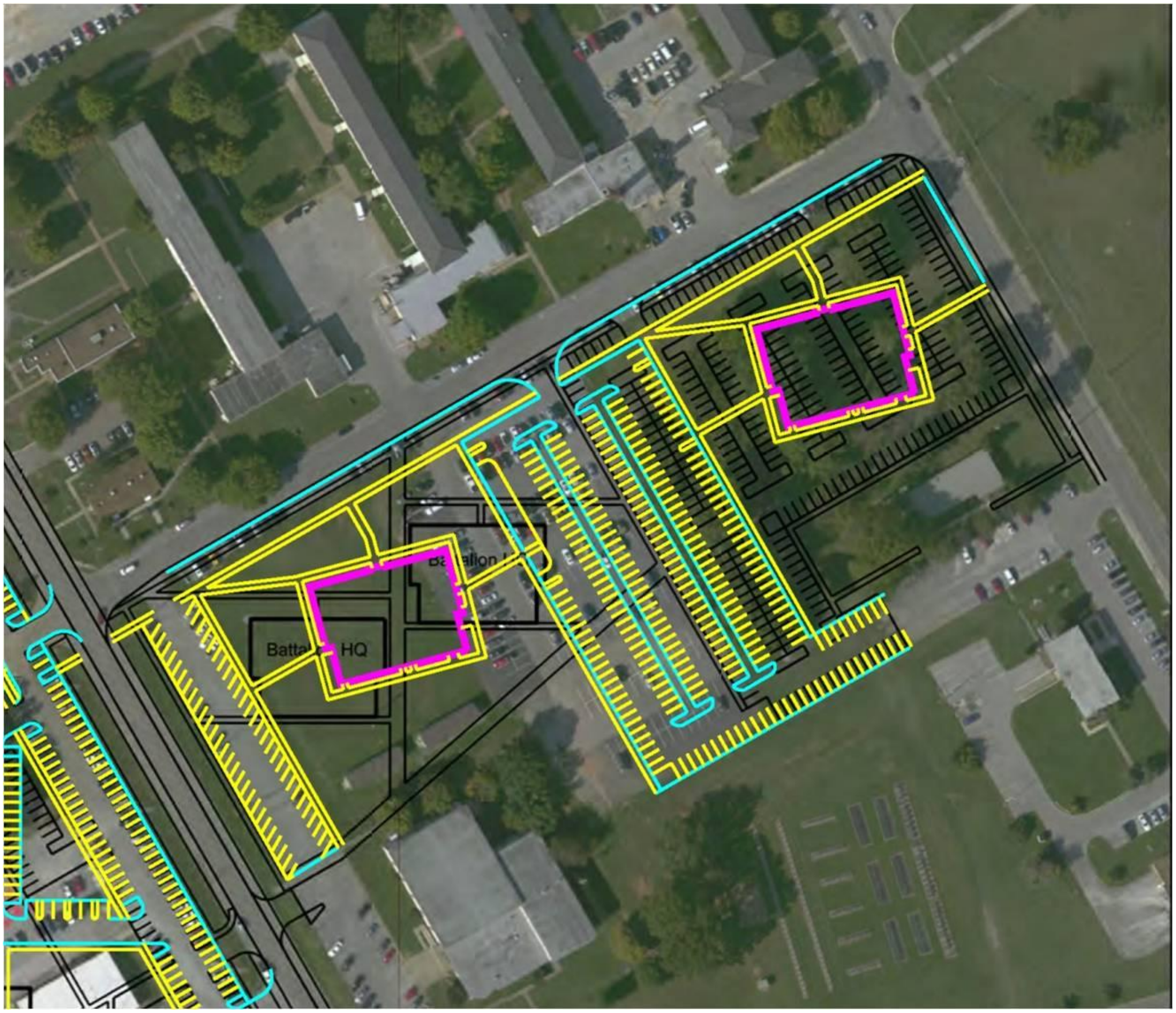
☑ Original ☐ Alternative



Sketch

Alternative No.: HRC-7

☑ Original ☐ Alternative



Sketch

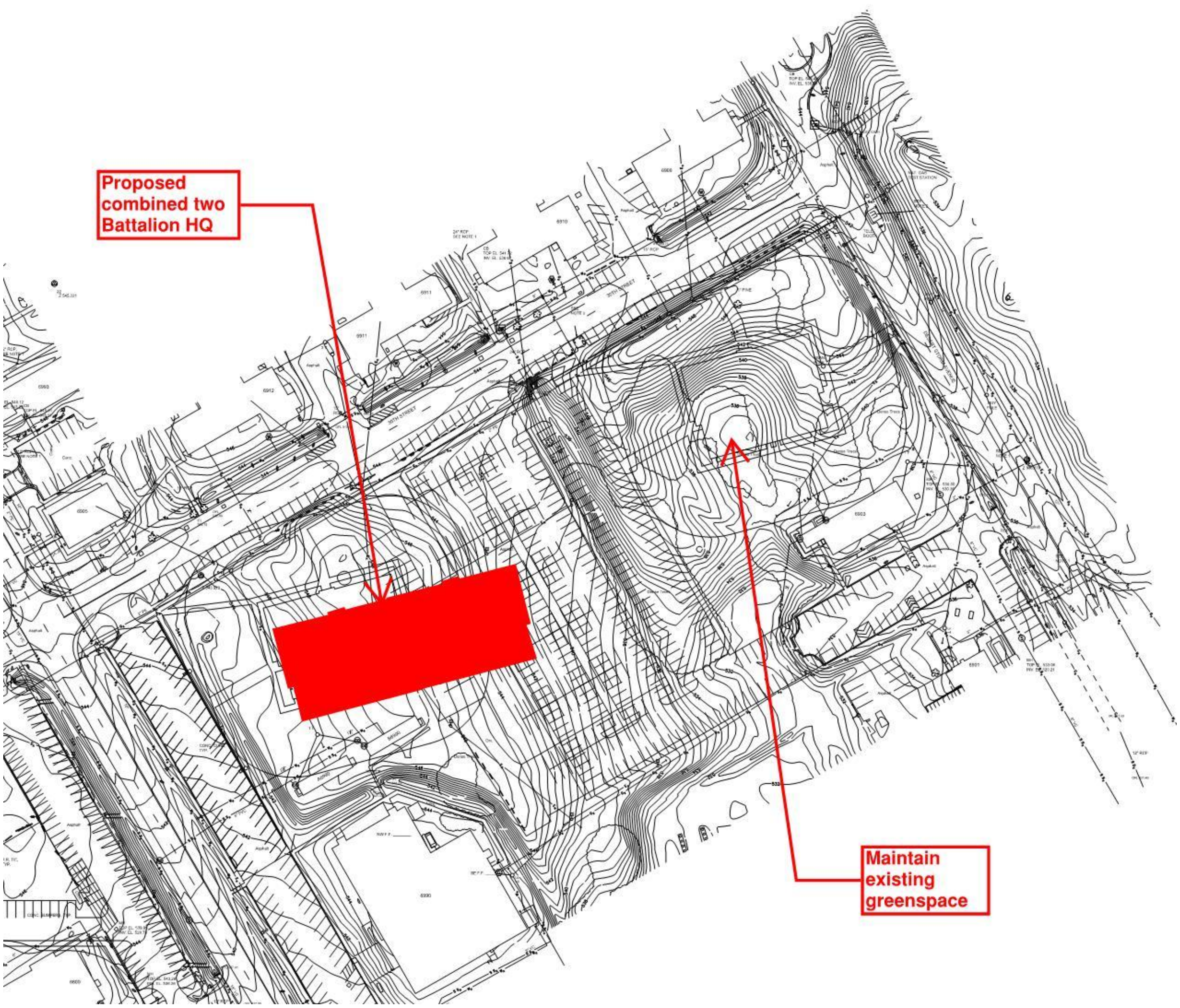
Alternative No.: HRC-7

☑ Original ☐ Alternative

Sketch

Alternative No.: HRC-7

☐ Original ☑ Alternative



Calculations

Alternative No.: HRC-7

☐ Original ☑ Alternative

Preliminary energy modeling estimates approximately a 20% reduction in the physical space required for the mechanical and electrical room sizes when the facilities are combined into a single room serving both battalions.

Eliminate 20% x (750 G.S.F. + 430 G.S.F.) x 2 facilities = 470 S.F. in Mech Rooms

Eliminate 20% x (340 GSF) x 2 facilities = 140 SF in Elec and Telecom Rooms

Similarly, preliminary energy modeling estimates approximately a 25% reduction in energy usage/consumption when the two battalion facilities are combined into a single facility.

Physical space can also be consolidated and reduced. Further study might lead to additional savings beyond what's included herein, but at a minimum, one can reduce the square footage of the building as follows:

Eliminate 1 stair tower – using three stair towers for the entire facility instead of four (currently each battalion building has two stair towers.

Eliminate 1 elevator. Currently each facility has its own elevator tower. In a combined facility, only one elevator tower would be needed – not two.

Eliminate one exterior wall in lieu of a common shared wall.

Deduct approximately 2x (92'x28') 5,352 S.F..

Interior wall 92 x 28' = 2,576 S.F.

This is approximately 25% of the exterior wall area of the original configuration.

Site disturbance and real estate damage at a minimum is the area between the two facilities currently used as setback between them. In reality, the value of this figure may be quite larger than this.

Minimal amount of site area saved = 82' setback x 103' = 8,446 SF = 938 S.Y.

Construction Cost Estimate

Alternative No.: HRC-7

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Mechanical Rooms	SF	235.84	2,360	$556,582	1,900	$448,096
Electrical Rooms	SF	235.84	680	$160,371	550	$129,712
Exterior Walls	SF	20.00	5,352	$107,040		
Interior Walls	SF	6.00			2,576	$15,456
Stair Towers	EA	25,000.00	4	$100,000	3	$75,000
Elevators	EA	125,000.00	2	$250,000	1	$125,000
Reduction in site disturbance	SY	100.00	938	$93,800		
Total Current Contract Cost				$1,268,000		$793,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$83,217		$52,044
Subtotal				$1,351,000		$845,000
Contingencies		5.00%		$67,550		$42,250
Subtotal				$1,419,000		$887,000
SIOH		5.70%		$80,883		$50,559
TOTALS				$1,500,000		$938,000
NET SAVINGS						$562,000

Life Cycle Cost Analysis

Alternative No.: HRC-7

LIFE CYCLE PERIOD 40 YEARS ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST			ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
					$1,500,000			$938,000
Capital Cost Savings								$562,000
ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT CAPITAL COST	ANNUAL COST	PRESENT WORTH	ALTERNATIVE CONCEPT CAPITAL COST	ANNUAL COST	PRESENT WORTH
Energy		19.7928		64,981	1,286,000		58,483	1,158,000
Generalized (% of Capital Cost)								
SUB-TOTAL					$1,286,000			$1,158,000

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT ESTIMATE	PRESENT WORTH	ALTERNATIVE CONCEPT ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
SUB-TOTAL				$0		$0
TOTAL PRESENT WORTH				$1,286,000		$1,158,000
PRESENT WORTH SAVINGS ON O&M						$128,000
LIFE CYCLE COST SAVINGS						$690,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
HRC-8

Title:
Combine the two Battalion Headquarters and the Brigade Headquarters into one building

Description of Original Concept:

The original concept is to construct three separate HQ buildings on adjacent sites. This includes one brigade headquarters and two battalion headquarters.

Description of Alternative Concept:

The alternative concept is to combine the three facilities, two battalion headquarters buildings and one brigade headquarters building, into a single building, making the combined facility 4 stories, rather than the two stories for each of the individual buildings.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 1,754,000
O&M Savings:	$ 990,000
Life Cycle Cost Savings:	$ 2,744,000

Advantages/Disadvantages

Alternative No.: HRC-8

Advantages of Alternative Concept

- Uses centralized mechanical, electrical and telecom rooms to serve both battalions and the brigade headquarters simultaneously
- Increased energy efficiency
- Economies of scale for sizing of equipment to service the combined facility
- Reduced disturbances to the surrounding site as a result of a tighter overall building footprint and associated building setbacks around the perimeter of the facility
- Maintains more green space to enhance sustainability
- Reduces long-term maintenance efforts for a single facility's compared to multiple facilities
- Reserves a greater amount of existing valuable real estate for potential future needs
- Will reduce the number of elevators from three to two
- Reduces the number of external access points and stair towers
- Reduces the roofing area thereby reducing the stormwater retention requirements

Disadvantages of Alternative Concept

- Does not meet the standard consolidated HQ design
- Could require reprogramming
- Redesign efforts may impact schedule

Discussion

Alternative No.: HRC-8

Combining the three HQ facilities provides opportunities to achieve a lot of efficiencies including initial costs, reduced square footage, reduced site size and development costs, preserving real estate for future use, preserving green space for improved stormwater management, achieve significant reductions in ongoing energy consumption and future maintenance costs.

There is also the possibility of reducing the number of classrooms since they are located on the same site and scheduling of rooms will be enhanced. This alternative does not consider a reduction in the number of classrooms, but does consider the reduced area required for mechanical, electrical and telecom.

Currently, each of the two battalion headquarters buildings occupies a building footprint of 13,539 SF and includes a partial second floor. The brigade headquarters occupies a building footprint of 21,681 SF and has a full second floor. Constructing a 4-story building with the brigade headquarters occupying two floors, and each of the battalions occupying one floor fits within the footprint of the brigade headquarters. This would eliminate half of the site disturbance, half of the roofed area, half of the stormwater runoff, and half of the foundations. It also eliminates some of the wall area and would allow the mechanical and electrical equipment to be sized more efficiently, capitalizing on the economy of scale.

The addition of two floors to the Brigade HQ building will require construction of one elevated structural floor in lieu of a slab on grade. In addition, the elevated structural floor for the battalion headquarters buildings is slightly smaller than that required in the new combined facility.

Preliminary estimates suggest a 20% reduction in the physical space required for the mechanical and electrical room sizes when the facilities are combined into a single room serving both battalions and the brigade. For purposes of this alternative, a 10% reduction was taken to account for the areas that have independent systems (BOC, NOC, computer areas).

Because this building is three or more stories high, consideration must be made in the design for progressive collapse, which was not done in the brief workshop time.

Some site adjustment will be required as a result of this consolidation, and site parking will require modification. This concept can be further enhanced with synergies from several other recommendations to further improve upon this concept.

Sketch

Alternative No.: HRC-8

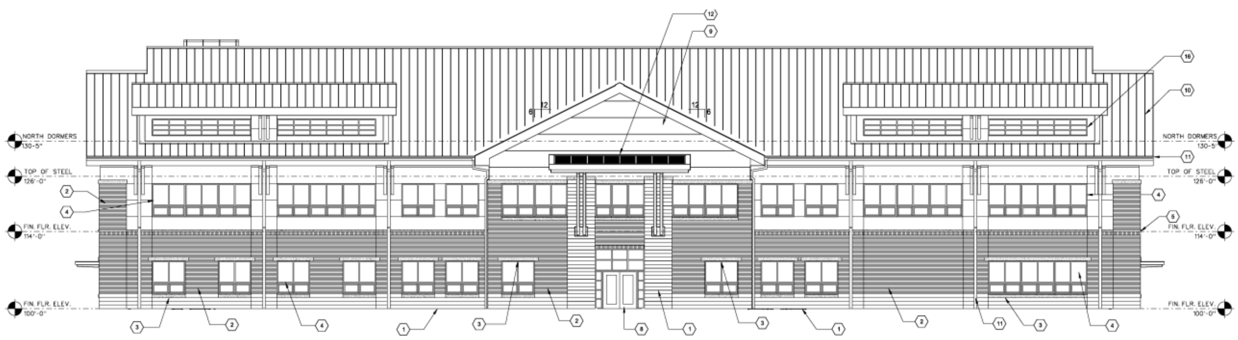
☑ Original ☐ Alternative

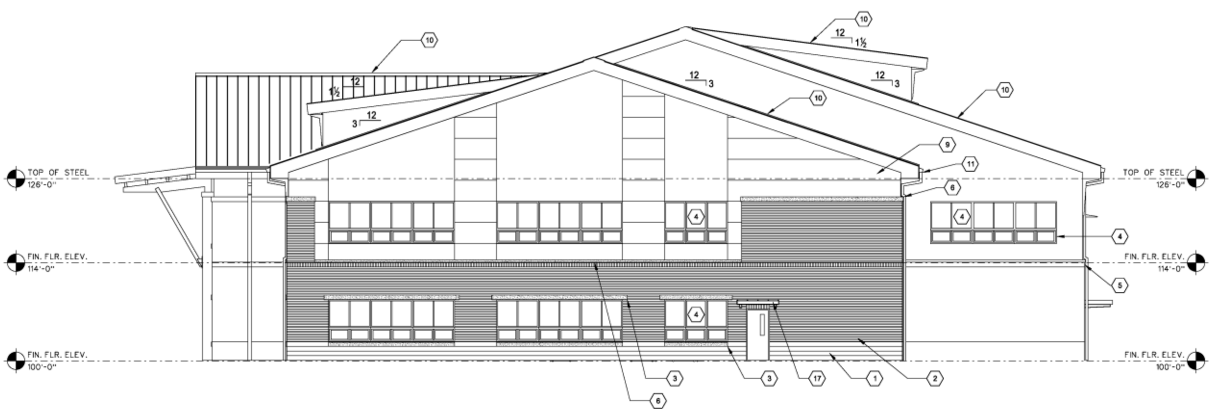
Batallion Headquarters

Sketch

Alternative No.: HRC-8

☑ Original ☐ Alternative



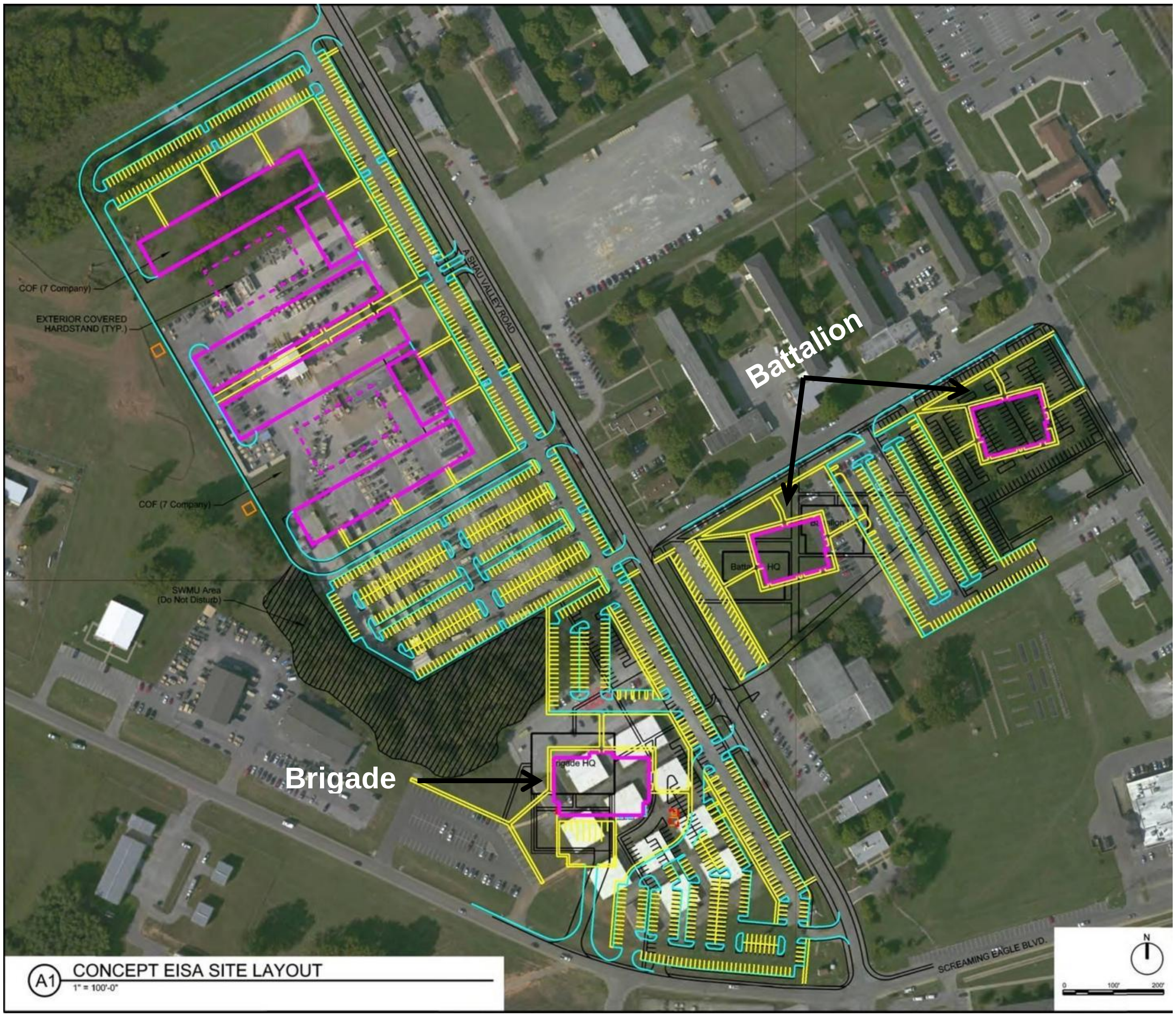


Brigade Headquarters

Sketch

Alternative No.: HRC-8

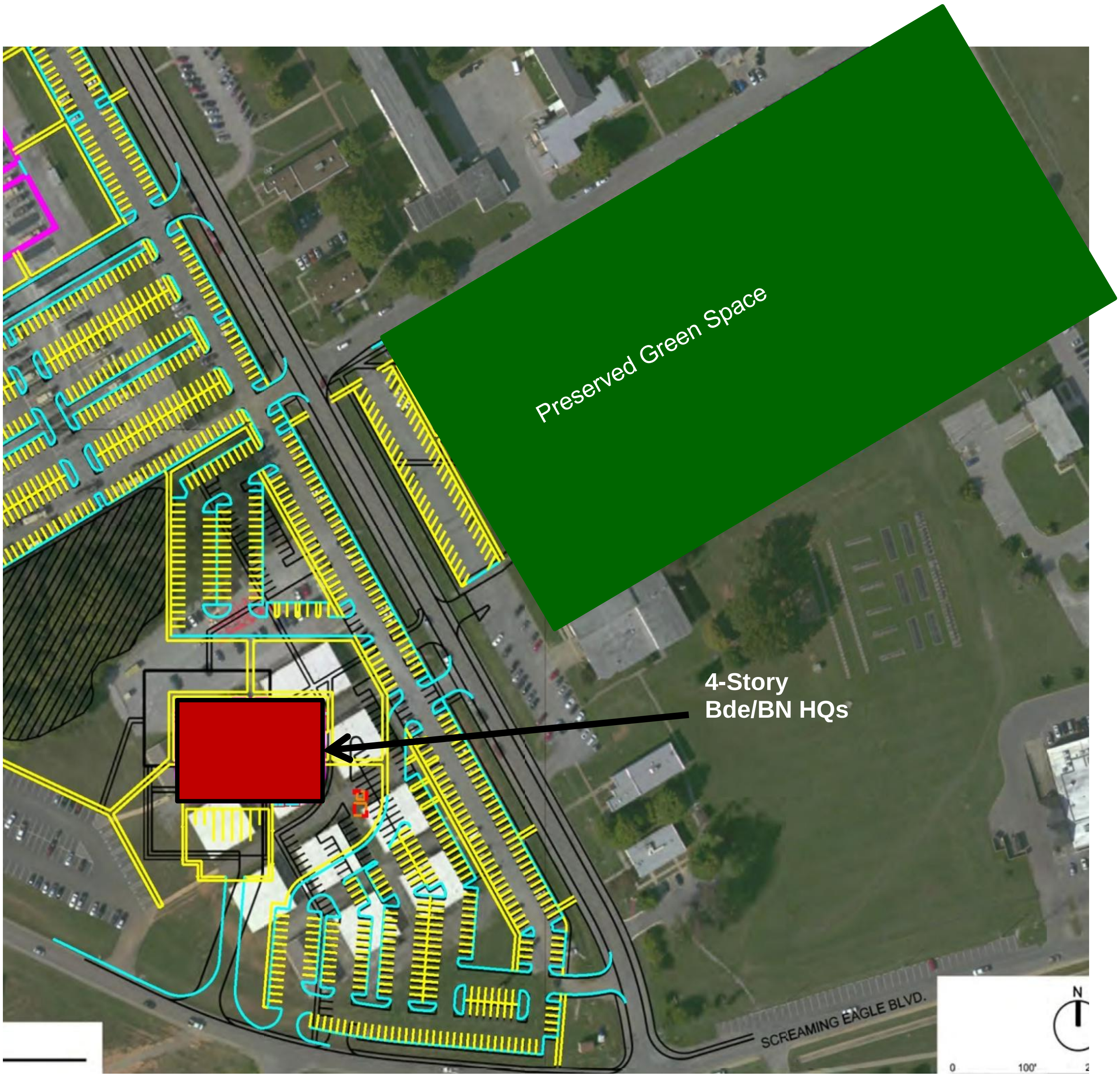
☑ Original ☐ Alternative



Sketch

Alternative No.: HRC-8

☐ Original ☑ Alternative

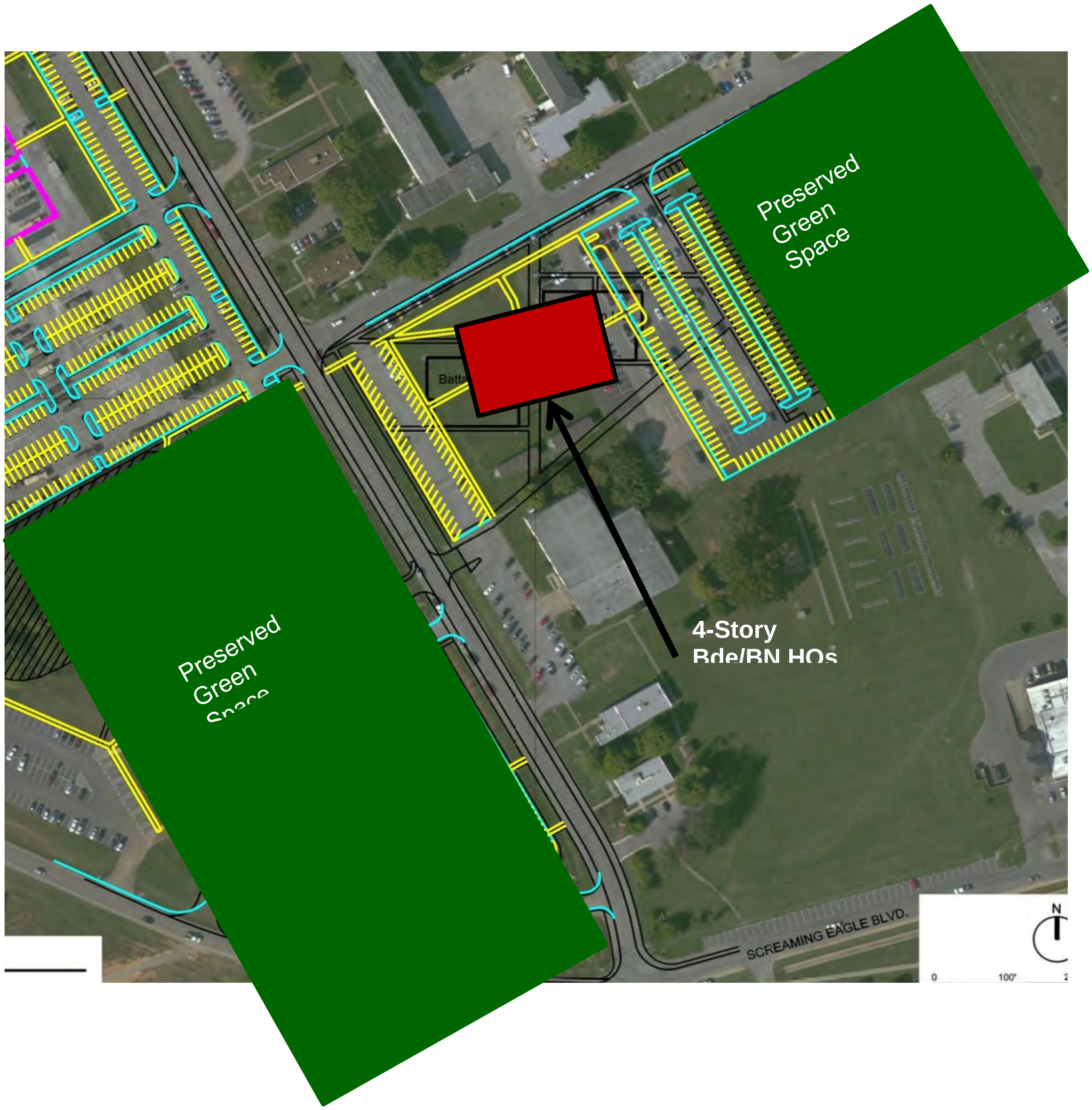


Potential site for 4-story BDE-BN HQs

Sketch

Alternative No.: HRC-8

☐ Original ☑ Alternative

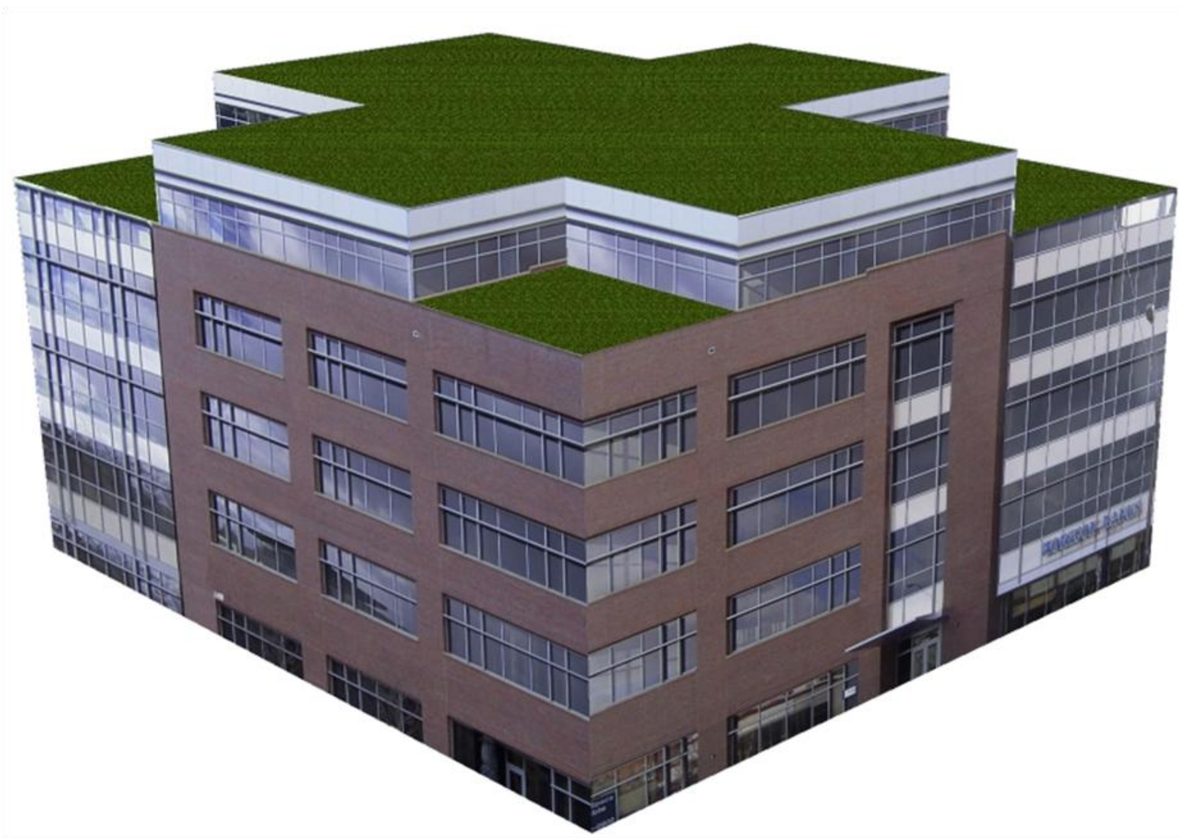


Alternative potential site for 4-story BDE/BN HQQs

Sketch

Alternative No.: HRC-8

☐ Original ☑ Alternative

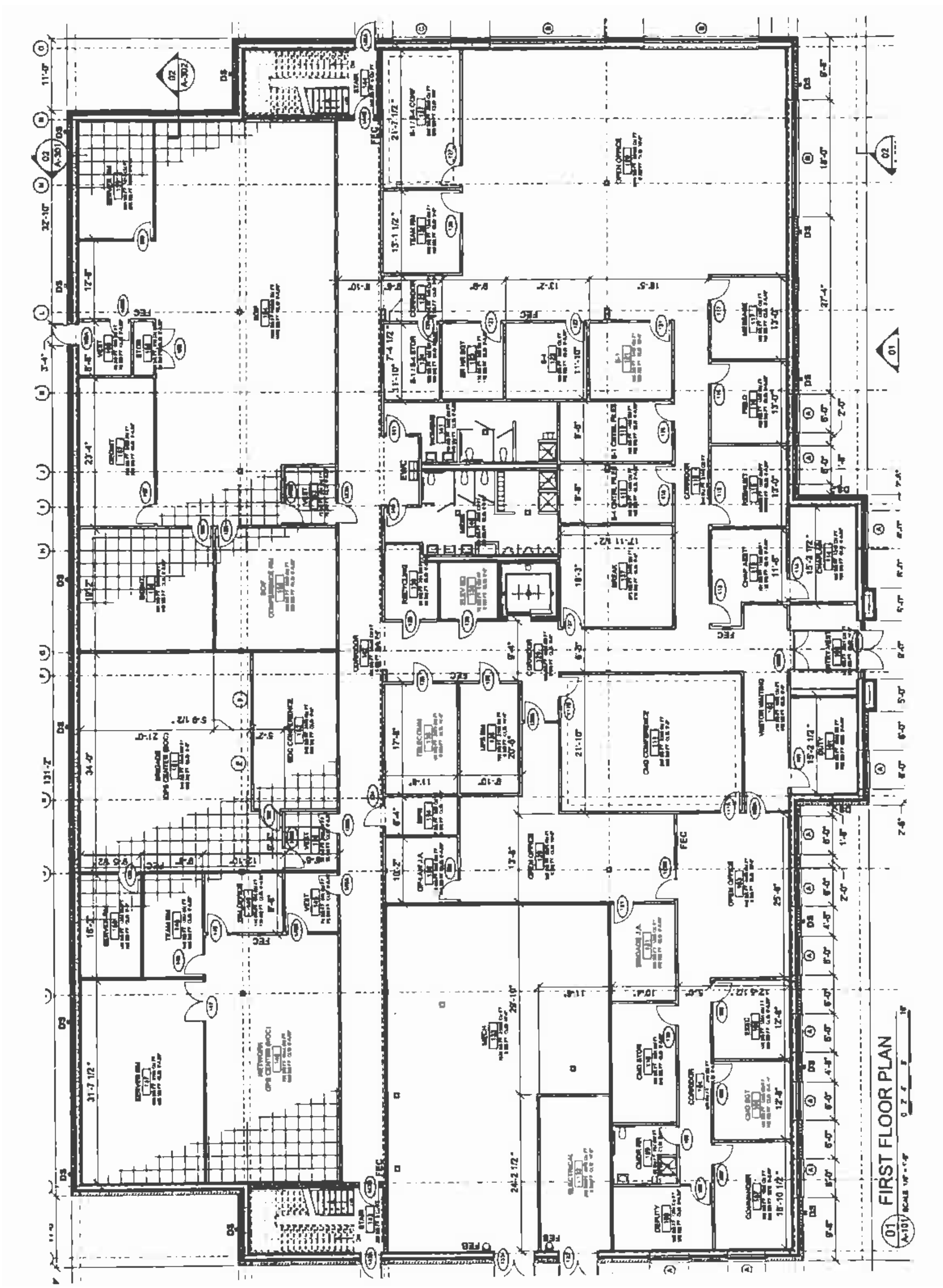


Representative model of possible stacked BN/BD HQ.

Sketch

Alternative No.: HRC-8

☐ Original ☑ Alternative

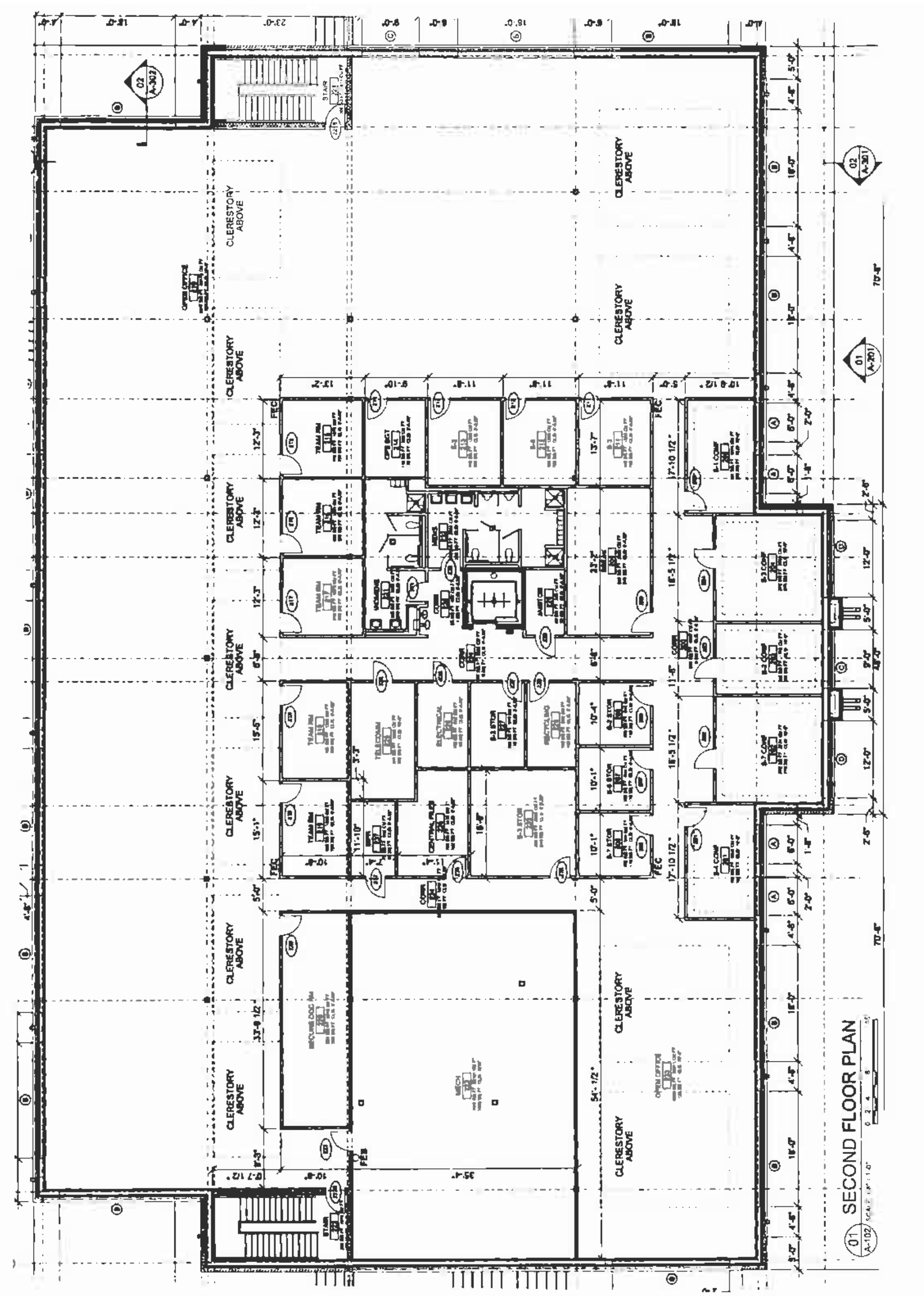


Brigade HQ, 1st Floor Plan

Sketch

Alternative No.: HRC-8

☐ Original ☑ Alternative

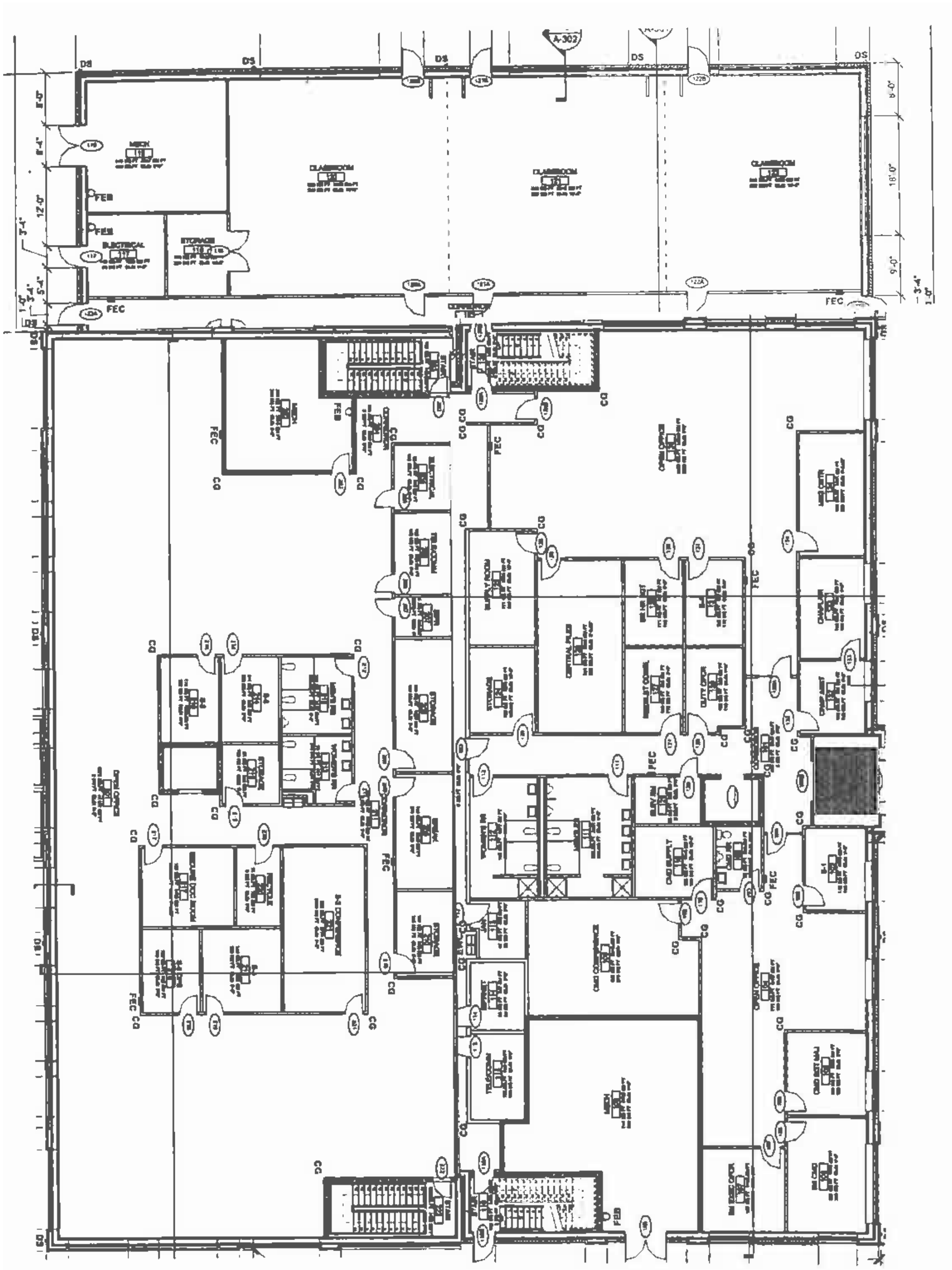


Brigade HQ, 2nd Floor Plan

Sketch

Alternative No.: HRC-8

☐ Original ☑ Alternative

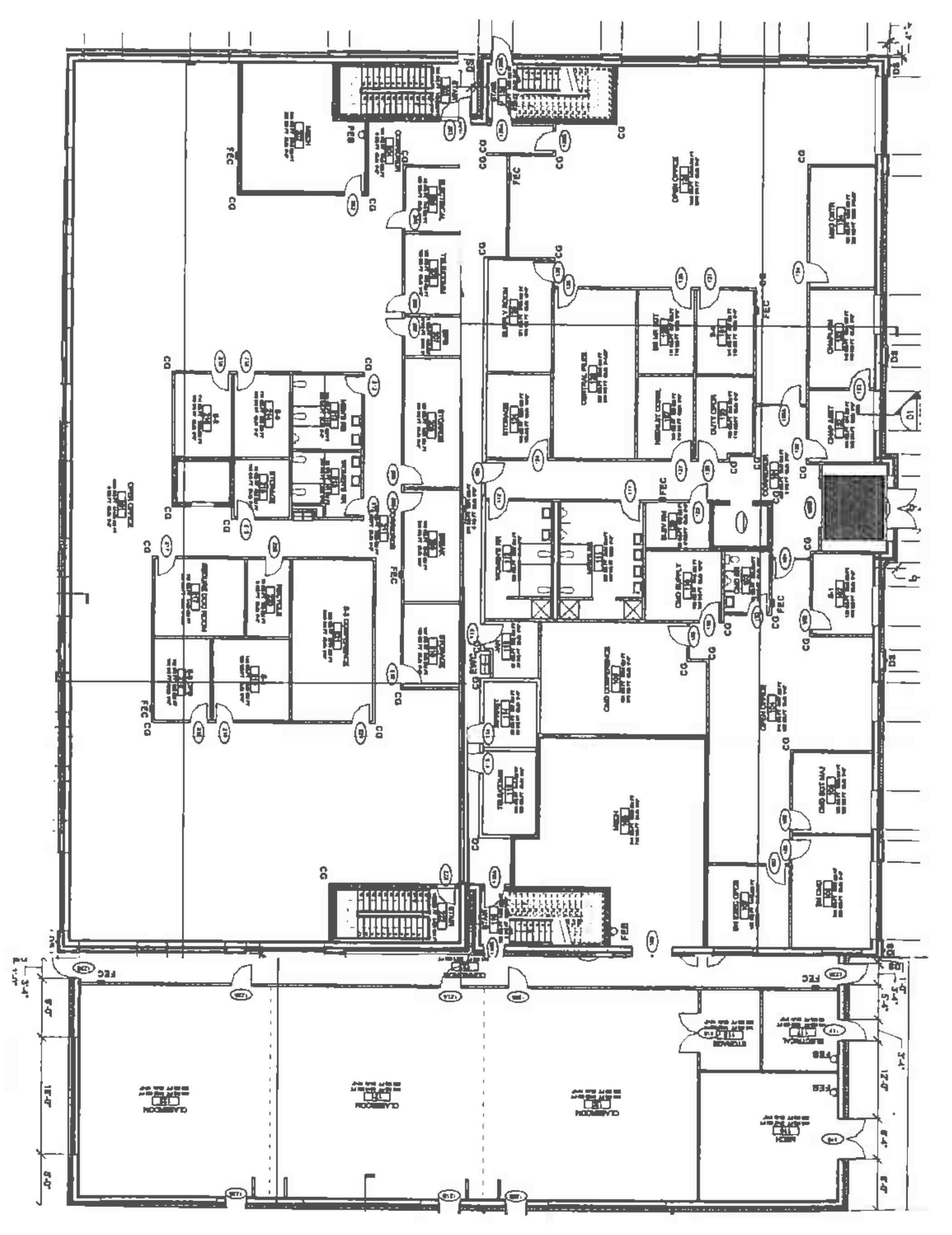


Battalion HQ -1 Floor Plan (potential 3rd floor plan)

Sketch

Alternative No.: HRC-8

☐ Original ☑ Alternative



Battalion HQ -2 Floor Plan (potential 4th floor plan)

Calculations

Alternative No.: HRC-8

☑ Original ☐ Alternative

Roofing Area = 13,539 sf	Battalion 1
13,539 sf	Battalion 2
21,681 sf	Brigade

Structural Floor:

8,782 sf	2^{nd} floor Battalion 1
8,782 sf	2^{nd} Floor Battalion 2
21,681 sf	2^{nd} Floor Brigade HQ

Slab on grade:

13,539 sf	1^{st} floor Battalion 1
13,539 sf	1^{st} floor Battalion 2
21,681 sf	1^{st} floor Brigade HQ

Foundation (perimeter):

While the building foundations will be reduced because three buildings will use the same foundation, some increase in the foundation will be required for the additional stories supported. Therefore, no credit is being taken for the reduction in the length of footings.

Calculations

Alternative No.: HRC-8

☐ Original ☑ Alternative

Physical space can be consolidated and reduced. Further study might lead to additional savings beyond what is included herein. As a minimum, the square footage of the buildings can be reduced as follows:

Eliminate 10% of the mechanical rooms' space:

10% x([(750 sf + 430 sf) x 2 facilities] + 1570 sf + 1547 sf) = 550 sf

Eliminate 10% of the electrical and telecom rooms' space:

10% x [(340 sf x 2 facilities) + 747 sf = 140 sf

Eliminate four stair towers – using two stair towers for the entire facility instead of six (currently each battalion building has two stair towers, and the brigade HQ has two stair towers).

Eliminate one elevator. Currently each facility has its own elevator tower. In a combined facility, a single tower with two elevators would be needed.

The facilities will share a single entrance lobby and vestibule and would eliminate 20 exterior doors.

Combining the two floors of the battalion headquarters buildings together will eliminate an exterior wall the length of each battalion headquarters building. Progressive collapse can be achieved in moment from structures without increasing the weight of the framing. However, a change in the connections is required to resists progressive collapse which will increase the still by approximately 1.5 pounds per square foot.[1]

Eliminate one exterior wall in lieu of a common shared wall.

Deduct approximately 259 x 14 x 2 facilities = 7,252 sf

Site disturbance and real estate left undisturbed = footprint of buildings plus 25% or approximately ¾ acre (3,630 sy), at a minimum.

New building roofing area = 21,681 sf (footprint of Brigade HQ)

Elevated Structural Slab = 3 floors x 21,681 sf = 65,043 sf

Shortened utility runs

Stormwater retention reduction =
Roofing area deleted = 13,539 sf x 2 =27,078 sf
Depth of runoff for 1.9" rainfall = 1.675" (Per TR 55)
27,078 sf x 1.675 in/12 in/ft = 3,723 cf = 138 cy

Preliminary energy modeling estimates approximately a 25% reduction in energy usage/consumption when the three buildings are combined into a single facility.

[1] *Design of steel structures for Blast Related Progressive Collapse Resistance, Hamburger, Ronald & Whitaker, Andrew.*

Construction Cost Estimate

Alternative No.: HRC-8

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Mechanical Rooms	SF	235.84	5,480	$1,292,403	4,930	$1,162,691
Electrical & Telecom Rooms	SF	235.84	690	$162,730	550	$129,712
Exterior walls	SF	20.00	7,252	$145,040		
Interior walls	SF	6.00			7,252	$43,512
Stair Towers	Each	25,000.00	4	$100,000	2	$50,000
Site disturbance/restoration	SY	100.00	938	$93,800		
Reduce number of entry doors	Each	3,000.00	28	$84,000		
Wall in-fill for doors	SF	20.00	588	$11,760		
Structural slab	SF	3.80	39,245	$149,131	65,043	$247,163
Standing Seam Metal Roof	SF	17.00	48,759	$828,903	21,681	$368,577
Slab on grade	CY	186.00	903	$167,958	402	$74,772
Stormwater retention (bioswales)	CY	6.00	3,723	$22,338		
Water, sewer, & gas	LS	500,000.00	1	$500,000		
Total Current Contract Cost				$3,558,000		$2,076,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$233,507		$136,245
Subtotal				$3,792,000		$2,212,000
Contingencies		5.00%		$189,600		$110,600
Subtotal				$3,982,000		$2,323,000
SIOH		5.70%		$226,974		$132,411
TOTALS				$4,209,000		$2,455,000
NET SAVINGS						$1,754,000

Life Cycle Cost Analysis

Alternative No.: HRC-8

CAPITAL COST			ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
					$4,209,000			$2,455,000
Capital Cost Savings								$1,754,000
ANNUAL EXPENDITURE	**%**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Energy (from energy modeling)		19.7928		130,000	2,573,000		97,500	1,930,000
O&M on Standing Seam Metal Roof		19.7928		17,553	347,000			
Generalized (% of Capital Cost)								
		SUB-TOTAL			$2,920,000			$1,930,000

SINGLE EXPENDITURE (REPLACEMENT)	**YEAR**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**		**ALTERNATIVE CONCEPT**	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
		SUB-TOTAL		$0		$0
		TOTAL PRESENT WORTH		$2,920,000		$1,930,000
				PRESENT WORTH SAVINGS ON O&M		$990,000
				LIFE CYCLE COST SAVINGS		$2,744,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft.. Campbell, KY

Alternative No: CR-4

Title:
Replace most of the surface parking with a parking garage

Description of Original Concept:

The original concept is to provide surface parking for POV at the two COF/Readiness facilities, the Brigade HQ, and the two Battalion HQ's. A portion of this surface parking is comprised of existing parking that will be milled and resurfaced, but the majority of the parking is comprised of new surface lots.

Description of Alternative Concept:

The alternative concept is to construct a new centrally located parking garage, in lieu of the new surface parking, to service all of the COF, Readiness, and HQ facilities denoted above. Existing surface parking will be milled, resurfaced and re-used.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	($ 3,320,000)
O&M Savings:	$ 3,728,000
Life Cycle Cost Savings:	$ 408,000

Advantages/Disadvantages

Alternative No.: CR-4

Advantages of Alternative Concept

- Minimize disruption of existing land, thereby conserving it for future alternative use.
- Minimize hardscape, thereby reducing amount of stormwater run-off.
- Minimize hardscape, thereby reducing any heat island effect
- Effective re-use of existing parking facilities
- Reduced site lighting
- Saving of currently forested greenspace
- Durability of parking structure is longer than a surface asphalt parking lots
- Centrally-located facility

Disadvantages of Alternative Concept

- Height of structure may be higher than other buildings in the vicinity of this project. At approximately 11.5 feet floor-to-floor, the overall building height to top of rail will be approximately 49 feet.
- Garage maintenance program will be required, and an intermittent repair program may be required approximately every 7 years after a initial use period of approximately 15 years. An annual cleaning and hosedown program will also be required.

Discussion

Alternative No.: CR-4

Use of a parking structure can save valuable real estate which is becoming a scarce commodity at Ft. Campbell. Initially this also preserves valuable existing green space, thereby improving the ability to address significant challenges with stormwater management faced by the fort in the face of increased low-impact-development requirements.

The stacking of the parking levels can also lead to a significant reduction in heat island effects at the adjoining facilities.

The site selected is centrally located between the three proposed HQ buildings as well as the COF / Readiness facilities. Walking distances from the parking structure to all of these buildings are less than ¼ mile at the extreme end.

Covered parking is also often desirable by building tenants, particularly in the extremely cold and hot seasons of the year.

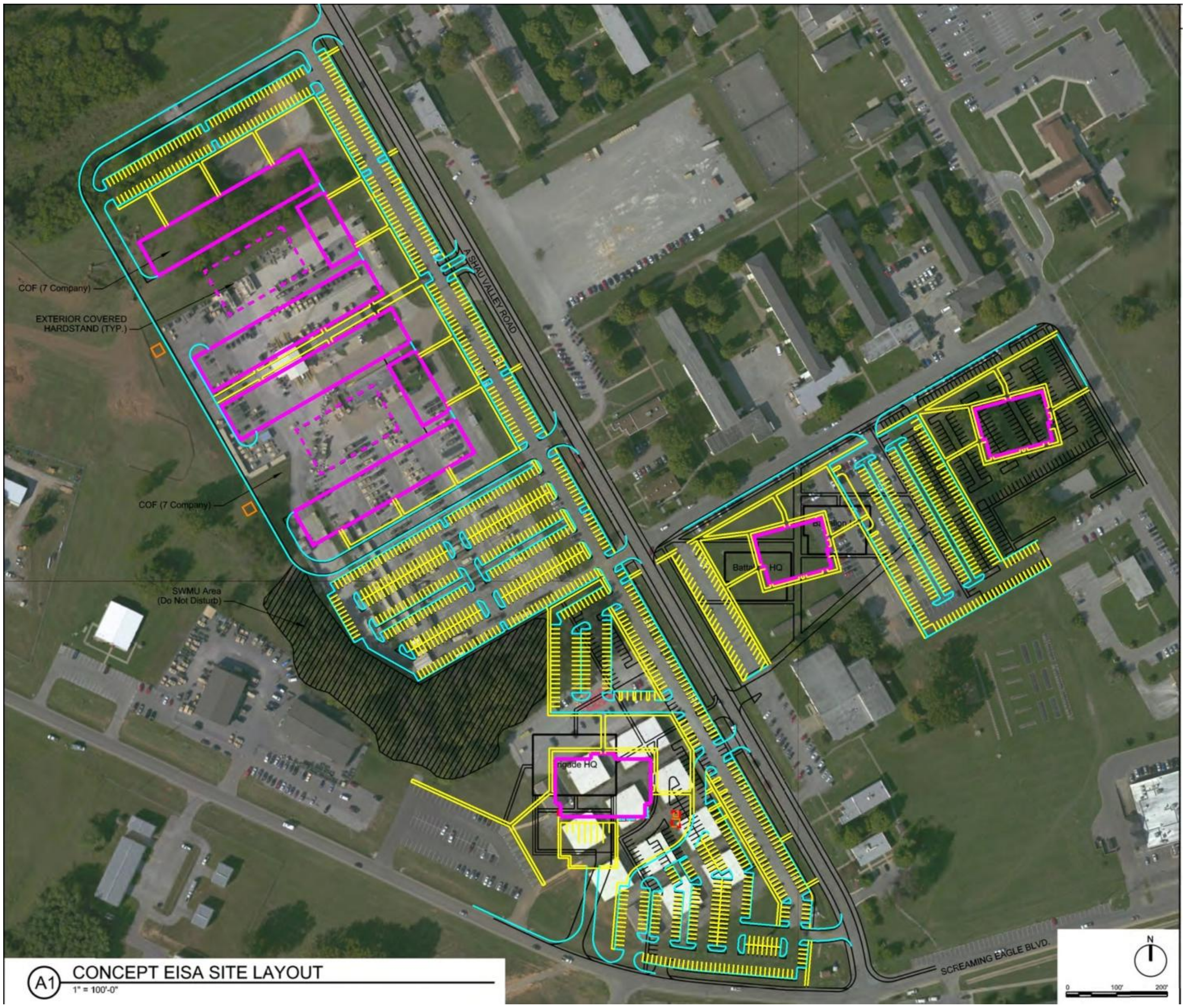
The proposed footprint, selected at 240' north-south x 300' east-west, allows for the eastern edge of the parking structure to be aligned with the eastern edge of the COF/Readiness facilities. In addition, the western, northern and southern edges of the parking structure were selected to roughly align with the proposed surface lot and setbacks utilized on the same site. However, it may be possible to lengthen the building in the east-west direction if these assumed constraints are not followed, wherein it may be very possible to reduce the height of a full story, or at least eliminate half of the uppermost story, thereby reducing the scale of the building more in line with its neighbors.

Should the parking structure be selected, there are also several additional synergies with other technologies that could be explored by the design team. These include the use of solar PV arrays attached to the south side of the garage as a canopy element, or PV solar arrays to provide covered canopy parking at the roof level of the parking structure. Wind turbines or wind pods could also be added at the corners or between the open spandrels at the upper levels of the garage structure. Cities such as Chicago have instituted some of these solar technologies with parking structures and also constructed "green" parking structures that include a combination of either vegetated roofs and/or vegetated exterior walls.

Sketch

Alternative No.: CR-4

☑ Original ☐ Alternative



Sketch

Alternative No.: CR-4

☐ Original ☑ Alternative

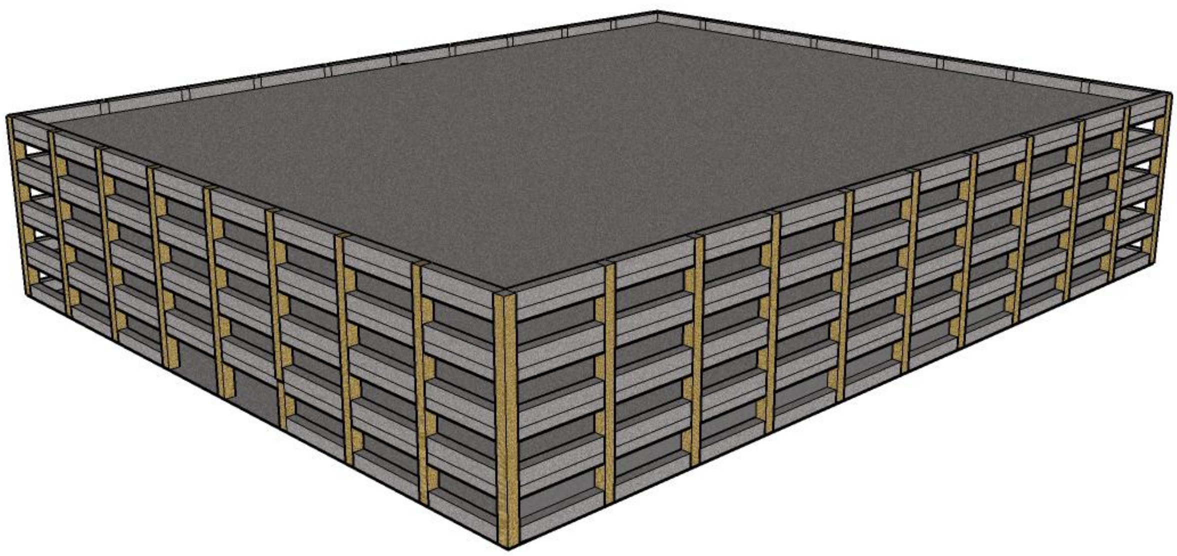
Proposed Location – 960 car parking structure (5-stories)

Sketch

Alternative No.: CR-4

☐ Original ☑ Alternative

Perspective: 5-Story Parking Structure (987 cars)



Calculations

Alternative No.: CR-4

☐ Original ☑ Alternative

Required and provided parking:

COF/Readiness:

1,150 persons x 2 facilities x 50% = 1,150 parking spaces desirable

Brigade HQ:

156 persons x 90% = 141 parking spaces required

Battalion HQ

85 persons x 2 facilities x 90% = 153 parking spaces required

Total Required Parking = 1,150 + 141 + 153 = 1,444 parking spaces desirable

Available existing surface parking spaces to re-use = 357 as planned and drawn

Available existing surface parking spaces currently located between the two Battallion HQ building available to recapture if buildings are re-sited is approximately 100

Total new parking demand = 1,444 – 357 – 100 = 987 new spaces desirable

Calculations

Alternative No.: CR-4

☑ Original ☐ Alternative

Calculate size of parking structure required to meet demand.

Utilize standard 60' column bay module. Parking structure width would be 240 feet (that's four 60' wide bays) x length and height to be determined.

Examining the existing surface parking site located at the west end of 30th street, the currently proposed surface parking length can be over 300 feet long, and can accommodate a north-south width of 240'.

Therefore a footprint for the new structure could be: 240' x 300' = 72,000 S.F. / story

For a rectangular parking structure with ramps integral with the full structural column bay, allowing parking stalls located on either side of the ramps (just like a regular parking bay), one can easily utilize 375 sq. feet per parking space for planning purposes.

Number of stalls per level = 72,000 S.F./story / 375 S.F./car = 192 cars/ level

Number of levels required (on-grade counts as one level) = 987 spaces / 192 spaces/level = 5.1 levels.

Therefore, one could build a full 5 levels and achieve 960 spaces. 4 levels will be elevated, 1 level will be on-grade.

Elevated garage floor area = 4 levels x 72,000 SF = 288,000 SF of elevated

This will require the construction of perhaps 987 – 960 = 27 more new spaces at the ground level, which can be accommodated at the west end of the proposed garage.

Calculations

Alternative No.: CR-4

☐ Original ☑ Alternative

For purpose of determining real estate recovered

Paving Deleted

SCIF Parking	979 sy
SCIF Service Drive	614 sy
COF Service Drive	6803 sy
COF parking	9453 sy
BDE Parking	8260 sy
BN Parking	4456 sy
COF POV Parking	5596 sy
BDE POV Parking	1847 sy
	41,866 sy x 9 sy/sf = 376,794 sf

Paving Blocks

COF – POV Parking	64,515 sf
BDE POV Parking	36,346 sf
BN POV Parking	34,0898 sf
	134,950 sf

Total = 511,744 sf

Area disturbed 511,744 + 25% = 639,680 sf = 14 acre

$495,000/84 acre = $5,900/acre

$472,000/80 acre = $5900/acre

Construction Cost Estimate

Alternative No.: CR-4

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Remill and resurface existing parking	Spaces	1,041.67	357	$371,875	457	$476,042
Construct new surface parking	Spaces	4,375.00	1,087	$4,755,625	27	$118,125
Construct new elevated parking garage	spaces	14,583.33			960	$14,000,000
Site Lighting, Parking	LF	84.31	2,240	$188,854		
Storm Drainage and LID	LS	1.00	1,300,000	$1,300,000		
Site Improvements	LS	1.00	4,500,000	$4,500,000		
Walks, curbs and gutters	LS	1.00	600,000	$600,000		
Real Estate	Acre	5,900.00	14	$82,600	2	$11,800
Total Current Contract Cost				$11,799,000		$14,606,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$774,353		$958,572
Subtotal				$12,573,000		$15,565,000
Contingencies		5.00%		$628,650		$778,250
Subtotal				$13,202,000		$16,343,000
SIOH		5.70%		$752,514		$931,551
TOTALS				$13,955,000		$17,275,000
NET SAVINGS						($3,320,000)

Life Cycle Cost Analysis

Alternative No.: CR-4

LIFE CYCLE PERIOD 40 YEARS

ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
	$13,955,000	$17,275,000
Capital Cost Savings		($3,320,000)

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Generalized (% of Capital Cost)								
maintenance and Repair	0.5%	19.7928				14,000,000	70,000	1,385,000
maintenance and Repair - site lighting, storm	0.5%	19.7928	6,600,000	33,000	653,000			
drain, w alks		19.7928						
		SUB-TOTAL			$653,000			$1,385,000

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Rejuvenator - Sealer, Striping	5	0.8219	51,240	42,000		0
Mill & Resurface	10	0.6756	999,360	675,000		0
Rejuvenator - Sealer, Striping	15	0.5553	51,240	28,000		0
Replacement	20	0.4564	4,200,000	1,917,000		0
Rejuvenator - Sealer, Striping	25	0.3751	51,240	19,000		0
Mill & Resurface	30	0.3083	999,360	308,000		0
Rejuvenator - Sealer, Striping	35	0.2534	51,240	13,000		0
Salvage Value at End of Economic Life						
Parking Structure	40	0.2083		0	7,000,000	(1,458,000)
		SUB-TOTAL		$3,002,000		($1,458,000)
		TOTAL PRESENT WORTH		$3,655,000		($73,000)

PRESENT WORTH SAVINGS ON O&M	$3,728,000
LIFE CYCLE COST SAVINGS	$408,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
CRC-4

Title:
Combine all COFs into one building

Description of Original Concept:

The original concept constructs four separate readiness bays and two separate admin buildings.

Description of Alternative Concept:

The alternative concept is to stack the readiness buildings and admin buildings to minimize the site impervious area, building foot print, and improve energy consumption.

.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$3,685,000
O&M Savings:	$1,089,000
Life Cycle Cost Savings:	$4,774,000

Advantages/Disadvantages

Alternative No.: CRC-4

Advantages of Alternative Concept

- 40% reduction in roof impervious area.
- 40% reduction in roof area that will save long term O&M responsibility.
- 2 acre reduction in site paving.
- The combining of buildings allows near ideal solar orientation.
- The covered hardstand is integral with the building which provides better function during inclement weather.
- A reduction in total site acreage may be realized once the site layout is optimized for vehicular turning movements.
- A total reduction of 3.4 acres of impervious area will translate into a substantial difference in stormwater management solutions as well as the heat island effect.
- The admin space is consolidated into one common area which will allow improved interaction with command.
- A single building mechanical system may be utilized which then allows exhaustive heat and cooling to be shared amongst the various spaces.
- The energy consumption of one multi-story building is far superior than the 6 sprawling buildings that were proposed.
- The proposed site orientation would allow additional companies to be added at a later date.

Disadvantages of Alternative Concept

- A slight change in the Army criteria that stipulates the readiness building must have ground level access.
- Requires a change to the Center of Standardization

Discussion

Alternative No.: CRC-4

The purpose of this demonstration project is to identify those opportunities that would help the Army meet the EISA law. This team discussed how aggressive EISA is and the fact it will take a paradigm shift in order to comply with this law. The current Army construction program is in a sprawling mentality which goes directly against the grain of EISA and the concept of Low Impact Development (LID).

This concept is encouraging the Army to consider stacking their buildings to reduce both their physical foot print as well as their environmental foot print. The key to low impact development is densification. Is it truly unreasonable to ask a foot soldier to climb one flight of stairs in order to access their gear? This small change in how the Army functions could be the single most important change that allows the Government to meet these aggressive laws.

This alternate design impacts the initial construction cost, operations and maintenance cost, and annual energy consumption. There are many variables tied to this alternative that could be quantified if additional time and effort were given, but for the sake of this concept the key items have been highlighted.

The combined COF/Admin building shown is positioned on the site where the admin glazing is rotated 15 degrees from due south. This orientation is considered near ideal for day lighting however this site could benefit from an additional 15 degrees of rotation. The design team is encouraged to run a comparative analysis to determine how much of an impact the additional rotation has on the energy consumption; exterior light-shelves or window fins may help to compensate for the change in rotation. The original site plan combined with the building design precludes future expansion capabilities whereas the alternate plan would allow additional readiness modules to be added in the future.

This alternate also recommends the cover hardstand be integrated with the building due to inclement weather; most of the COF's on Fort Campbell have the cover hardstand adjacent to the readiness module. The stacked building increases the available covered hardstand by 58%: 28,941 sq ft at ground level and 28,941 sq ft on level two. The integrated covered hardstand could also double as an instruction platform for troop formation within the court yard area. Although troop formation/instruction is not a required function of the COF this would offer added flexibility to this facility type.

Additionally, site grading may allow the readiness modules to be placed below grade, with a walkout at ground level, and still provide the elevated floor access on the opposite side of the building at a higher level, in a "walk-out" basement kind of manner.

Sketch

Alternative No.: CRC-4

☑ Original ☐ Alternative

Sketch

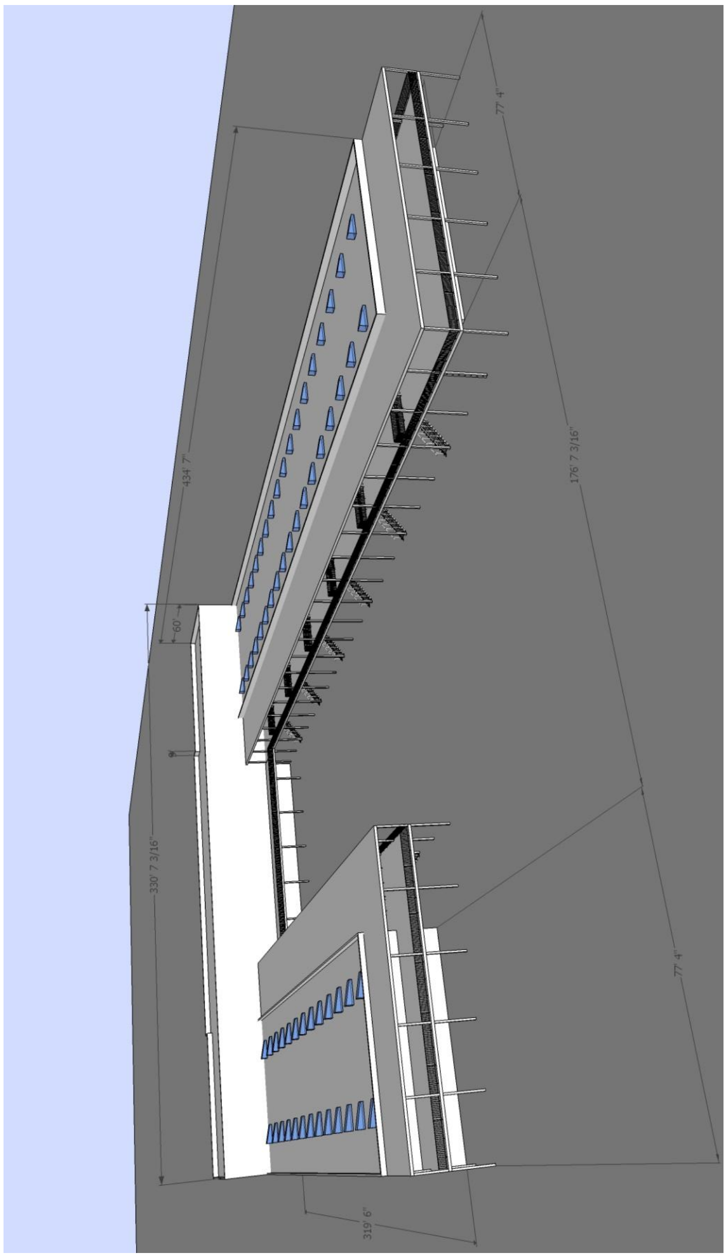
Alternative No.: CRC-4

☑ Original ☑ Alternative

Sketch

Alternative No.: CRC-4

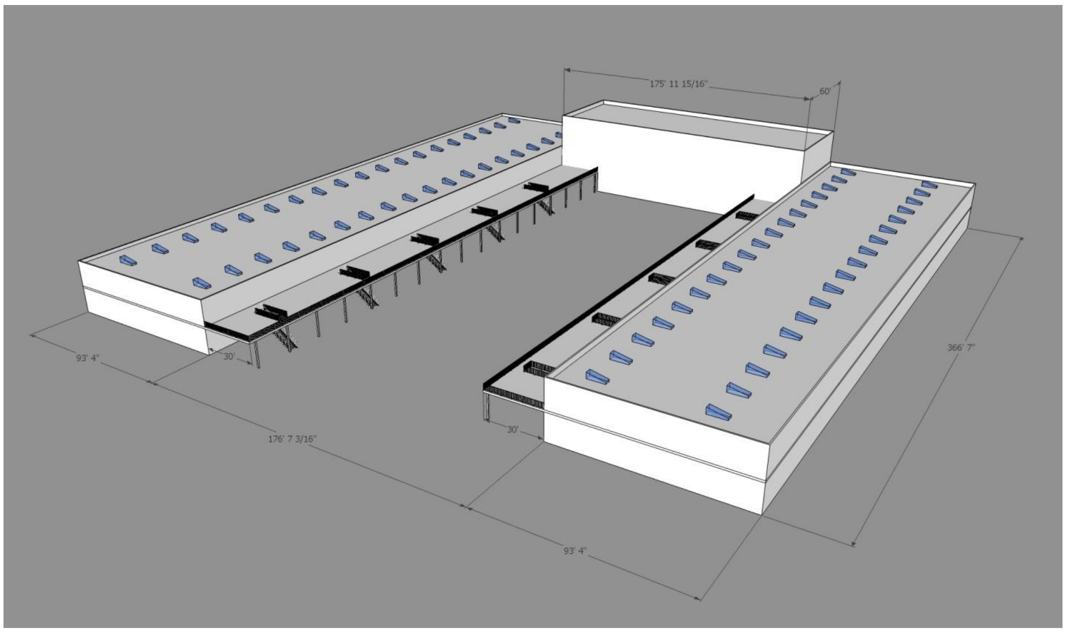
☐ Original ☑ Alternative



Sketch

Alternative No.: CRC-4

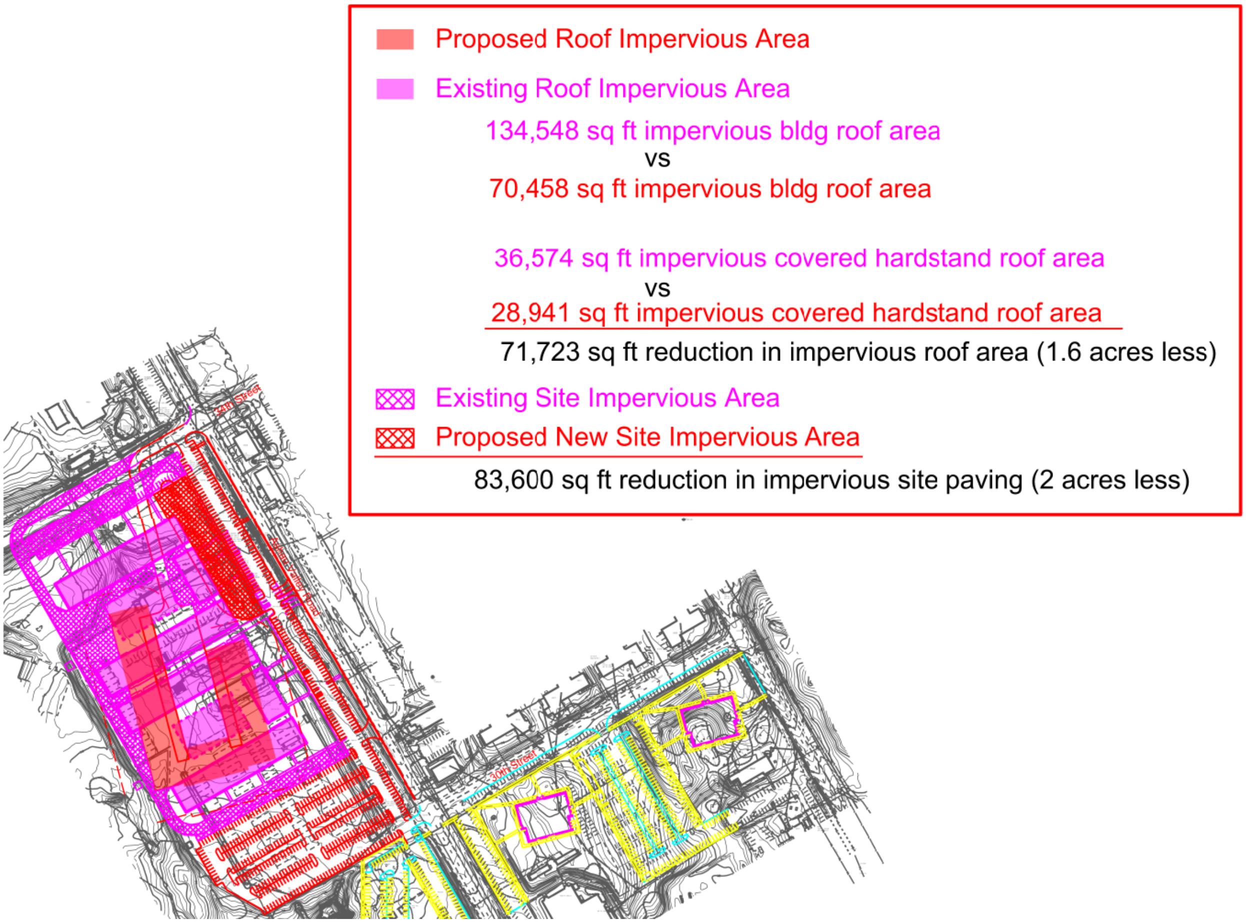
☐ Original ☑ Alternative



Calculations

Alternative No.: CRC-4

☐ Original ☑ Alternative



Calculations

Alternative No.: CRC-4

☐ Original ☑ Alternative

HVAC Annual Energy Savings Estimate
Combine COF Readiness and Administrative Buildings
Base (Current Design) Annual Energy Consumption per COF

Electrical	423,730	kWh
Gas	9,086	Therms

Cost of Energy from Base Building Energy Model

Electrical	$0.123
Gas	$0.576

Base (Current Design) Annual Energy Cost per COF

Electrical	$52,204
Gas	$5,234

Energy Model Energy Use Breakdown:

Clg/Fans	38%	kWh
Htg	75%	Therms
DHW	25%	Therms

Envelope roof and wall areas are 33% lower with the combined COF than with individual COF (141,700 SF vs 210,500 SF)

Calculations below are for combining two COFs

Cooling Load Reduction	15%	
Heating Load Reduction	20%	
Electrical Annual Savings	48,305	kWh
Gas Annual Savings	2,726	
Electrical Annual Cost Savings	$5,951	
Gas Annual Cost Savings	$1,570	
Total Annual Energy Cost Savings	**$7,521**	(per Administrative/Readiness module)

<u>Assumptions:</u>
Cooling load is approximately 50% from building envelope.
Space heating load is approximately 65% from building envelope.
Per Whitestone Facility Maintenance and Repair 2010-2011
Standing Seam Metal Roof (SSMR) = 0.35/sf/year
Built-up Roof = 0.04/sf/year

Company Operations Administration

Comm Rooms	(8 x 100 sf) x 50% = 400 sf
Electrical	(8 x 100 sf) x 50% = 400 sf
Mechanical	(1,500 sf x 8) x 25% = 3,000 sf

Calculations

Alternative No.: CRC-4

☐ Original ☑ Alternative

ENERGY CONSUMPTION SUMMARY
By DEMO

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 2						
Primary heating						
Primary heating	10	884,448		66.7 %	884,482	931,100
Other Htg Accessories	5,176		15	1.3 %	17,666	53,003
Heating Subtotal	**5,186**	**884,448**	**15**	**68.1 %**	**902,148**	**984,103**
Primary cooling						
Cooling Compressor	17,354			4.5 %	59,228	177,702
Tower/Cond Fans	4,011		76	1.0 %	13,691	41,077
Condenser Pump	2,047			0.5 %	6,987	20,964
Other Clg Accessories	2,447			0.6 %	8,353	25,061
Cooling Subtotal....	**25,860**		**76**	**6.7 %**	**88,259**	**264,804**
Auxiliary						
Supply Fans	21,821			5.6 %	74,475	223,449
Pumps	2,475			0.6 %	8,447	25,343
Stand-alone Base Utilities				0.0 %	0	0
Aux Subtotal....	24,296			6.3 %	82,922	248,791
Lighting						
Lighting	26,189			6.8 %	89,384	268,178
Receptacle						
Receptacles	47,601			12.3 %	162,462	487,434
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	**129,132**	**884,448**	**90**	**100.0 %**	**1,325,175**	**2,253,311**

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

Project Name: Brigade Combat Team Complex PN 63641
Dataset Name: COF Admin rotate.TRC

TRACE®700 v6.2.6.5 calculated at 05:02 PM on 04/21/2011
Alternative - 2 Energy Consumption Summary report page 1

Alternative No.: CRC-4

☐ Original ☑ Alternative

ENERGY CONSUMPTION SUMMARY

By DEMO

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		24,211		2.4 %	24,211	25,485
Other Htg Accessories	1,021			0.3 %	3,486	10,458
Heating Subtotal	**1,021**	**24,211**		**2.7 %**	**27,696**	**35,943**
Primary cooling						
Cooling Compressor	31,933			10.6 %	108,989	326,998
Tower/Cond Fans	12,570		133	4.2 %	42,903	128,720
Condenser Pump	7,141			2.4 %	24,373	73,125
Other Clg Accessories	2,749			0.9 %	9,382	28,148
Cooling Subtotal....	**54,394**		**133**	**18.0 %**	**185,645**	**556,991**
Auxiliary						
Supply Fans	73,616			24.4 %	251,251	753,828
Pumps	3,346			1.1 %	11,419	34,262
Stand-alone Base Utilities				0.0 %	0	0
Aux Subtotal....	76,962			25.5 %	262,670	788,090
Lighting						
Lighting	108,667			36.0 %	370,879	1,112,748
Receptacle						
Receptacles	53,554			17.8 %	182,781	548,398
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	**294,598**	**24,211**	**133**	**100.0 %**	**1,029,672**	**3,042,170**

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

Project Name: Brigade Combat Team Complex PN 63641
Dataset Name: COF READINESS_raise setpt.TRC

TRACE® 700 v6.2.6.5 calculated at 05:11 PM on 04/21/2011
Alternative - 1 Energy Consumption Summary report page 1

Construction Cost Estimate

Alternative No.: CRC-4

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Roof Area	SF	17.00	134,548	$2,287,316	70,458	$1,197,786
Wall Area	SF	20.00	76,514	$1,530,280	67,788	$1,355,760
Paving Area	SY	45.00	44,312	$1,994,040	32,215	$1,449,675
Communications Room (50% reduction in sq ft)	SF	187.59	800	$150,072	400	$75,036
Mechanical Room (25% reduction in sq ft)	SF	187.59	12,000	$2,251,080	9,000	$1,688,310
Electrical Room (50% reduction in sq ft)	SF	187.59	800	$150,072	400	$75,036
Footing	LF	24.00	4,432	$106,368	2,067	$49,608
Reduction (40%) in Mechanical & Electrical Equipment Size -> 20% reduction in cost	SF	20.00	134,548	$2,690,960	107,638	$2,152,760
Total Current Contract Cost				$11,160,000		$8,044,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$732,416		$527,917
Subtotal				$11,892,000		$8,572,000
Contingencies		5.00%		$594,600		$428,600
Subtotal				$12,487,000		$9,001,000
SIOH		5.70%		$711,759		$513,057
TOTALS				$13,199,000		$9,514,000
NET SAVINGS						$3,685,000

Life Cycle Cost Analysis

Alternative No.: CRC-4

LIFE CYCLE PERIOD 40 YEARS

ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
	$13,199,000	$9,514,000
Capital Cost Savings		$3,685,000

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Energy		19.7928		15,042	298,000			
Roof Repair/Maintenance-SSMR		19.7928		48,437	959,000			
Roof Repair/Maintenance - Built Up roof		19.7928					2,822	56,000
Generalized (% of Capital Cost)								
SUB-TOTAL					$1,257,000			$56,000

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Replacement - Built up Roof	15	0.5553		0	136,689	76,000
Replacement - Built up Roof	30	0.3083		0	243,080	75,000
Paving Rejuvenator, Striping	5	0.8219	44,312	36,000	32,215	26,000
Mill & Resurface	10	0.6756	44,312	30,000	32,215	22,000
Paving Rejuvenator, Striping	15	0.5553	44,312	25,000	32,215	18,000
Mill & Resurface	20	0.4564	44,312	20,000	32,215	15,000
Paving Rejuvenator, Striping	25	0.3751	44,312	17,000	32,215	12,000
Mill & Resurface	30	0.3083	44,312	14,000	32,215	10,000
Salvage Value at End of Economic Life						
SUB-TOTAL				$142,000		$254,000
TOTAL PRESENT WORTH				$1,399,000		$310,000
				PRESENT WORTH SAVINGS ON O&M		$1,089,000
				LIFE CYCLE COST SAVINGS		$4,774,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
HCR-1

Title:
Move Battalion HQ to PT Site and move PT site to tree covered site

Description of Original Concept:

The original concept has Battalion HQ Bldg. #2 (the most eastern of the two) located between 30th Street and existing building 6903 in a partially wooded site. This site contains several trees of fairly large size (~ 24") and has the following characteristics:

- EISA orientation
- Fairly steep backfill slopes in rear
- Size and configuration per COS requirements
- Tree removal required

Description of Alternative Concept:

The alternative concept is to relocate the HQ building in the area to the south of the original in an area currently occupied by PT equipment. This site provides these attributes:

- EISA orientation
- Reduced backfill slopes in the rear of the building
- Size and configuration per COS requirements
- Removal of treed area not required

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 53,000
O&M Savings:	$ 4,000
Life Cycle Cost Savings:	$ 57,000

Advantages/Disadvantages

Alternative No.: HCR-1

Advantages of Alternative Concept

- Does not require removal of significant trees; leaves “green space” in the project area.
- Provides better back slope in the rear of the building and possibly better grading surrounding the building, also reduces fill required for project.
- Increases “live-ability” for troops
- Removes requirement for a small electric line relocation

Disadvantages of Alternative Concept

- Encroaches upon PT area where large formations of troops are required to have access
- Mapping and surveying for this site do not exist; existing Civil designs would require re-work.
- Geotechnical information does not exist for this area
- Drainage issues may exist in this area from a drain which comes from 30th Street; will require additional investigation.
- May reduce “connectivity” for the BCT campus area
- Impact on schedule

Discussion

Alternative No.: HCR-1

Loss of green areas at Ft. Campbell is a serious problem. The BCT project, which includes the (2) 7-company COF's, (1) Brigade HQ, and (2) Battalion HQ's, provides significant new roof and paved area construction. The construction of these buildings will require the removal of several acres of trees which is considered unavoidable, although the majority of this tree removal is in areas where the trees are not mature.

One particular area of concern is the area proposed for the eastern-most Battalion Building. This area requires the removal of several mature trees on the order of 36" diameter. This area is maintained in a mown grassed condition and would be considered by most observers as attractive, and beneficial to quality of life. It is desirable to have this treed area remain. Although not a high dollar cost savings or addition, the saving of this natural area is felt important enough to warrant inclusion in this study.

Several issues exist if this change is made. These issues are:

- Removal of area which is currently used for PT; parade type access with large troop formations to this PT area is considered as important; relocation to the existing treed area may not provide this same access.
- No survey or mapping exists in the proposed area. Also, Civil engineering work which has been completed on the original site would need to be abandoned. Geotechnical work would also need to be required to be completed on the new site.
- Impact on schedule would exist. The survey/design would require possibly a month to get coordinated and completed.
- Drainage issues may exist; see below.

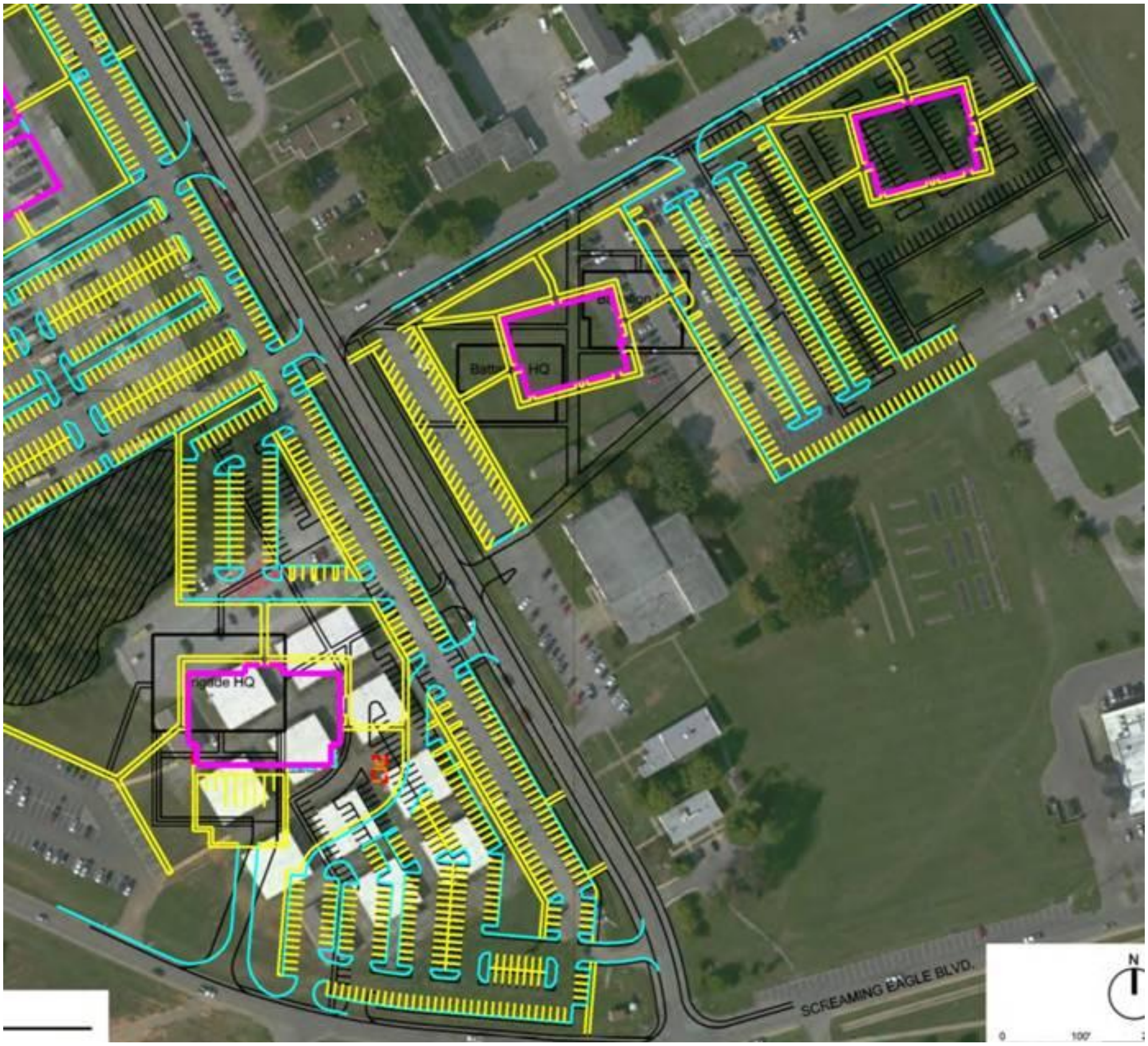
A sketch is given on the following page. As shown, the proposed site moves to the south relative to the original site. This area is generally flat, much flatter than the original. This flatness will reduce the required engineered fill for the proposed site. There is a significant drain which comes from the north (from 30th Street) which would require investigation into its impact on the proposed site but it is felt that this would not be a large cost factor. Available bio-retention area would be increased for the proposed area with the potential for increased infiltration rate given the speed with which existing drainage dissipates in the proposed area.

There are many benefits to this proposal for which there is no current method to quantify. Tree cover for the troops provides a cooler area to train and an overall better environment. Trees provide oxygen, reduce erosion from heavy rains and sustain a "greener" environment. For purposes of this exercise, the life cycle cost calculated is simply for the loss in carbon reduction by removing the trees.

Sketch

Alternative No.: HCR-1

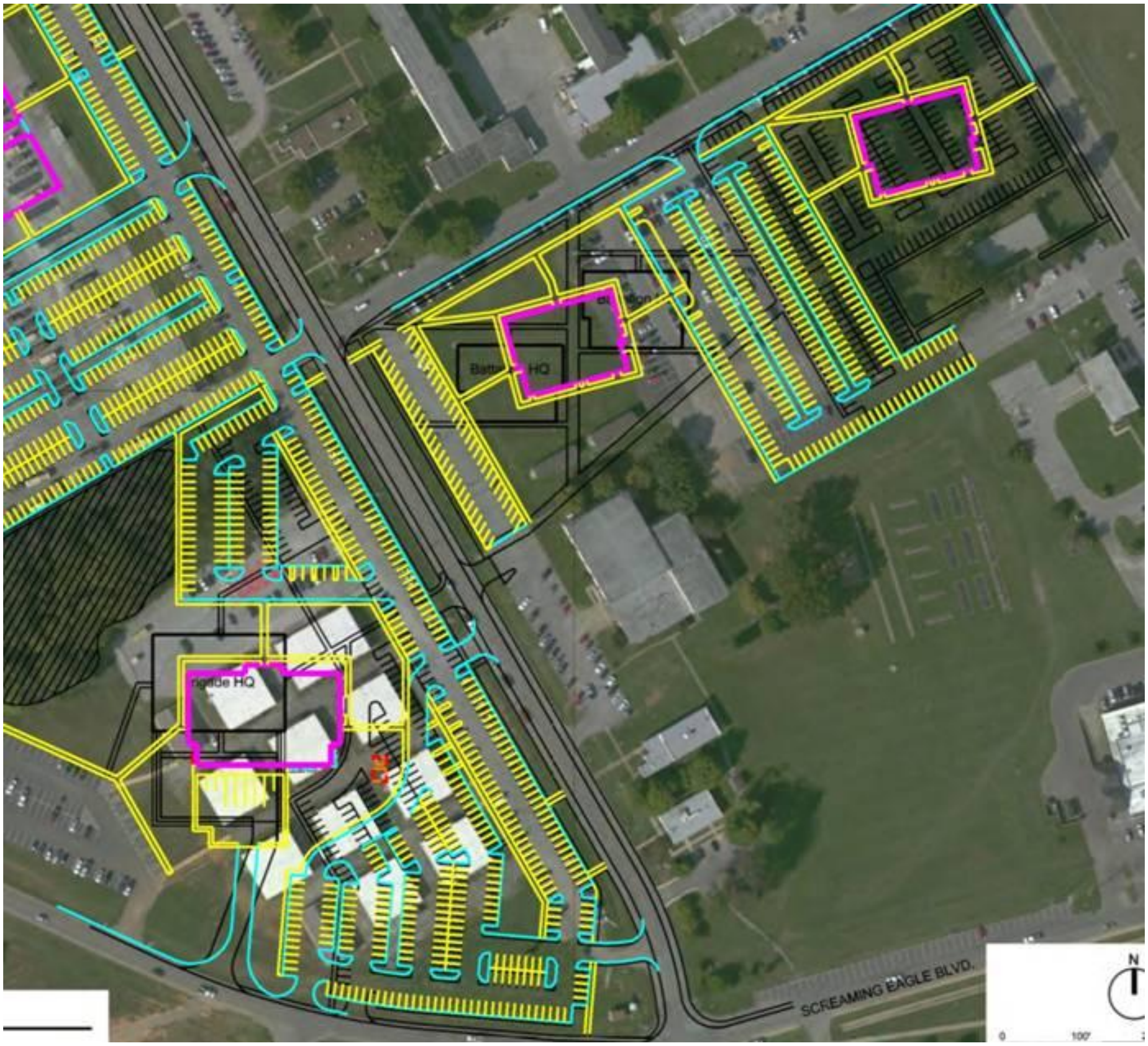
☑ Original ☐ Alternative



Sketch

Alternative No.: HCR-1

☐ Original ☑ Alternative



Construction Cost Estimate

Alternative No.: HCR-1

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Engineered Fill	CY	15.00	5,000	$75,000		
Tree Removal,24"	EA	798.00	3	$2,394		
8"C900 Waterline	LF	75.00			500	$37,500
8" Valves	EA	1,687.00			3	$5,061
Hydrant	EA	2,614.00			2	$5,228
6" Valves	EA	1,387.00			2	$2,774
Clear	Acre	5,664.00	0	$1,869		
Grub	Acre	3,426.00	0	$1,131		
Hauling	Acre	7,787.00	0	$2,570		
Electrical Relo	LF	23.35	570	$13,310		
Total Current Contract Cost				$96,000		$51,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$6,300		$3,347
Subtotal				$102,000		$54,000
Contingencies		5.00%		$5,100		$2,700
Subtotal				$107,000		$57,000
SIOH		5.70%		$6,099		$3,249
TOTALS				$113,000		$60,000
NET SAVINGS						$53,000

Life Cycle Cost Estimate

Alternative No.: HCR-1

LIFE CYCLE PERIOD 40 YEARS ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
	$113,000	$60,000
Capital Cost Savings		$53,000

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT CAPITAL COST	ORIGINAL CONCEPT ANNUAL COST	ORIGINAL CONCEPT PRESENT WORTH	ALTERNATIVE CONCEPT CAPITAL COST	ALTERNATIVE CONCEPT ANNUAL COST	ALTERNATIVE CONCEPT PRESENT WORTH
Tree Removal - Carbon Reduction		19.7928		190	4,000			
Generalized (% of Capital Cost)								
		SUB-TOTAL			$4,000			$0

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT ESTIMATE	ORIGINAL CONCEPT PRESENT WORTH	ALTERNATIVE CONCEPT ESTIMATE	ALTERNATIVE CONCEPT PRESENT WORTH
Salvage Value at End of Economic Life						
		SUB-TOTAL		$0		$0
		TOTAL PRESENT WORTH		$4,000		$0
				PRESENT WORTH SAVINGS ON O&M		$57,000
				LIFE CYCLE COST SAVINGS		$57,000

SITE

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
CR-1

Title:
Maintain natural vegetative cover over soil

Description of Original Concept:

The potential impact on natural systems and processes as evidenced by the selection of undisturbed woodlands for development when there are viable options present an opportunity to expand on the value of maintaining natural vegetative cover in a watershed context to avoid the issue in the future.

Description of Alternative Concept:

The alternative concept is to protect and conserve undisturbed land in order to maintain the numerous free services that are provided by natural ecosystems such as maintaining a balanced hydrology and water quality function to offset development impacts.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:

O&M Savings: **No costs developed**

Life Cycle Cost Savings:

Advantages/Disadvantages

Alternative No.: CR-1

Advantages of Alternative Concept

- Maintains healthy ecosystem services to protect water quality and reduce downstream flooding by retaining a balanced relationship between vegetation and soil that minimizes erosion and maximizes infiltration and the physical, chemical and biological processes that take place within the soil profile.

- Maintaining pockets of natural vegetation protects diminishing habitat for plants and animals and provides diversity in a rapidly changing landscape that is devoid of natural elements.

Disadvantages of Alternative Concept

- The disadvantages are primarily economic in that protected sites are not available for development although studies have shown that adjacent property values increase substantially in the vicinity of protected natural areas due to the improved quality of life it provides.

Discussion

Alternative No.: CR-1

Healthy ecosystems are dependent on three primary factors, 1) retaining clean liquid water to sustain essential biological processes such photosynthesis and to recharge groundwater, 2) preventing soil erosion through the stability provided by plant roots, soil being the essential medium where the essential physical, chemical and biological processes take place and 3) maintaining the cycling of nutrients through the breakdown of organic material into nutrients that support plant growth.

The incremental loss of healthy ecosystems that sustain life can be viewed as a national security issue since it represents our ability to produce goods, such as clean water and services that are necessary to support viable social and economic systems. It is the incremental loss of forest cover that threatens water quality and availability over time. A ten percent reduction in forest canopy with a concurrent increase in impervious surfaces within an urbanizing watershed begins to be reflected in stream channel stability. Stream bank erosion is exacerbated further as deforestation continues and that, combined with the loss of pollution mitigation that takes place naturally within the soil profile is reflected in degraded water quality.

Individual sites, therefore, must be viewed in a watershed context, in addition to their local value as a resource to be exploited, in order to determine the appropriate disposition.

In terms of the economic value provided by natural vegetation communities, The City of New York in the 1990s was faced with constructing an eight billion dollar water treatment plant to improve the quality of water running off of a rapidly developing one million acre watershed in variable ownership 100 miles to the north. To place a value on the land, the entire watershed could have been protected by purchase at $8,000 per acre for the price of the treatment plant, which is several times the market value of the land at that time. Instead, the option elected to avoid the cost of mechanical treatment was to implement a watershed conservation plan to conserve forested areas with potential for development and to require farm conservation plans and low impact development methods that would mimic natural hydrologic function.

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No: CR-2

Title:
Reduce Vehicle Parking by 20%

Description of Original Concept:

The original concept is to provide POV parking spaces based on accepted algorithms for each facility.

Description of Alternative Concept:

The alternative concept is to reduce the overall parking count for each facility (excluding the 4 TEMF sites) by 20%.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 436,000
O&M Savings:	$ 275,000
Life Cycle Cost Savings:	$ 711,000

Advantages/Disadvantages

Alternative No.: CR-2

Advantages of Alternative Concept

- Reduced infrastructure associated with runoff storage
- Available land for runoff quality devices (Low Impact Development [LID] IMPs)
- Reduced urban heat island effect
- Reduced site lighting needs
- Opportunity for tree canopy planting

Disadvantages of Alternative Concept

- Requires a paradigm shift mentality throughout the ranks
- Longer walking distance to facilities
- May require additional waiver

Discussion

Alternative No.: CR-2

Parking counts based on 35% Submittals are shown below:

Facility	Requirement	#spaces (35% design)	#spaces (20% reduction)
3 HQs	varies	1,018	815
Barracks	70%	265	212

Circulation patterns, proximity to building entrances, topography, soils, mature vegetation, and resource area protection should be considered when choosing specific parking spaces to be eliminated. Parking areas that would remove mature vegetation should be reconsidered and the green space maintained.

If this concept is approved, coordination with LID stormwater strategy shall occur. Where possible, existing adjacent lots can be utilized as overflow parking (i.e. Korean Air Motor Pool parking lot next to proposed barracks).

To compensate for the parking reduction, it is recommended that FTC consider implementing a public transit system and or limiting who may be allowed to have a POV on post. Daily trips on post could either utilize public shuttle services or consider the use of unit assigned military vehicles.

Consideration should be given to motorcycle parking in lieu of full parking spaces in addition to more bicycle in a very convenient location to encourage their use.

Reduced parking spaces at TEMF sites were not proposed due to the existing low parking/user ratio (56%) and their relatively isolated locations.

Calculations

Alternative No.: CR-2

☐ Original ☑ Alternative

Parking removed* and pavement types:

3 BCT:

203 spaces x 540 sf/2 spaces = 54,810 SF = 6,090 sy

Asphalt Paving: 60% x 6,090 sy = 3,650 sy

Porous Concrete Pavers: 40% x 6,090 sy = 2,440 sy

Barracks:

53 spaces x 540 sf/2 spaces = 14,310 SF = 1,600 sy

Total Reduction in Parking Area = 6,090 + 1,600 = 7,690 sy

*Does not include parking to be resurfaced in existing lots

Calculations

Alternative No.: CR-2

☐ Original ☑ Alternative

For purpose of determining real estate recovered

Paving Deleted

SCIF Parking	979 sy
SCIF Service Drive	614 sy
COF Service Drive	6,803 sy
COF parking	9,453 sy
BDE Parking	8,260 sy
BN Parking	4,456 sy
COF POV Parking	5,596 sy
BDE POV Parking	1,847 sy
	41,866 sy x 9 sy/sf = 376,794 sf

Paving Blocks

COF – POV Parking	64,515 sf
BDE POV Parking	36,346 sf
BN POV Parking	34,089 sf
	134,950 sf

Total = 511,744 sf

Area disturbed 511,744 + 25% = 639,680 sf = 14 acre

14 acres x 20% = 2.8 acre recovered

From MLS listings in Clarksville, TN

$495,000/84 acre = $5,900/acre

$472,000/80 acre = $5,900/acre

Calculations

Alternative No.: CR-2

☐ Original ☑ Alternative

Life Cycle Calculations:

Rejuvenator – Sealer

3,650 sy paving x $1.22/sy = $4,453

Mill & Resurface

3,650 sy x 9 = 32,850 sf

Parking stall = 375 sf

14,400/375 sf = 87.6 say 88 stalls

88 stalls x $1,041.67 = $91,700

Replace

88 stalls x $4,375 = $385,000

Construction Cost Estimate

Alternative No.: CR-2

BCT

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Pov Parking Asphalt	SY	32.55	3,650	$118,808		
Site Lighting	LF	138.77	477	$66,193		
Bioretention System	SY	114.55	650	$74,458		
Pervious Pavement	SY	21.42	2,440	52,265		
Landscape Trees	EA	258.00			50	$12,900
Landscape Seed	SY	0.97			300	$291
Clear & Grub	Acre	17,846.00	3	$53,538		
Real Estate	Acre	5,900.00	3	$17,700		
Total Current Contract Cost				$383,000		$13,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$25,000		$1000
Subtotal				$408,000		$14,000
Contingencies		5.00%		$20,000		$700
Subtotal				$428,000		$14,700
SIOH		5.70%		$24,000		$800
TOTALS				$452,000		$16,000
NET SAVINGS						$436,000

Construction Cost Estimate

Alternative No.: CR-2

Bks

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Pov Parking Asphalt	SY	32.55	1,600	$52,080		
Site Lighting	LF	138.77	477	$66,193		
Bioretention System	SY	114.55	650	$74,458		
Real Estate	AC	5,900.00	0.33	$1,947		
Total Current Contract Cost				$195,000		
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$12,798		
Subtotal				$208,000		
Contingencies		5.00%		$10,400		
Subtotal				$218,000		
SIOH		5.70%		$12,426		
TOTALS				$230,000		
NET SAVINGS						$230,000

Life Cycle Cost Estimate

Alternative No.: CR-2

LIFE CYCLE PERIOD 40 YEARS ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
	$452,000	$16,000
Capital Cost Savings		$436,000

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Generalized (% of Capital Cost)								
		SUB-TOTAL			$0			$0

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Rejuvenator - Sealer, Striping	5	0.8219	4,453	4,000		0
Mill & Resurface	10	0.6756	91,700	62,000		0
Rejuvenator - Sealer, Striping	15	0.5553	4,453	2,000		0
Replacement	20	0.4564	385,000	176,000		0
Rejuvenator - Sealer, Striping	25	0.3751	4,453	2,000		0
Mill & Resurface	30	0.3083	91,700	28,000		0
Rejuvenator - Sealer, Striping	35	0.2534	4,453	1,000		0
Salvage Value at End of Economic Life						
		SUB-TOTAL		$275,000		$0
		TOTAL PRESENT WORTH		$275,000		$0

PRESENT WORTH SAVINGS ON O&M	$275,000
LIFE CYCLE COST SAVINGS	$711,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
CR-20

Title:
Infiltrate rainfall close to where it falls

Description of Original Concept:

The original concept as presented on the 35% drawings for the Brigade Combat Team 3 Complex provided for infiltration through the use of pervious pavers in the parking stalls throughout the project area along with underground detention and some bio-swales. This is an effective technique but is not sufficient to meet the EISA requirement to "maintain or restore, to the maximum extent practically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume and duration of flow".

Description of Alternative Concept:

The alternative concept as shown on the attached sketches and demonstrated in the calculations, provides the additional LID techniques, primarily in the form of bioretention basins, to meet the spirit and letter of the law to capitalize on all opportunities for infiltration in a distributed manner throughout the site and, for the 95th percentile storm, to limit the off site runoff to that which would have occurred prior to development and underground detention. The technique used meets the EISA requirement for pre development hydrology and, simultaneously, substantially improves the quality of the water on site and downstream.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☑ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost Savings:	($ 130,000)
O&M Savings:	$ 0
Life Cycle Cost Savings:	($ 130,000)

Advantages/Disadvantages

Alternative No.: CR-20

Advantages of Alternative Concept

- Extends available spaces for bio-retention and infiltration to all suitable locations
- The use of bio-retention basins for infiltration provides a water quality component through the uptake of a wide variety of contaminants
- Provides better distribution of infiltrated water throughout the site
- Meets the letter and spirit of the law to employ LID practices to the maximum extent practicable

Disadvantages of Alternative Concept

- There is not sufficient time to develop an accurate grading plan to ensure the viability of the recommended additions to the plan
- Hand calculations and scaling of areas on plans with a very tight schedule has produced a good approximation at best and requires verification
- Analysis is limited to Brigade Combat Team 3 Complex

Discussion

Alternative No.: CR-20

Meeting the letter and spirit of the law requires an evaluation of every possible opportunity to infiltrate water near its source and to address the pollution issue. The designer has utilized porous pavement to advantage in this regard but the plans lack recognition of the distributed spaces in parking islands and near buildings that fully utilize the LID principles.

Also, there is a lack of available information of the soil that is an important component in the analysis as it relates directly to infiltration capacity. For this reason the VE team has used a conservative value in the calculations of predevelopment runoff (HSGC) that may not accurately reflect the pre-development condition.

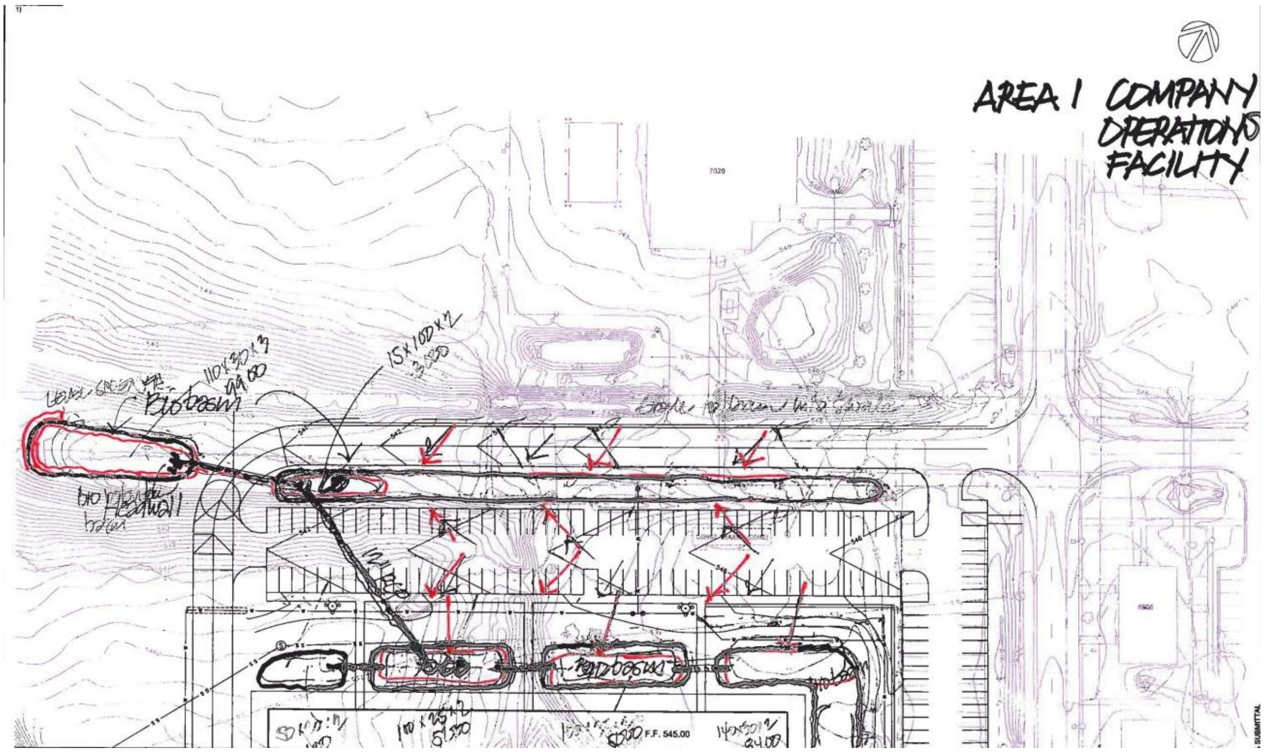
These calculations are considered suitable for a preliminary estimate but verification is needed for design development.

Area 1, attached, modified as proposed, meets the required on-site runoff retention for 1.9" of rainfall. Area 2 requires approximately 552 sq ft of additional bio-basin space to meet the standard. Terrain and available space in Area 3, however, limit bio-retention space, and therefore will require subsurface detention or an expansion of porous pavement to achieve compliance.

Sketch

Alternative No.: CR-20

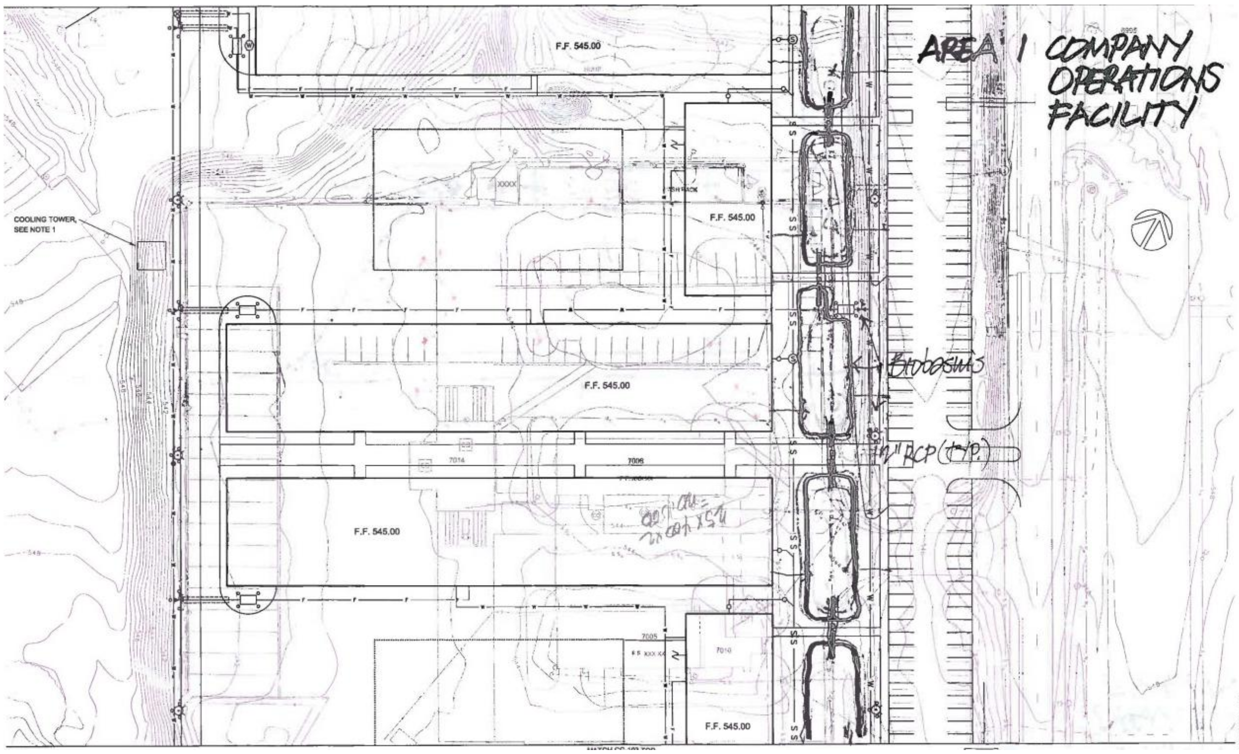
☐ Original ☑ Alternative



Sketch

Alternative No.: CR-20

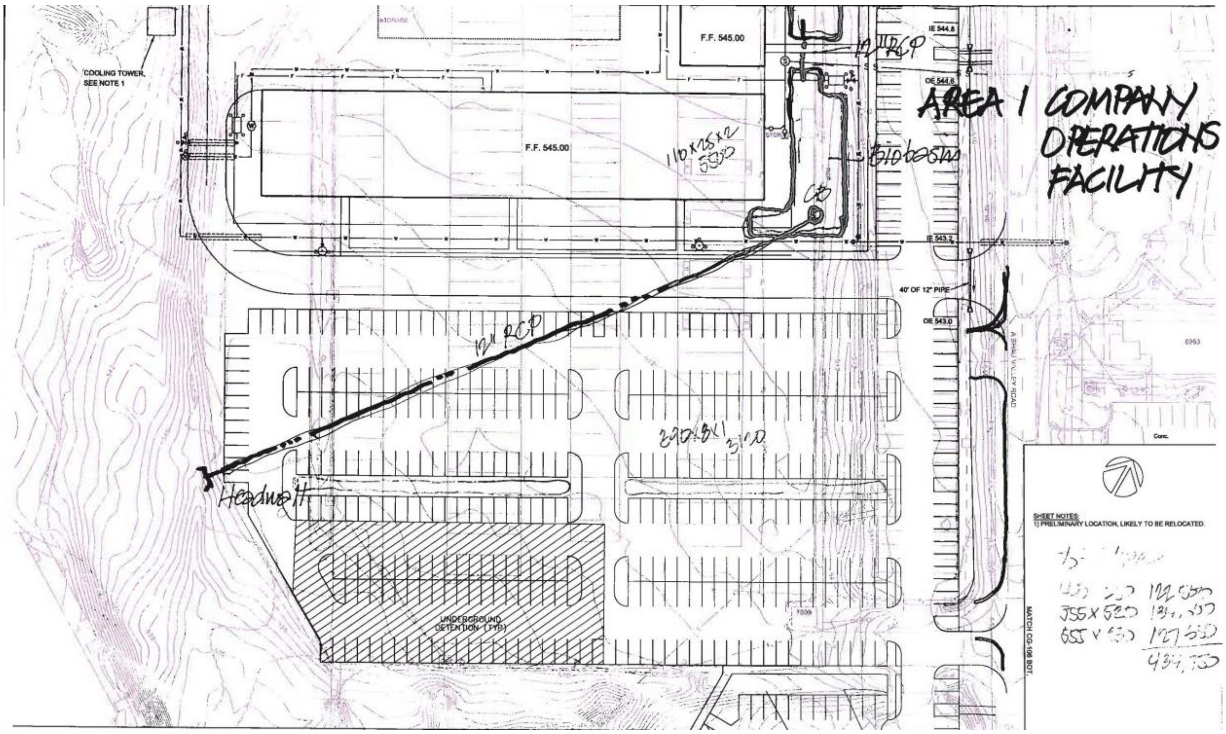
☐ Original ☑ Alternative



Sketch

Alternative No.: CR-20

☐ Original ☑ Alternative



Sketch

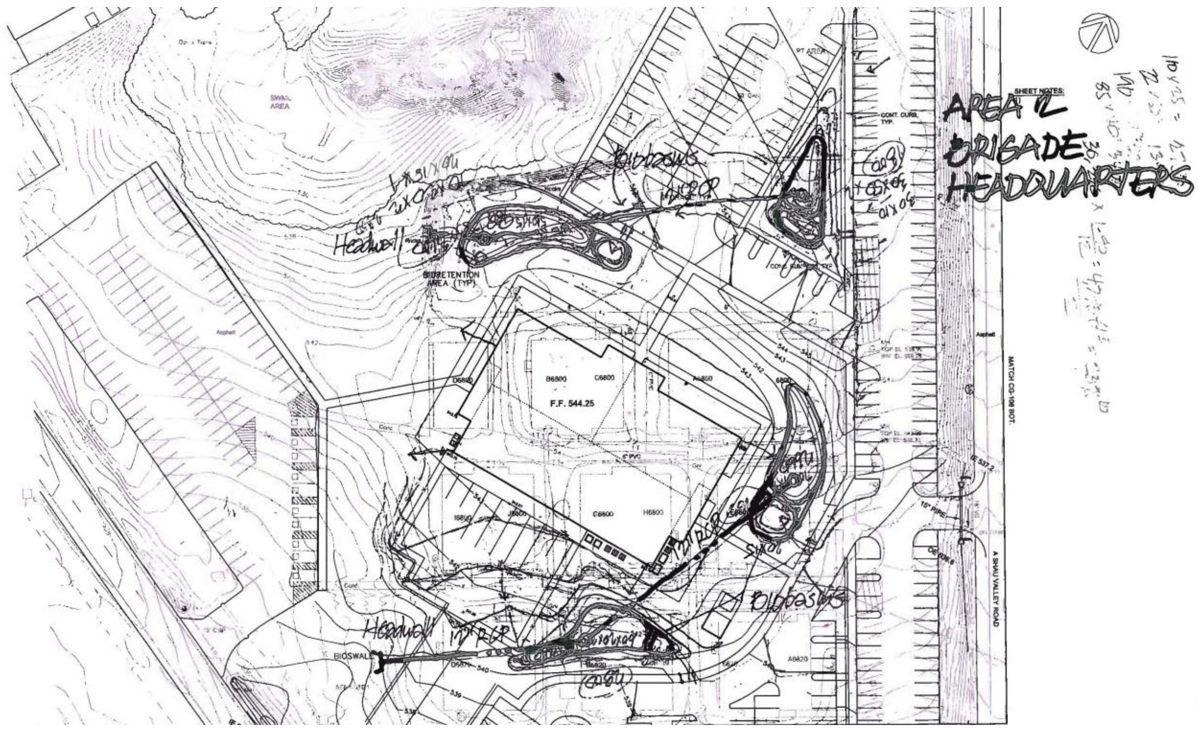
Alternative No.: CR-20

☐ Original ☑ Alternative

Sketch

Alternative No.: CR-20

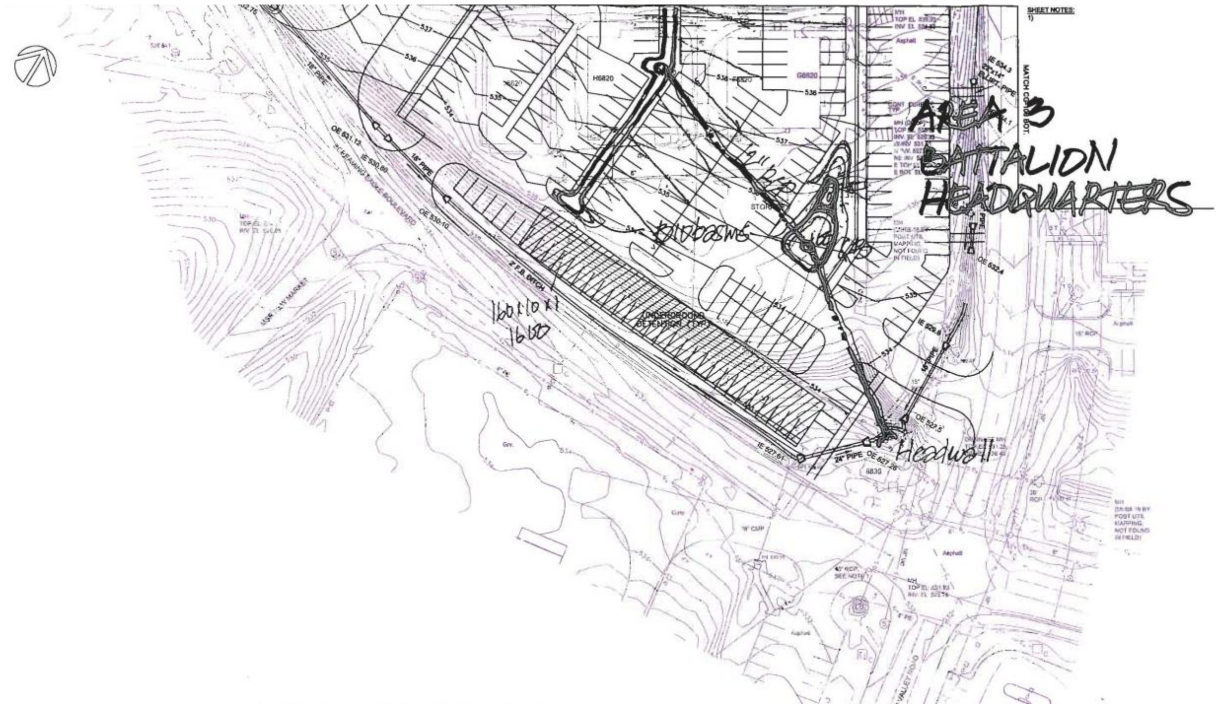
☐ Original ☑ Alternative



Sketch

Alternative No.: CR-20

☐ Original ☑ Alternative



Calculations

Alternative No.: CR-20

☐ Original ☑ Alternative

Area 1 – Company Operations Facility

Impervious surfaces 483,502 sq ft – curve # = 98 (TR55)

Depth of runoff for 1.9" rainfall = 1.68", Table 2.1 (TR55)

Runoff volume = 483.502 sq ft x $\frac{1.68"}{12"/ft}$ = 68,110 cf

Pervious pavement = 67,774 sq ft – curve #30 (min # from TR55)

Depth of runoff for 1.9" rainfall = 0", table 2.1 (TR55)

<u>Required calculation for pre-development hydrology:</u>

Assume forested condition on HSGC soils

Total area of site = $\frac{434{,}750\ sq\ ft}{43{,}560}$ = 9.98 AC – CN = 70 (TR55)

Depth of runoff for 1.9" rainfall = 0.205", Table 2.1 (TR55)

Runoff volume = 434,750 sq ft x $\frac{0.205"}{12"/ft}$ = 7,427 cf

<u>Required on-site storage</u>

Proposed runoff volume = 68,110 cf

Pre-development volume = 7,427 cf

Total =60,683 cf

Available Bio-basin storage (as modified 3/30/2011)

61,920 – 60,683 = 1,237 surplus storage

Calculations

Alternative No.: CR-20

☐ Original ☑ Alternative

Area 2 – Brigade Headquarters

Total Area of site =	443,900 sq ft	
Impervious area=	119,282" x CN 98 =	11,689,636
Pervious pavement=	33,858 x CN 30 =	1,015,740
Grass area =	290,760 x CN 79 =	<u>22,970,040</u>
		35,675,416 ÷ 443,900 = 80.4

Average CN = 80

<u>Post-development runoff volume</u>

Depth of runoff for 1.9" rainfall = 0.50", Table 2.1 (TR55)

Runoff volume 443,900 sq ft x $\frac{0.50"}{12"/ft}$ = 18,495 cf

<u>Pre-development runoff volume</u>

Assume forested conditions on HSGC soil – CN = 70 (TR55)

Depth of runoff for 1.9" rainfall = 0.205", table 2.1 (TR55)

Runoff volume 443,900 sq ft x $\frac{0.205"}{12"/ft}$ = 7,583 cf

Required on-site storage = 18,495 – 7,583 = 10,912 cf

Available on-site storage (as modified 3/30/2011) = 10,360

= - 552 cf

Solution adds 552 cf to bio basin

Calculations

Alternative No.: CR-20

☐ Original ☑ Alternative

Area 3 – Double Batallion Headquarters

Total Area of site = 325,450 sq ft

Impervious area= 123,580" x CN 98 = 12,110,840

Pervious pavement= 34,020 x CN 30 = 1,020,600

Grass area = 201,870 x CN 79 = 15,947,730

29,079,170 ÷ 325,450 = 89.3

Average CN = 89

Post-development volume

Depth of runoff for 1.9" rainfall = 0.95", Table 2.1 (TR55)

Runoff volume 325,450 sq ft x $\frac{0.95"}{12"/ft}$ = 25,765 cf

Pre-development runoff volume

Assume forested conditions on HSGC soil – CN = 70 (TR55)

Depth of runoff for 1.9" rainfall = 0.205", table 2.1 (TR55)

Runoff volume 325,450 sq ft x $\frac{0.205"}{12"/ft}$ = 5,560 cf

Required on-site storage = 25,765 – 5,560 = 20,205 cf

Available on-site storage (as modified 3/30/2011) (Roof runoff, 3 parking stands) = 9,258 cf

= - 10,947 cf

On site options limited use, subsurface detention for 10,947 cf or expand porous pavement.

Construction Cost Estimate

Alternative No.: CR-20

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Bio-Retention Area	SY	114.55			9,121	$1,044,823
12" RCP	LF	66.11			1,830	$120,981
Catch Basin	EA	2,950.00			9	$26,550
U/G Detention Area	CY	237.80			1,216	$289,244
Headwalls (12" Pipe)	EA	1,000.00			5	$5,000
U/G Retention @ Battalion	LS			$202,782		
U/G Retention @ COFS	LS			$317,802		
U/G Retention @BN	LS			$734,814		
U/G Retention @BDE	LS			$60,965		
U/G Retention @COFS	LS			$46,687		
				$146,283		
Total Current Contract Cost						$1,487,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%				$97,590
Subtotal						$1,585,000
Contingencies		5.00%				$79,250
Subtotal						$1,664,000
SIOH		5.70%				$94,848
TOTALS				$1,889,000		$1,759,000
NET SAVINGS						$130,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
CR-32

Title:
Use vegetation and trees to reduce the heat island effect around the buildings (includes CR-36, and RC-108)

Description of Original Concept:

The original concept includes some minor landscaping throughout the site.

Description of Alternative Concept:

The alternative concept is to enhance the landscaping throughout the site to increase the tree canopy near the buildings and around the parking areas, and to connect the streetscapes to the green areas by using trees, shrubs, and ground cover. The objective in adding more trees is to keep the buildings and the area around the buildings cooler, thereby reducing the energy load.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☑ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost Savings:	($ 222,000)
O&M Savings:	$ 367,0000
Life Cycle Cost Savings:	$ 145,000

Advantages/Disadvantages

Alternative No.: CR-32

Advantages of Alternative Concept

- From a sustainability perspective trees can reduce runoff with the tree canopy
- The tree canopy reduces heat island effect
- Reduced energy use by directly shading buildings which decreases demand for air conditioning.
- Vegetation reduces runoff and improves water quality by absorbing and filtering rainwater.
- Tree shade can slow deterioration of street pavement, decreasing the amount of maintenance needed.
- Trees and vegetation provide aesthetic value, habitat for many species, and can reduce noise.
- Trees offer both aesthetic softening of the site
- Use of low shrubs, native or adapted, that are climate tolerant mitigates replacement
- Selection of species can provide “alee” designs and streetscape rhythm, variations of species within the plan offer further design enhancements
- Shade for pedestrians, soldiers
- Low ground cover can be used to break up turf and enhance building environment
- Trees can decrease solar insolation

Disadvantages of Alternative Concept

- Seasonal replacement at 1-3% if native and adaptive species are used
- More time and more careful mowing procedures, including trimming
- Requires bed preparation for plants

Discussion

Alternative No.: CR-32

The proper utilization of natural vegetation such as trees can drastically improve the site characteristics from a Low Impact Development (LID) and sustainability perspective. Trees and forests improve stream quality and watershed health primarily by decreasing the amount of stormwater runoff and pollutants that reaches our local waters. Trees and forests reduce stormwater runoff by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. The USDA Forest Service performed a study on controlling stormwater runoff with trees and they found that a typical medium size tree can intercept as much as 2,380 gallons of rainfall per year.

According to www.epa.gov, the shade provided by a tree canopy can reduce surface temperatures by 20-45° F cooler than the peak temperatures of unshaded areas. Trees and vegetation are most useful as a mitigation strategy when planted in strategic locations around buildings or to shade pavement in parking lots and on streets. Researchers have found that planting deciduous trees or vines to the west is typically most effective for cooling a building, especially if they shade windows and part of the building's roof.

From Department of Natural Resources for the State of Maryland:

Strategically placed trees can be as effective as other energy saving home improvements, such as insulation and the installation of weather-tight windows and doors. Trees help reduce your heating and cooling costs.

Trees save energy through cooling in the hotter months. They provide a wind break during winter. This result is burning less fossil fuels to generate electricity for cooling and heating.

Strategically placed *shade trees*-a minimum of three large trees around your home-can reduce air conditioning costs up to 30 percent. Shade trees offer their best benefits when you:

- Plant *deciduous* trees, which shed their leaves during the winter. These trees provide shade and block heat during hotter months. By dropping their leaves in the fall they admit sunlight in the colder months.
- Place these trees on the south and west sides of buildings.
- Shade all hard surfaces such as driveways, patios and sidewalks to minimize landscape heat load.

Fort Campbell (FTC) has interpreted the Anti Terrorism Force Protection (ATFP) rules to allow the use of trees within the ATFP setback as long as the tree canopy is well above visual inspected site lines. A tree trunk has been interpreted as not being an obstacle on other projects on FTC therefore this alternative recommends the use of native trees along the perimeter of the buildings as well as throughout the parking lot.

Use of native/adapted trees, shrub and ground cover can be used not only to enhance the hardscape, but also bring the sites together and create vistas that bring the streets and buildings together. Runoff from hardscapes can be mitigated and use of low ground covers can break up turf, enhance the building environment and setting while still adhering to AT/FP requirements.

By using an overall design species selection can be varied within the plan to further enhance interest and reinforce landscape broad vistas. Wherever possible landscape species should be selected and coordinated with bioretention and rain garden features to create a total integrated micro-climate for the site. Existing tree stands and extraordinary specimens should be reserved and integrated into the overall design scheme.

Sketch

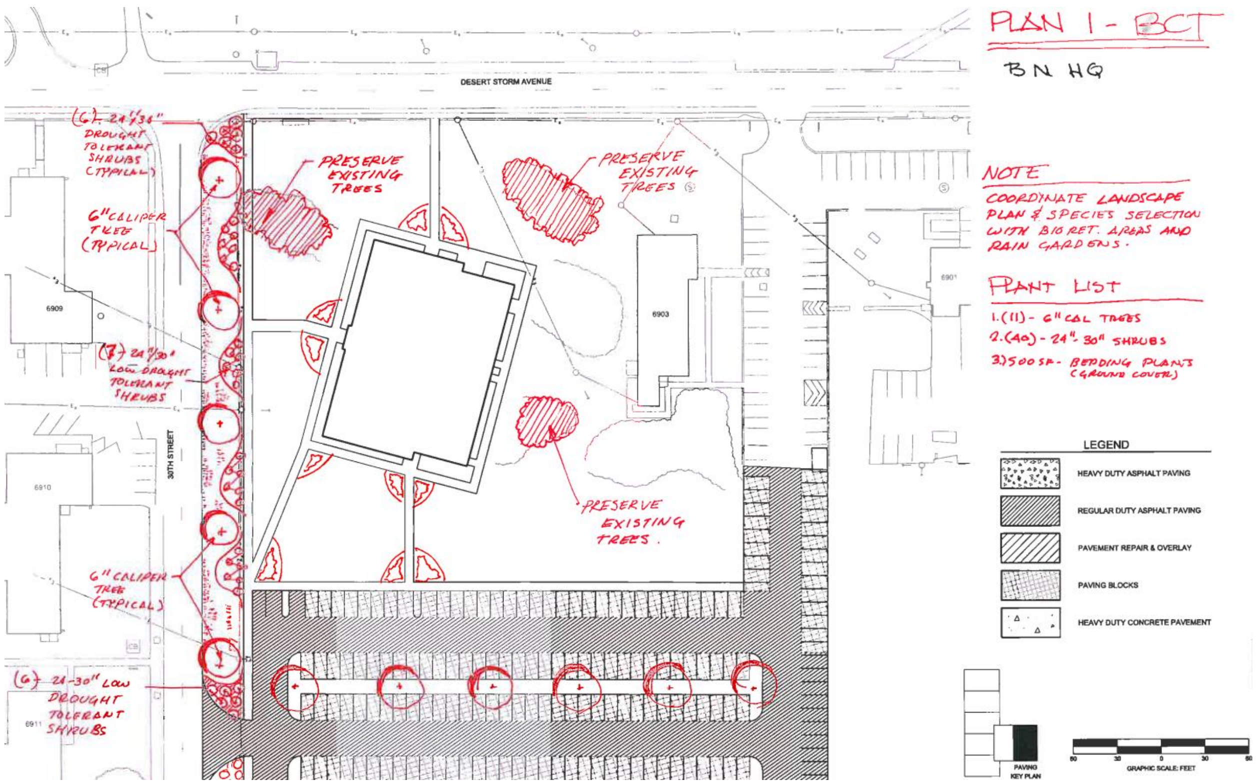
Alternative No.: CR-32

☑ Original ☐ Alternative

Sketch

Alternative No.: CR-32

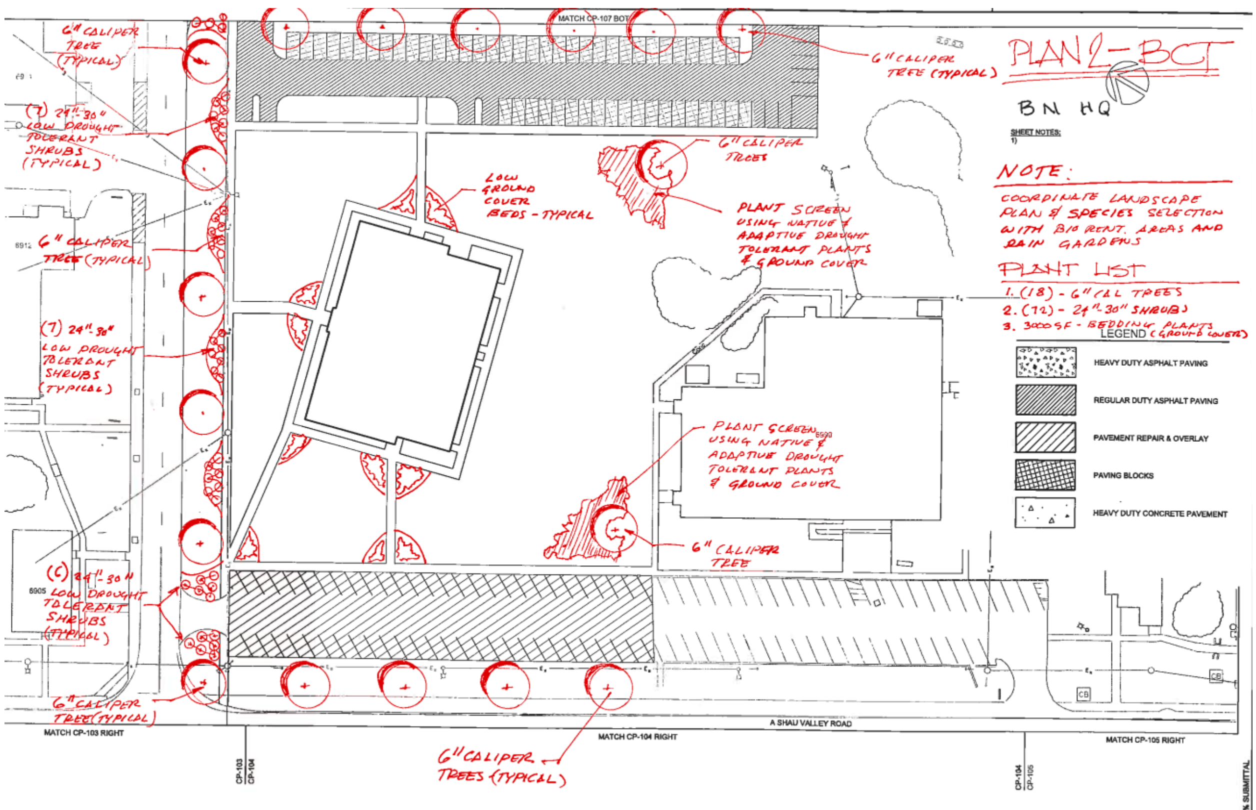
☐ Original ☑ Alternative



Sketch

Alternative No.: CR-32

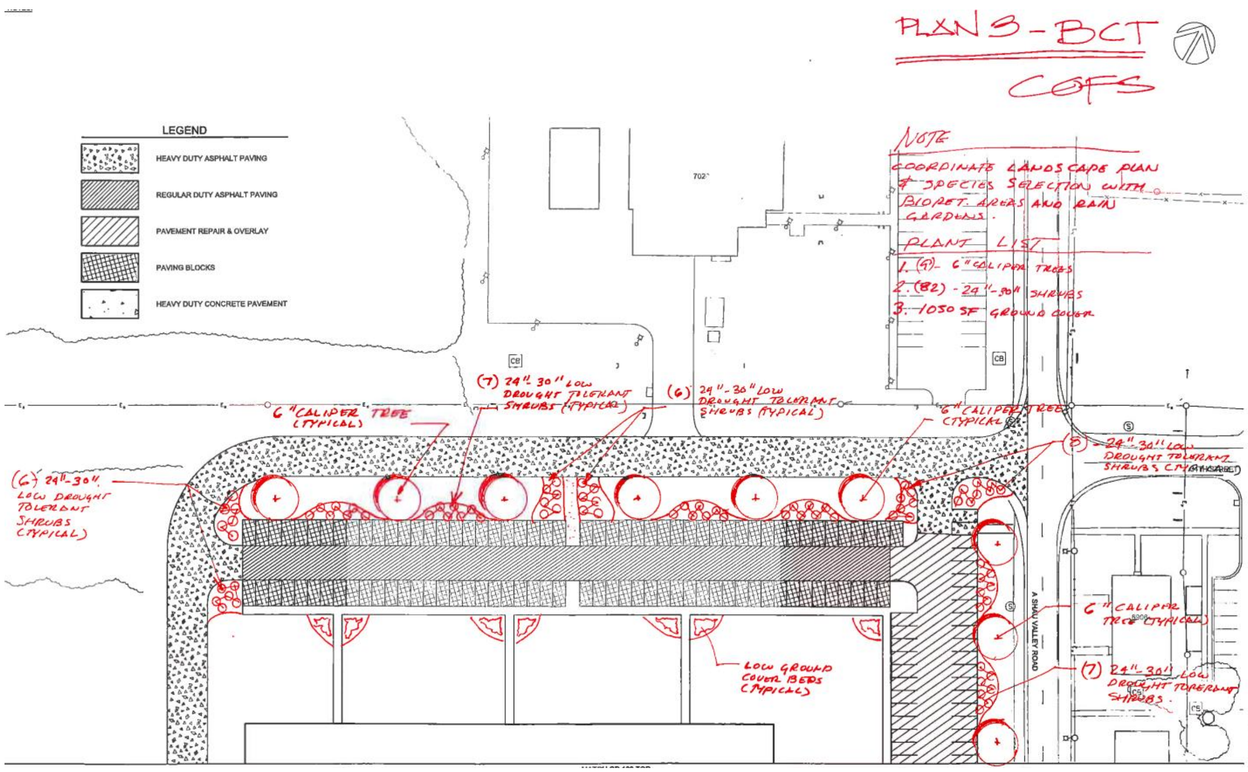
☐ Original ☑ Alternative



Sketch

Alternative No.: CR-32

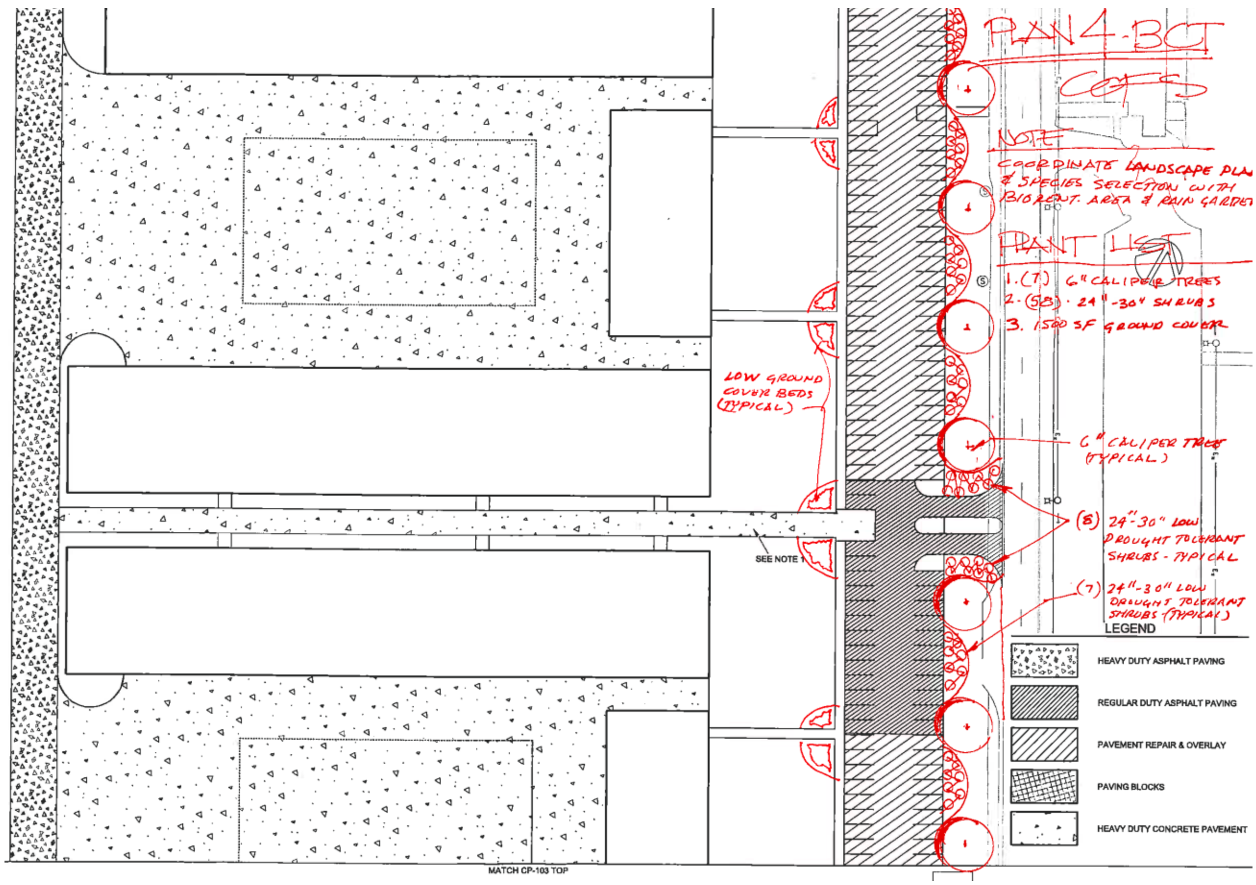
☐ Original ☑ Alternative



Sketch

Alternative No.: CR-32

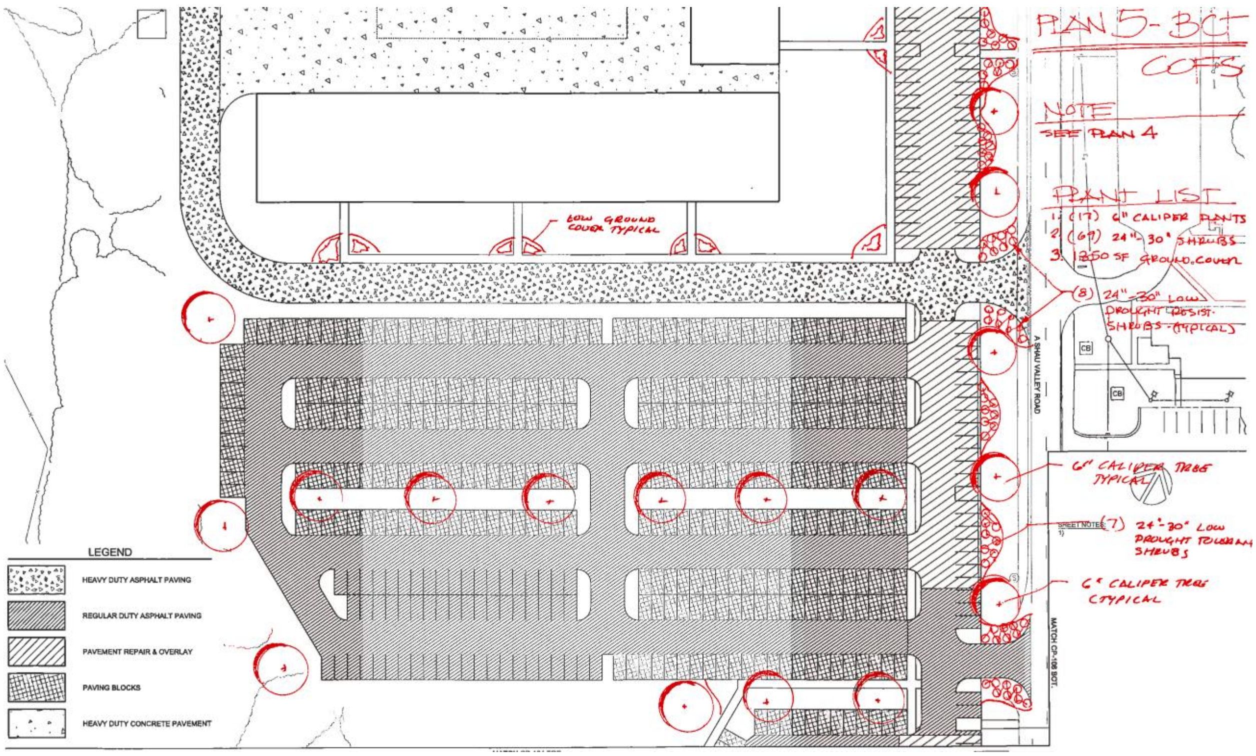
☐ Original ☑ Alternative



Sketch

Alternative No.: CR-32

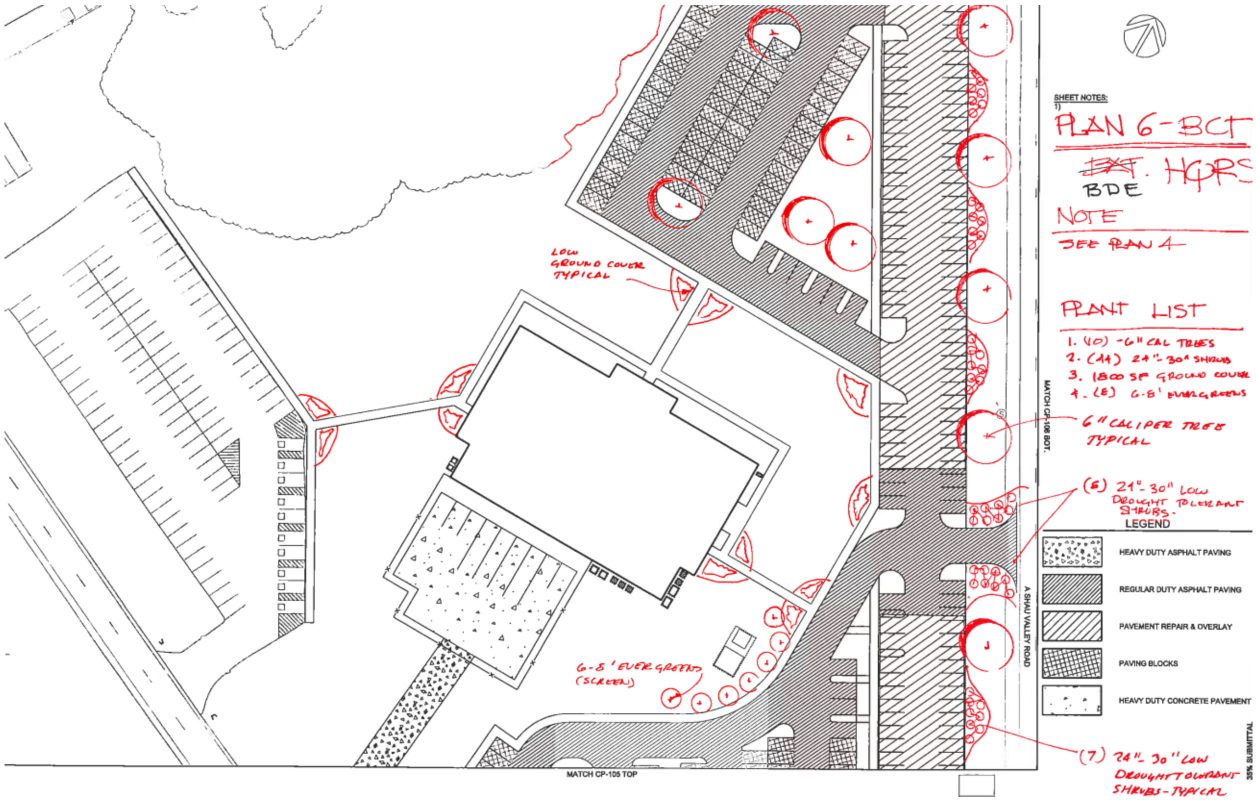
☐ Original ☑ Alternative



Sketch

Alternative No.: CR-32

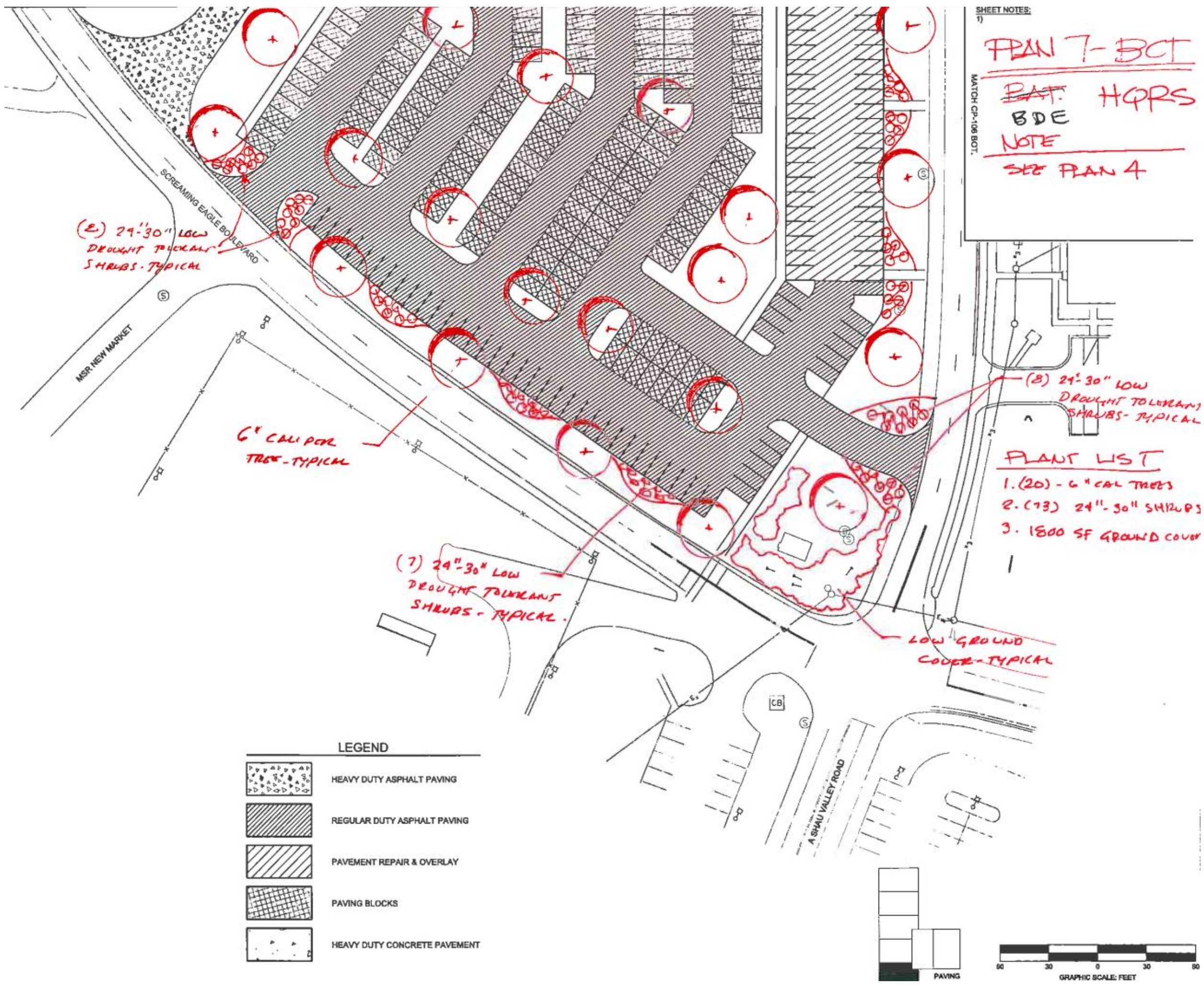
☐ Original ☑ Alternative



Sketch

Alternative No.: CR-32

☐ Original ☑ Alternative



Calculations

Alternative No.: CR-32

☐ Original ☑ Alternative

Life Cycle Costs:

Assume, conservatively 25% of air conditioning energy usage is saved by strategically locating landscaping.

Total annual electrical usage for HQ's and COF's is $195,064.

Assume cooling accounts for 38% of electrical usage (See RC-109)

38% x $195,064 = $74,124

Savings = 25% x $74,124 = $18,531

Construction Cost Estimate

Alternative No.: CR-32

BN

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
6" Caliper Trees	EA	960.00			29	$27,840
24"-30" Shrubs	EA	70.00			112	$7,840
Bedding Plants	MSF	1,400.00			3.5	$4,900
Plant Bed Preparation	MSF	3,500.00			5.2	$18,316
Total Current Contract Cost						$59,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%				$3,872
Subtotal						$63,000
Contingencies		5.00%				$3,150
Subtotal						$66,000
SIOH		5.70%				$3,762
TOTALS						$70,000
NET SAVINGS						($70,000)

Construction Cost Estimate

Alternative No.: CR-32

Bde

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
6" Caliper Trees	EA	960.00			30	$28,800
24"-30" Shrubs	EA	70.00			117	$8,190
Bedding Plants	MSF	1,400.00			2.6	$3,640
Plant Bed Preparation	MSF	3,500.00			4.4	$15,411
Total Current Contract Cost						$56,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%				$3,675
Subtotal						$60,000
Contingencies		5.00%				$3,000
Subtotal						$63,000
SIOH		5.70%				$3,591
TOTALS						$67,000
NET SAVINGS						($67,000)

Construction Cost Estimate

Alternative No.: CR-32

COF

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
6" Caliper Trees	EA	960.00			33	$31,680
24"-30" Shrubs	EA	70.00			175	$12,250
Bedding Plants	MSF	1,400.00			3.9	$5,460
Plant Bed Preparation	MSF	3,500.00			6.3	$22,050
Total Current Contract Cost						$71,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%				$4,660
Subtotal						$76,000
Contingencies		5.00%				$3,800
Subtotal						$80,000
SIOH		5.70%				$4,560
TOTALS						$85,000
NET SAVINGS						($85,000)

Life Cycle Cost Analysis

Alternative No.: CR-32

LIFE CYCLE PERIOD 40 YEARS   ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
	$0	$222,000
Capital Cost Savings		($222,000)

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Energy Savings		19.7928		18,531	367,000			
Generalized (% of Capital Cost)								
		SUB-TOTAL	$367,000			$0		

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
		SUB-TOTAL	$0		$0	
		TOTAL PRESENT WORTH	$367,000		$0	

PRESENT WORTH SAVINGS ON O&M	$367,000
LIFE CYCLE COST SAVINGS	$145,000

BUILDING ARCHITECTURE

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
RC-13

Title:
Use flat roofs to facilitate solar; combined with pre-stressed concrete slabs

Description of Original Concept:

The Brigade HQ and Battalion HQ are currently designed as having pitched roofs with high R-Value insulated standing seam metal roof panels on metal roof trusses over the second floor space.

Second floor deck: Open web bar joists, metal deck w/ concrete

Roof: Factory formed Standing Seam Insulated Roof Panels

Description of Alternative Concept:

Provide pre-stressed concrete core slab decks for second floor deck and for flat roof deck

Flat roof construction:

Utilize pre-stressed concrete core slabs with tapered roof insulation, interior drains, overflow scuppers, and 80 mil reinforced PVC membrane roofing.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 90,000
O&M Savings:	$ 0
Life Cycle Cost Savings:	$ 90,000

Advantages/Disadvantages

Alternative No.: RC-13

Advantages of Alternative Concept

- Flat roof allows for greater flexibility of solar orientation for building relative to site.
- Flat roof facilitates optimal PV panel maintenance and installation.
- Flat roof reduces floor to floor building height due to thinness of core slab construction.
- Pre-stressed concrete core slab construction provides high sound transmission values
- Pre-stressed concrete core slabs construct more quickly than bar joist, metal deck, and concrete.

Disadvantages of Alternative Concept

- Current design FTC design guidelines discourage flat roof construction

Discussion

Alternative No.: RC-13

There are thousands of acres of water-tight, non-leaking, flat roof buildings located in a variety of climate zones across the United States. Big-box retail stores (Target, Wal-Mart, etc) utilize reinforced membranes on hundreds of their flat roof facilities. Additionally, there are thousands of manufacturing plants that do the same. The flat roof solution is the perfect ratio of real estate displacement. When a building with a flat roof occupies a site the roof becomes usable square footage for mechanical equipment. It is a nation-wide industry standard that the Army (FTC) should re-consider.

The flat roof solution would significantly reduce roof building costs and possibly shave several feet of wall material around the entire building perimeter.

Assumptions for Life Cycle Costing:

From Whitestone Facility Maintenance Manual, 2010-11

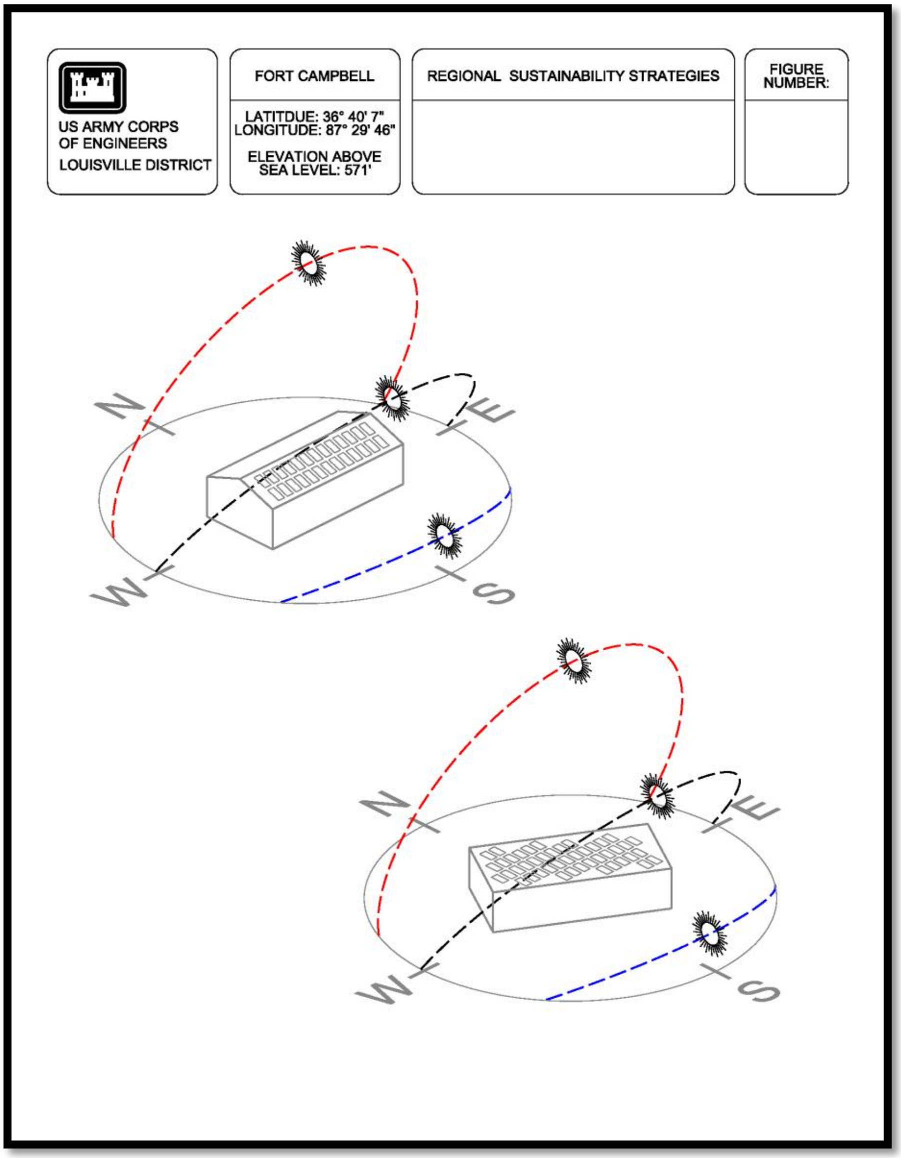
Standing Seam Metal Roof O&M = $0.35/sf/year

Built up Roofing O&M = $0.04/sf/year

Sketch

Alternative No.: RC-13

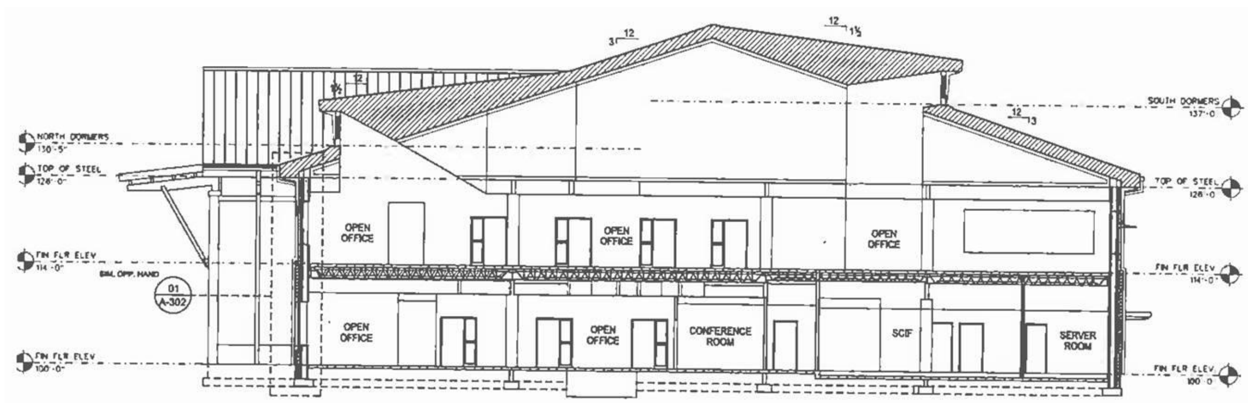
☐ Original ☑ Alternative



Sketch

Alternative No.: RC-13

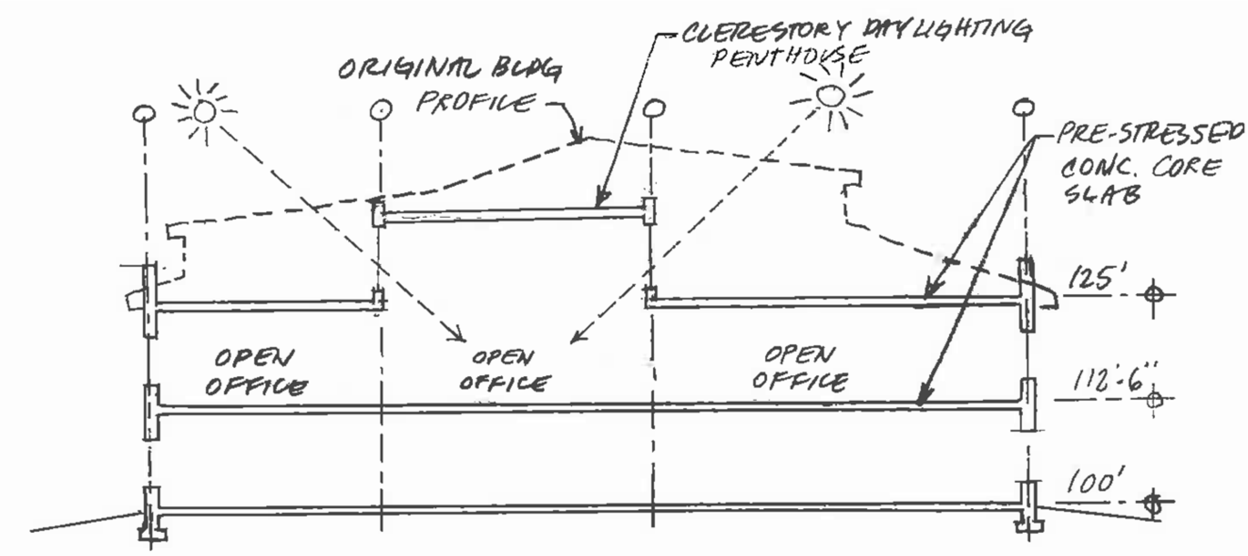
☑ Original ☐ Alternative

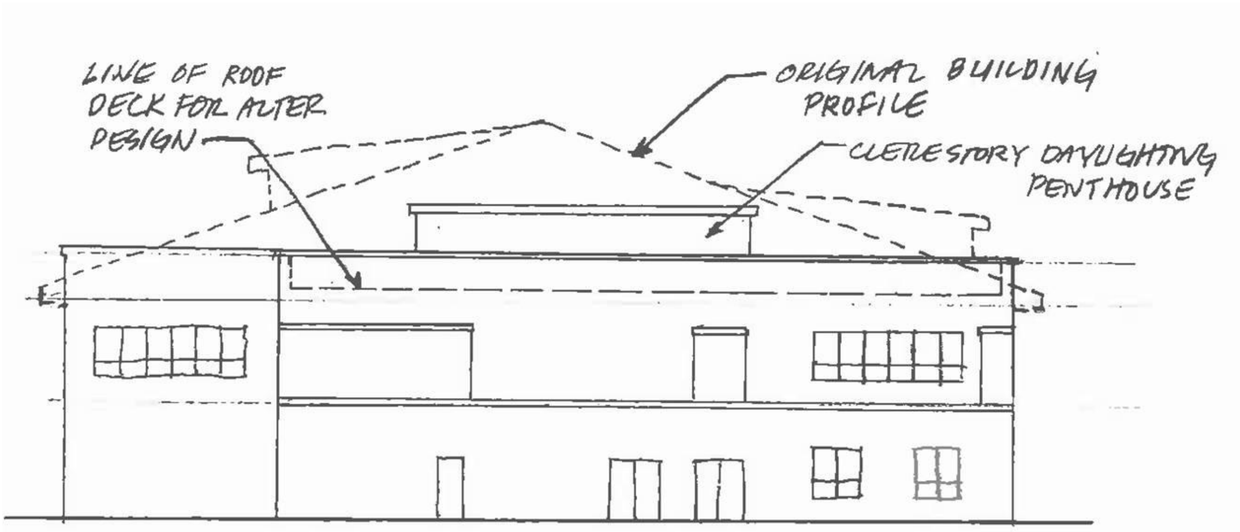


Sketch

Alternative No.: RC-13

☐ Original ☑ Alternative





Sketch

Alternative No.: RC-13

☐ Original ☑ Alternative

Solar Panels

Construction Cost Estimate

Alternative No.: RC-13

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Factory Formed Insulated Standing Seam Metal Roof Panels with high R Values	SF	17.00	15,204	$258,468		
Area covered w/ metal roof truss 4:12 pitch	SF	6.00	13,621	$81,726		
Pre-finished Gutter	FT	10.00	550	$5,500		
2nd Flr Deck (open bar joist, mtl deck, conc)	SF	10.00	13,621	$136,210		
80 mil. Reinforced PVC Membrane Roof						
(includes turned up on face of 42" parapet)	SF	5.50			15,371	$84,541
Tapered Roof Insulation on Flat Deck	SF	2.50			13,621	$34,053
Pre-finished conductor heads -No gutters	EA	120.00			12	$1,440
8" Pre-stressed Conc. Core Slab Roof Deck	SF	11.00			13,621	$149,831
8" Pre-stressed Conc. Core Slab 2nd Flr	SF	10.00			13,621	$136,210
Total Current Contract Cost				$482,000		$406,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$31,633		$26,645
Subtotal				$514,000		$433,000
Contingencies		5.00%		$25,700		$21,650
Subtotal				$540,000		$455,000
SIOH		5.70%		$30,780		$25,935
TOTALS				$571,000		$481,000
NET SAVINGS						$90,000

Life Cycle Cost Analysis

Alternative No.: RC-13

LIFE CYCLE PERIOD 40 YEARS

ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST			ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
					$571,000			$481,000
Capital Cost Savings								$90,000
ANNUAL EXPENDITURE	**%**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
SSMR O&M		19.7928		48,437	959,000		2,822	56,000
Generalized (% of Capital Cost)								
SUB-TOTAL					$959,000			$56,000

SINGLE EXPENDITURE (REPLACEMENT)	**YEAR**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**		**ALTERNATIVE CONCEPT**	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
SUB-TOTAL				$0		$0
TOTAL PRESENT WORTH				$959,000		$56,000
PRESENT WORTH SAVINGS ON O&M						$903,000
LIFE CYCLE COST SAVINGS						$993,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
RC-53

Title:
Use modular and construction systems for interior

Description of Original Concept:

The original concept appears to be to conventionally frame and finish all interior partitions onsite using standard stud and drywall, with paint finish. Additionally, plumbing, electrical and data systems reflect conventional hard-wire installation.

Description of Alternative Concept:

The alternative concept is to maximize the flexibility in the facility by installing a high end, modular systems. These systems include Modular Walls, Modular service capabilities (ie., Electric/Data), and low profile raised floors in data center areas.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 702,000
O&M Savings:	$ 0
Life Cycle Cost Savings:	$ 702,000

Advantages/Disadvantages

Alternative No.: RC-53

Advantages of Alternative Concept

Interior Walls:

- Quality Control increases due to factory based construction
- Considerable reduction in carbon emissions for overall sustainability ratings
- Considerable reduction in construction waste
- Reduction in partition and electric installation time
- Considerable increase in daylight usage within building which lowers heat and lighting loads, and energy demand.
- Easier maintenance, relocation of electric/data, reconfiguration, and addition/deletion of spaces as user mission adjustments are required.
- Ease of facility occupancy reconfiguration.
- High quality systems and aesthetics
- Less trades onsight
- Higher sustainability/LEED ratings
- True GREEN systems
- Any furniture system can be hung from this system.
- Structurally high end partition system
- Permanent construction verses old style office partitions that were considered furniture/occupant property.

Low Height Raised Floors:

- Provides more headroom within building, allowing for reduction in building height
- Easier/Quicker installation
- Higher durability/maintainability

Advantages/Disadvantages

Alternative No.: RC-53

Modular Electrical:

- Faster Installation
- Extremely flexible for reconfiguration, relocation, etc.
- Lower installation cost

Modular Data:

- Lower installation cost
- Quickly and efficiently distributes data and voice cable infrastructure.
- Zone distribution provides intrinsic value in the management and service of the communications cable infrastructure through the application of consolidation points.
- Moves, adds, and changes are more readily executed with an appreciable reduced cost.
- The modular aspect of this solution brings all of the repetitive and sensitive termination activities into a controlled, clean room factory environment.
- The benefits are the speed a cabling system can be installed, reduction or elimination of installation errors and material waste typically associated with legacy installations.
- This solution is fully 100% reusable and can be removed and reinstalled by competent personnel for the life of the building.

Disadvantages of Alternative Concept

Interior Walls:

- Perception of lower quality walls of the 1980’s-1990’s.
- Maintenance requires replacement of simple panel, verses local personnel simply “patch/paint”
- Reconfiguration requires manufacture representative verses local personnel “demo/rebuild” concept.
- First cost can be higher depending on manufacturers products
- Quality level of manufacturers varies per product even at the high end grade

Advantages/Disadvantages

Alternative No.: RC-53

Low Height Raised Floors:

- Space for runs tighter, which may not suit legacy electrical and data distribution methods.
- HVAC distribution (if in floors) will require smaller high efficiency type distribution.

Modular Electrical:

- Possible higher first cost depending on the manufacturer selected
- Requires that relocation or addition of service boxes be installed back to main module rather than simple “pig tail” and J-box at location.

Modular Data:

- Possible higher first cost depending on the manufacturer selected
- Requires that relocation or addition of service boxes be installed back to main module rather than simple “pig tail” and J-box at location.

Interior Walls:

Manufacturers now exist that produce high end, Innovative and sustainability/energy conservation responsive Panalized/Modular interior wall systems. Aesthetic possibilities are endless. These systems give the occupant/owner the flexibility to meet a variety of aesthetic and functional needs. Walls can be designed with a variety of surfaces and can be quickly dismantled and moved to wherever they are needed a number of times. All walls accommodate data management and can support a range of items, including lighting, furniture, and shelving. Allows for more cost effective use of daylighting than through tradition stick-built interior partitions. Expand, contract and reshape office elements as your needs grow and evolve.

Low Height Raised Floors:

This floor system provides a low-profile access floor suitable for power, data and building management technologies. It is designed to give you fast installation, inherent cable management, a quiet foot-fall and quick, easy access to make moves, adds and changes to your power infrastructure.

Modular Electrical:

No matter how flexible you make the walls and furniture in your space, you are only as agile as your electrical infrastructure. If you have to bring in electrical trades to cut and reroute your wiring every time you make a move, add or change, then you will lose the freedom you worked so hard to create. Modular plug & play power is a faster installation because the parts are engineered and manufactured in a factory – not in your space. Once installed, the system allows you to control your electrical needs without creating material waste or adding extra cost and time to the changes needed.

Modular Data:

Modular zoned cabling is a pre-engineered and manufactured cabling solution installed in a star topology. The zone cabling method utilizes consolidation points or zone boxes strategically located within the structure in a grid pattern spread across the building space.

Traditional Zoned Cabling: Like the previous, this cabling solution utilizes a grid or zoned distribution and management topology, applying consolidations points within each zone. The primary difference between these two methods is that this system is installed using legacy methods, terminating each cable in the field and installing raw, unbundled cable. The end result is similar with regards to the flexibility of the system, but adds considerable waste, time for initial installation, and usually entails the removal and full replacement of at least some of the cabling during the moves, adds, and change (operational maintenance) of the cable infrastructure.

Legacy Cabling Methods: This installation method has been most common in construction of new voice and data cabling infrastructure to date. Commonly referred to as “home run” cabling,

Discussion

Alternative No.: RC-53

each individual cable is installed from a telecommunications closet to each faceplate or work area and terminated in the field. This system will not provide any surge capacity as it is fixed in place and offers no flexibility in the movement or repurposing of the cable system.

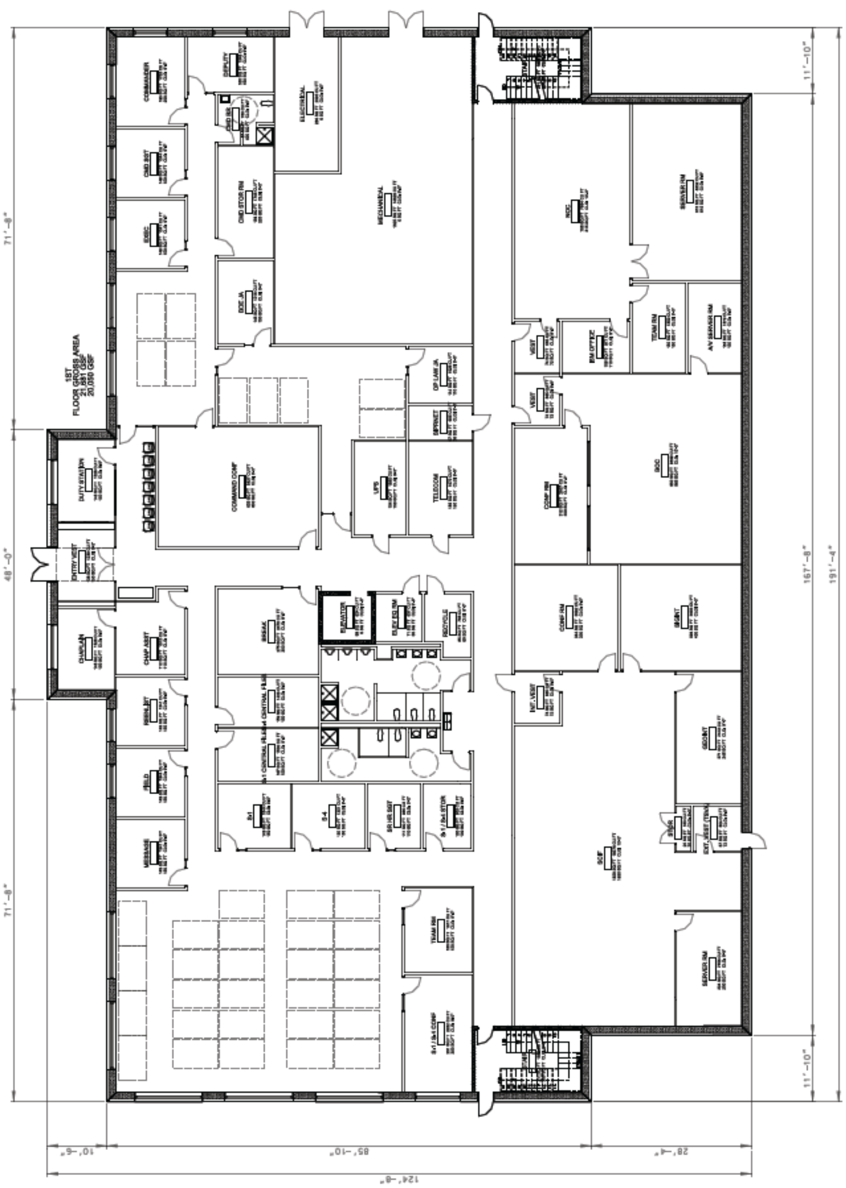
This cabling method is incredibly wasteful during initial construction and continues with increased waste as each time a faceplate or outlet location needs to be moved, the existing cable is removed, thrown away, and a new cable installed to the new required location. It is possible that initial costs of construction may be less expensive, but these potential savings are erased within the first year of ownership though higher expenditures in labor and material to manage the cable infrastructure.

Sketch

Alternative No.: RC-53

☑ Original ☐ Alternative

BRIGADE HQ BUILDING:

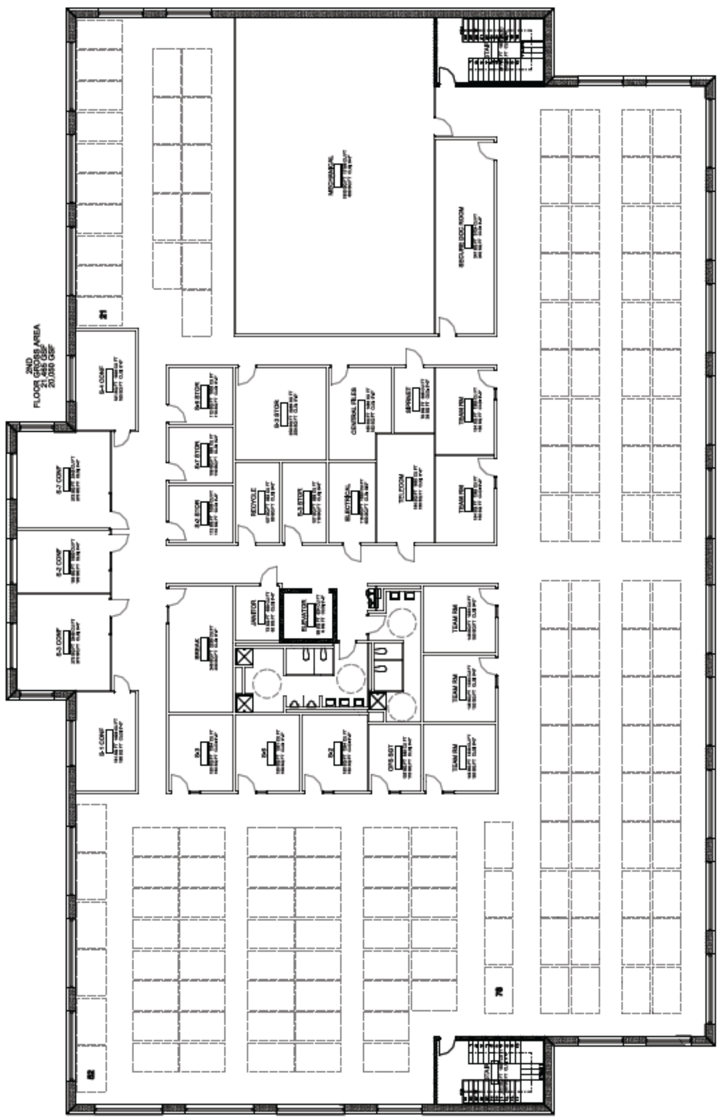


Sketch

Alternative No.: RC-53

☑ Original ☐ Alternative

BRIGADE HQ BUILDING:

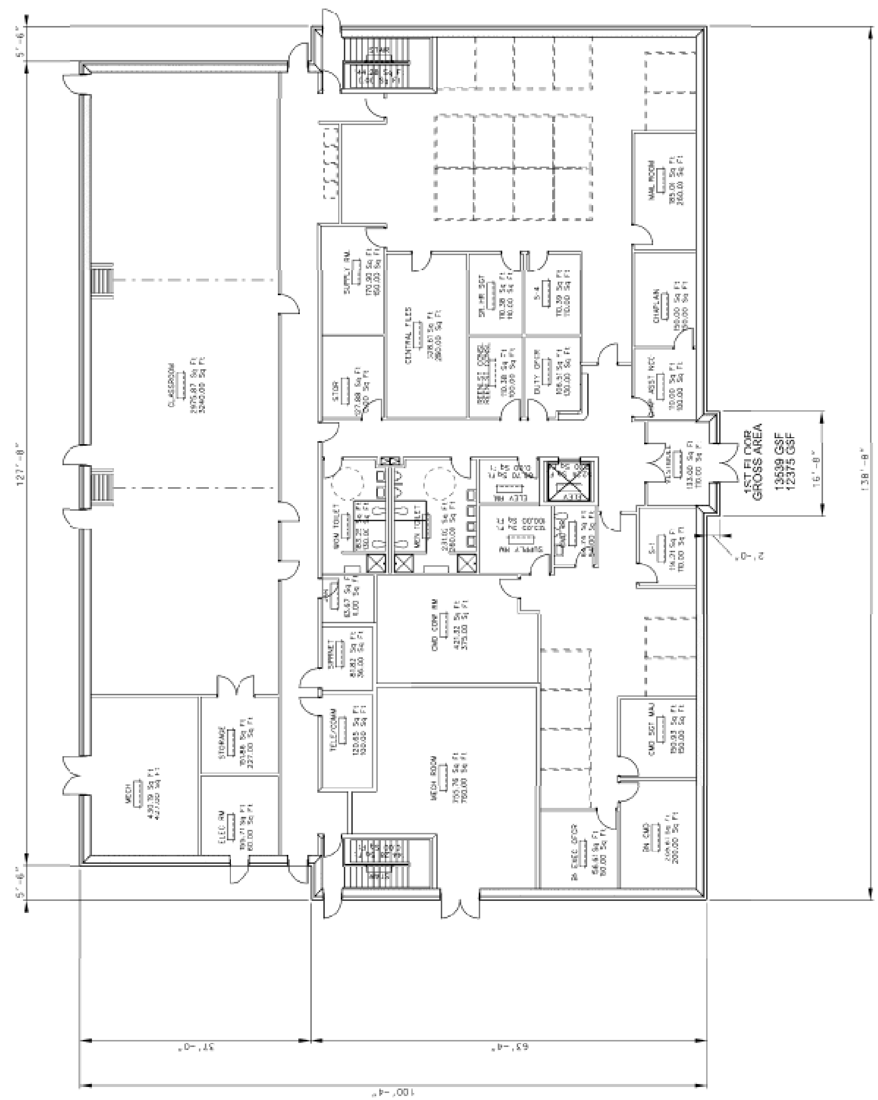


Sketch

Alternative No.: RC-53

☑ Original ☐ Alternative

BATTALION HQ BUILDING:

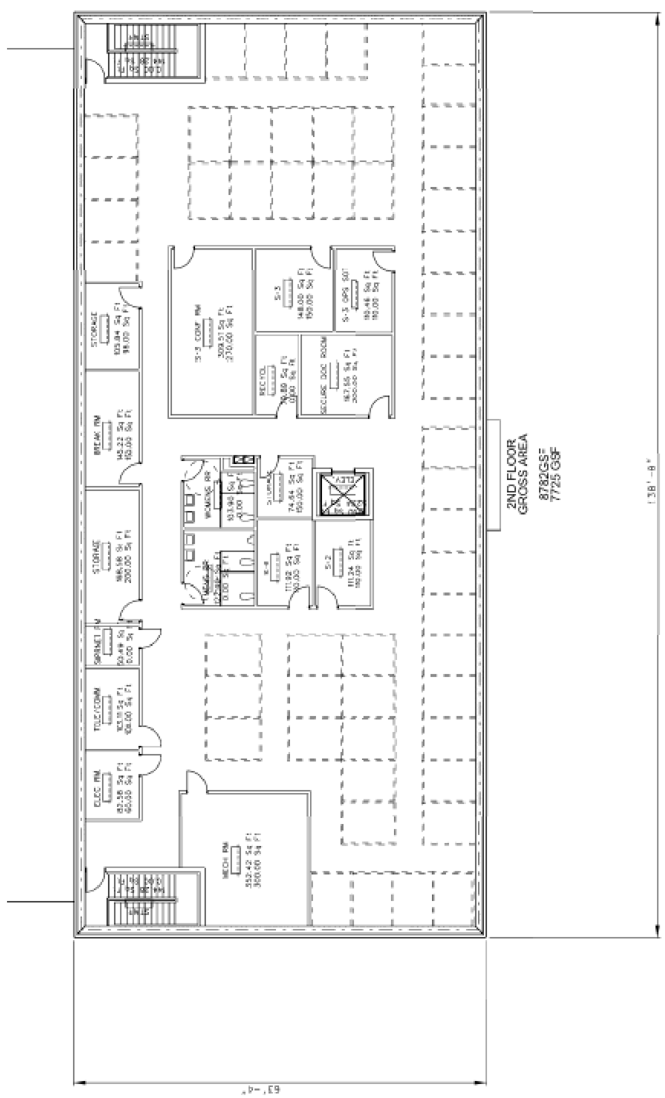


Sketch

Alternative No.: RC-53

☑ Original ☑ Alternative

BATTALION HQ BUILDING:

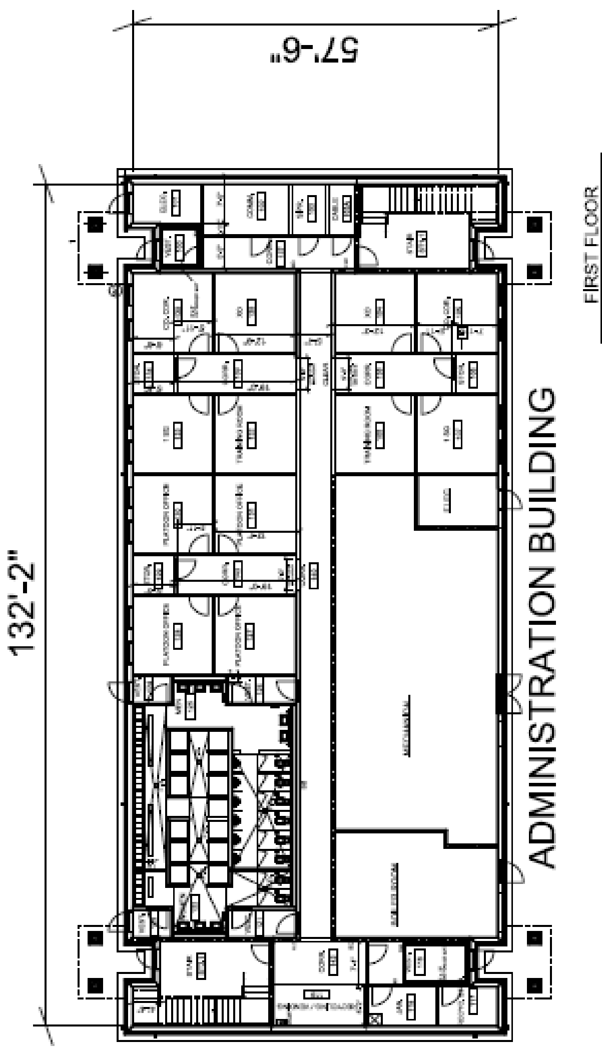


Sketch

Alternative No.: RC-53

☑ Original ☐ Alternative

COMPANY OPERATIONS FACILITY (ADMIN) (X2):

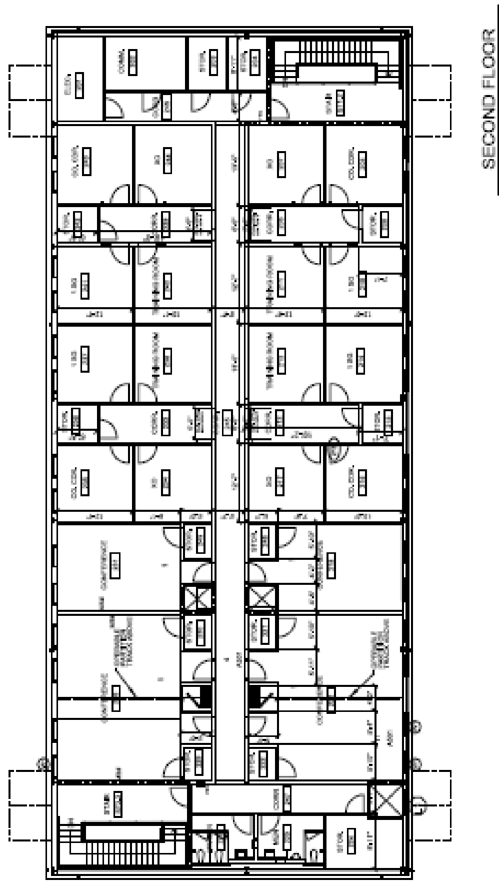


Sketch

Alternative No.: RC-53

☑ Original ☐ Alternative

COMPANY OPERATIONS FACILITY (ADMIN) (X2):



Sketch

Alternative No.: RC-53

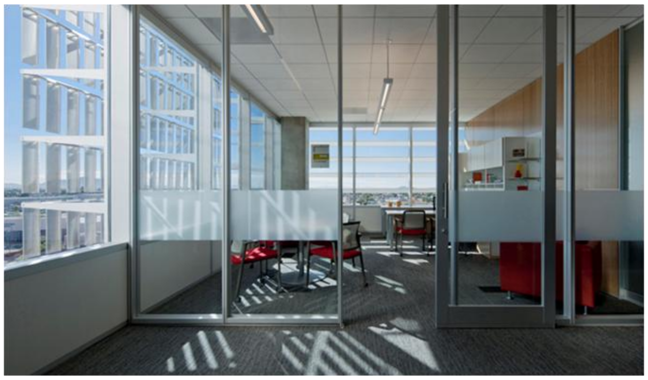
☐ Original ☑ Alternative

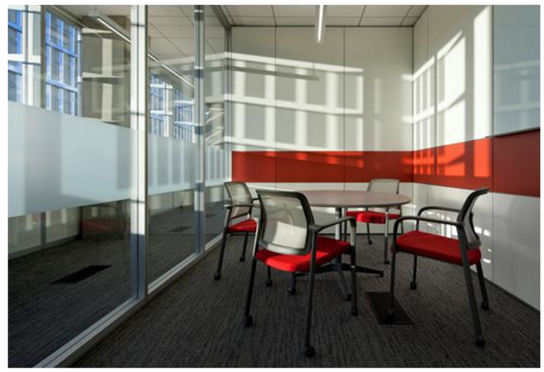
Prewired Modular Panel

Sketch

Alternative No.: RC-53

☐ Original ☑ Alternative

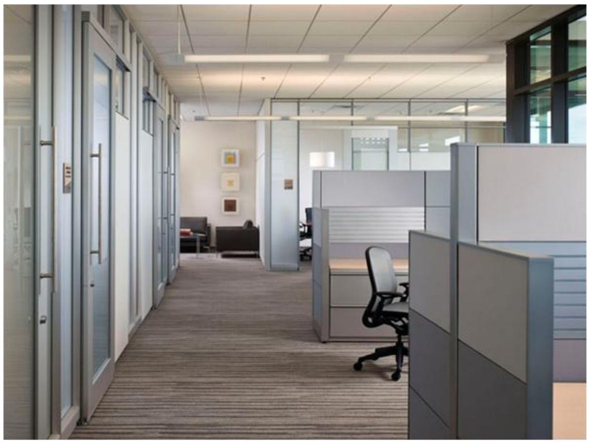




Sketch

Alternative No.: RC-53

☐ Original ☑ Alternative



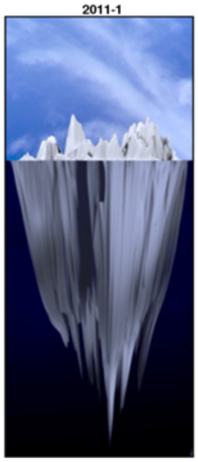
Sketch

Alternative No.: RC-53

☐ Original ☑ Alternative

DIRTT ICEberg®

ICEberg 2011-1



Select State/Province/City: KY - Ownsboro

An ICEberg®. What you see is only a small portion of all there is to see.

The same is true when building out your office interior.
An upfront cost comparison of options is only the tip of the ICEberg.

COSTS		Cost		Cost/SF.	
		DIRTT	Conventional	DIRTT	Conventional
Details	Interior Space	$617,873	$683,342	$34.33	$37.96
	Total Installed Cost	$617,873	$683,342	$34.33	$37.96

Cost Premium or (Savings)	($65,469)	-9.58%

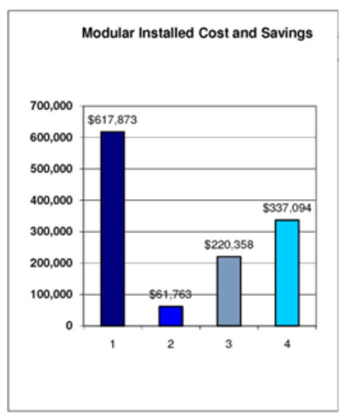
Reconfigurations, construction schedule, overhead, energy savings, tax recovery, can all save you time and money during install and in the years to come.

Let's go deeper to see what ICEberg really looks like.

ICEberg demonstrates possible cash benefits of Sustainable Modular Interiors versus Conventionally Constructed Interiors.

Cost Premium or (Savings)	($65,469)	-9.58%

SAVINGS		Cash savings/recovery by going movable			
		After 1 year	After 3 years	After 5 years	Settings
Details	Churn	$ 10,742	$ 33,265	$ 57,513	24%
Details	Reconfigurations	$ 24,441	$ 75,852	$ 131,460	5%
Details	Tax Benefits	$ 26,580	$ 111,241	$ 148,121	40%
Details	Construction Schedule	-	-	-	-
Details	Contractor Overhead	$ -	$ -	$ -	10%
	Cumulative Cash Savings	$61,763	$220,358	$337,094	
	Per Square Foot Savings	$ 3.43	$ 12.24	$ 18.73	
	% of Total Project Cost Recovered	10.00%	35.66%	54.56%	
	Other Savings*	$231,782	$36,736	$956,468	



*There are many other benefits to a modular interior. We have seperated these items into their own section since their calculation requires some assumptions to be made. Check out this section for information on, Renovation Soft Costs, Cost of Wasted Space, What Happens When You Move, etc.

DIRTT

Sketch

Alternative No.: RC-53

☐ Original ☑ Alternative

Interior Space Installed Cost — Back to: [Top]

		Installed Cost		Cost/Unit		%	Settings
		DIRTT	Conventional	DIRTT	Conventional	% Difference	Factor 106.09%
Details	Interior solid walls	$ 271,917	$ 110,635	$224.41 / LF.	$91.31 / LF	146%	Year 2011
Details	Interior glazing	$ 57,033	$ 150,378	$130.93 / LF.	$345.21 / LF	-62%	Month Jun-11
Details	Perimeter walls	$ -	$ -	$0.00 / LF.	$0.00 / LF	-	Contract $ Less than 1M
Details	Doors w trim/hardware	$ 62,669	$ 176,856	$1,253.37 / EA.	$3,537.12 / EA	-65%	Seismic No
Details	Refreshment centers	$ -	$ -	$0.00 / LF.	$0.00 / LF	-	GSA Yes
Details	Electrical in walls	$ 11,415	$ 16,564	$0.63 / SF.	$0.92 / SF	-31%	Level 3
Details	Raised access floor	$ -	$ -	$0.00 / SF.	$0.00 / SF	-	
Details	Floor covering	$ 75,315	$ 94,144	$37.66/ SYD.	$47.07 /SYD	-20%	Type Rolled
Details	Ceilings	$ 36,864	$ 36,864	$2.05 /SF.	$2.05 /SF	0%	
Details	Acoustics	$ 17,685	$ 17,685	$0.98 / SF.	$0.98 / SF	0%	Not Specified
	Freight	$ 28,320	$ -	$1.57 / SF.	$0.00 / SF	100%	% Total Cost 5.31%
	Contingencies	$ 3,365	$ 18,094	$0.00 / SF.	$0.00 / SF	-81%	Rate of Ctgcs 3.00%
Details	Conditions & Fees	$ 53,290	$ 62,122	$2.96 / SF.	$3.45 / SF	-14%	Rate of C&F 10.00%
	Total	$617,873	$683,342	$34.33 / SF.	$37.96 / SF	-9.58%	

Sketch

Alternative No.: RC-53

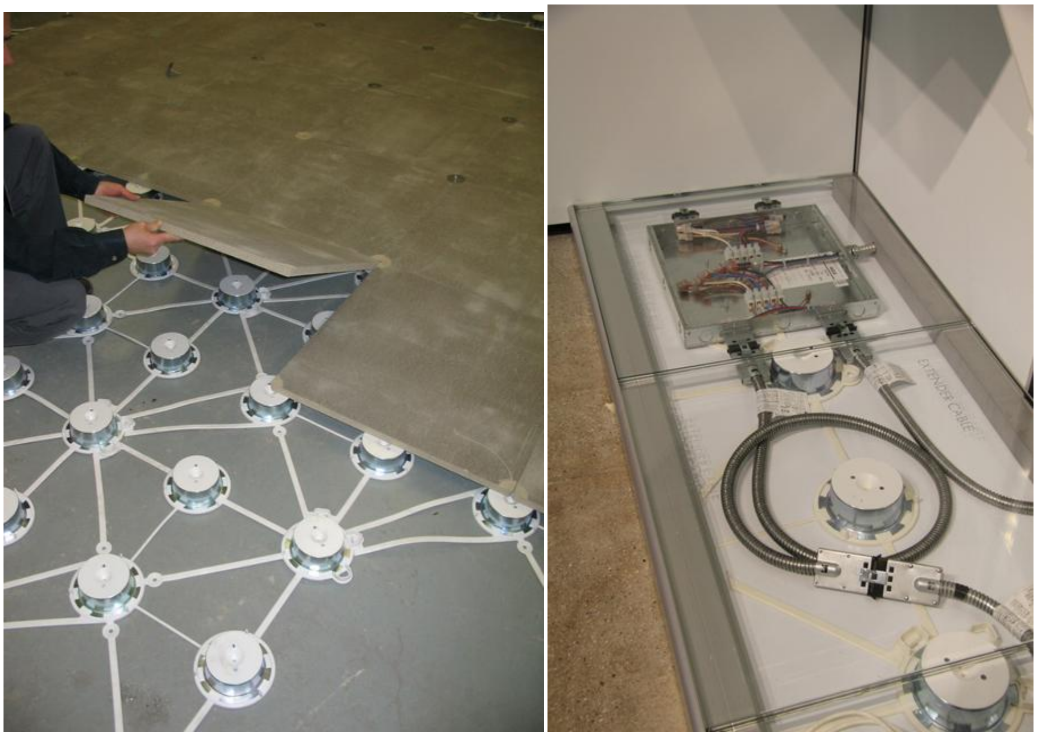
☐ Original ☑ Alternative

Low height access flooring with underfloor cabling

Sketch

Alternative No.: RC-53

☐ Original ☑ Alternative



Underfloor Cabling Systems

Calculations

Alternative No.: RC-53

☐ Original ☑ Alternative

Costing assumptions:

All costs were provided from DIRTT and their venders. Since there was no detailed building cost data with the 35% design, the conventional systems costs from DIRTT were also used for the original concept cost. Backup for the DIRTT systems and related quotes are included in the Appendix to this report.

Interior Construction

According to DIRTT, the conventional interior office type construction will average $37.96 per square foot of building area. Since this recommendation addresses the electrical system separately, that cost $0.92/sf) was deducted from the unit cost resulting in a unit cost for the conventional interior construction of $37.04

The same rationale was used to adjust the unit cost for the modular interior construction system.

Electrical System

For the modular electrical system, costs were calculated based on the Brigade Headquarters building.

Conventional system: $483,692

Modular system: $375,320

The costs for the Battalion Headquarters were prorated to 50% of the cost of the Brigade Headquarters.

Conventional system: $241,846 (each)

Modular system: $187,660 (each)

The costs for the COF Admin were prorated to 80% of the cost for the Battalion Headquarters.

Conventional system: $193,477

Modular system: $150,128

Total Cost

Conventional system: $1,160,861

Modular system: $900,768

Construction Cost Estimate

Alternative No.: RC-53

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Interior walls with drywall and glazing	SF	37.04	100,000	$3,704,000		
Conventional electrical distribution system	LS		1	$1,160,861		
Conventional raised floor system						
Modular wall system	SF	33.70			100,000	$3,370,000
Modular electrical system	LS				1	$900,768
Total Current Contract Cost				$4,865,000		$4,271,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$319,283		$280,300
Subtotal				$5,184,000		$4,551,000
Contingencies		5.00%		$259,200		$227,550
Subtotal				$5,443,000		$4,779,000
SIOH		5.70%		$310,251		$272,403
TOTALS				$5,753,000		$5,051,000
NET SAVINGS						$702,000

THIS PAGE INTENTIONALLY LEFT BLANK.

MECHANICAL

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
RC-51

Title:
Optimize Face Velocity on Air Handlers

Description of Original Concept:

The original concept is to size air handlers with a face velocity of 500 fpm.

Description of Alternative Concept:

The alternative concept is to reduce face velocity in air handlers in order to reduce static pressure drop on filters and cooling and heating coils.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 27,000
O&M Savings:	$ 25,000
Life Cycle Cost Savings:	$ 52,000

Advantages/Disadvantages

Alternative No.: RC-51

Advantages of Alternative Concept

- Reduces the size of the air handler fans and motors and results in smaller electrical requirements

Disadvantages of Alternative Concept

- Increases size of the physical air handler in the Mechanical Room

Discussion

Alternative No.: RC-51

Conventional rule-of-thumb in the HVAC industry has been to size air handlers for 500-fpm face velocity. This velocity is the maximum recommended velocity to prevent moisture carryover from the condensate on the cooling coil.

Increasing coil and filter face area can reduce air pressure drop and save fan energy. This analysis evaluates the COF, Brigade HQ and Battalion HQ air handling systems. It is assumed that these facilities operate 12 hours per day, 5 days per week.

A face velocity of 350-fpm would require roughly 50% of the air handler internal pressure drop when compared to an air handler sized at 500-fpm.

This alternative would impact the following air handlers:

COFs	AHU-01 (10,940-cfm)
Battalion HQ	AHU-1 (7,620-cfm)
	AHU-2 (7,455-cfm)
Brigade HQ	AHU-1 (16,000-dfm)
	AHU-2 (5,000-cfm)

Calculations

Alternative No.: RC-51

☐ Original ☑ Alternative

The energy savings calculations have been calculated using Trace 700. Savings were based on evaluating the impact of reducing air handler face velocity to 350-fpm. Savings calculations were performed for Brigade HQ, Battalion HQs, and COFs.

This resulted in annual energy cost savings of $1,245 over the original base case.

Construction Cost Estimate

Alternative No.: RC-51

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
COFs						
AHU-01 – change in CFM = 10,940	CFM	0.30	10,940	$3,282		
Battalion HQ						
AHU-1 – change in CFM = 7,620	CFM	0.40	7,620	$3,048		
AHU-2 – change in CFM = 7,455	CFM	0.40	7,455	$2,982		
AHU-1 – change in CFM = 7,620	CFM	0.40	7,620	$3,048		
AHU-2 – change in CFM = 7,455	CFM	0.40	7,455	$2,982		
Brigade HQ						
AHU-1 – change in CFM = 16,000	CFM	0.25	16,000	$4,000		
AHU-2 – change in CFM = 5,000	CFM	0.50	5,000	$2,500		
Total Current Contract Cost				$22,000		
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$1,444		
Subtotal				$23,000		
Contingencies		5.00%		$1,150		
Subtotal				$26,000		
SIOH		5.70%		$1,482		
TOTALS				$27,000		
NET SAVINGS						$27,000

Life Cycle Cost Analysis

Alternative No.: RC-51

LIFE CYCLE PERIOD 40 YEARS ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST			ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
			$27,000	$0
Capital Cost Savings				$27,000

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Energy		19.7928		1,245	25,000			
Generalized (% of Capital Cost)								
SUB-TOTAL					$25,000			$0

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
SUB-TOTAL				$0		$0
TOTAL PRESENT WORTH				$25,000		$0

PRESENT WORTH SAVINGS ON O&M	$25,000
LIFE CYCLE COST SAVINGS	$52,000

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No: RC-56

Title:
Provide bypasses for ERV's when free cooling

Description of Original Concept:

The original concept employs Energy Recovery Ventilator (ERV) to units to allow the use of waste energy from exhaust air to be used to reduce the amount of energy to temper incoming outside air.

Description of Alternative Concept:

The alternative concept provides a bypass around the ERV so that when the outdoor temperature is suitable, incoming outside air will bypass the ERV, thereby reducing external static pressure on the air handler and the resulting power consumption.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☑ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	($ 10,000)
O&M Savings:	$ 122,000
Life Cycle Cost Savings:	$ 112,000

Advantages/Disadvantages

Alternative No.: RC-56

Advantages of Alternative Concept

- Reduces fan energy
- Low initial cost since the ERV's are already called for in the design

Disadvantages of Alternative Concept

- No apparent disadvantages

Discussion

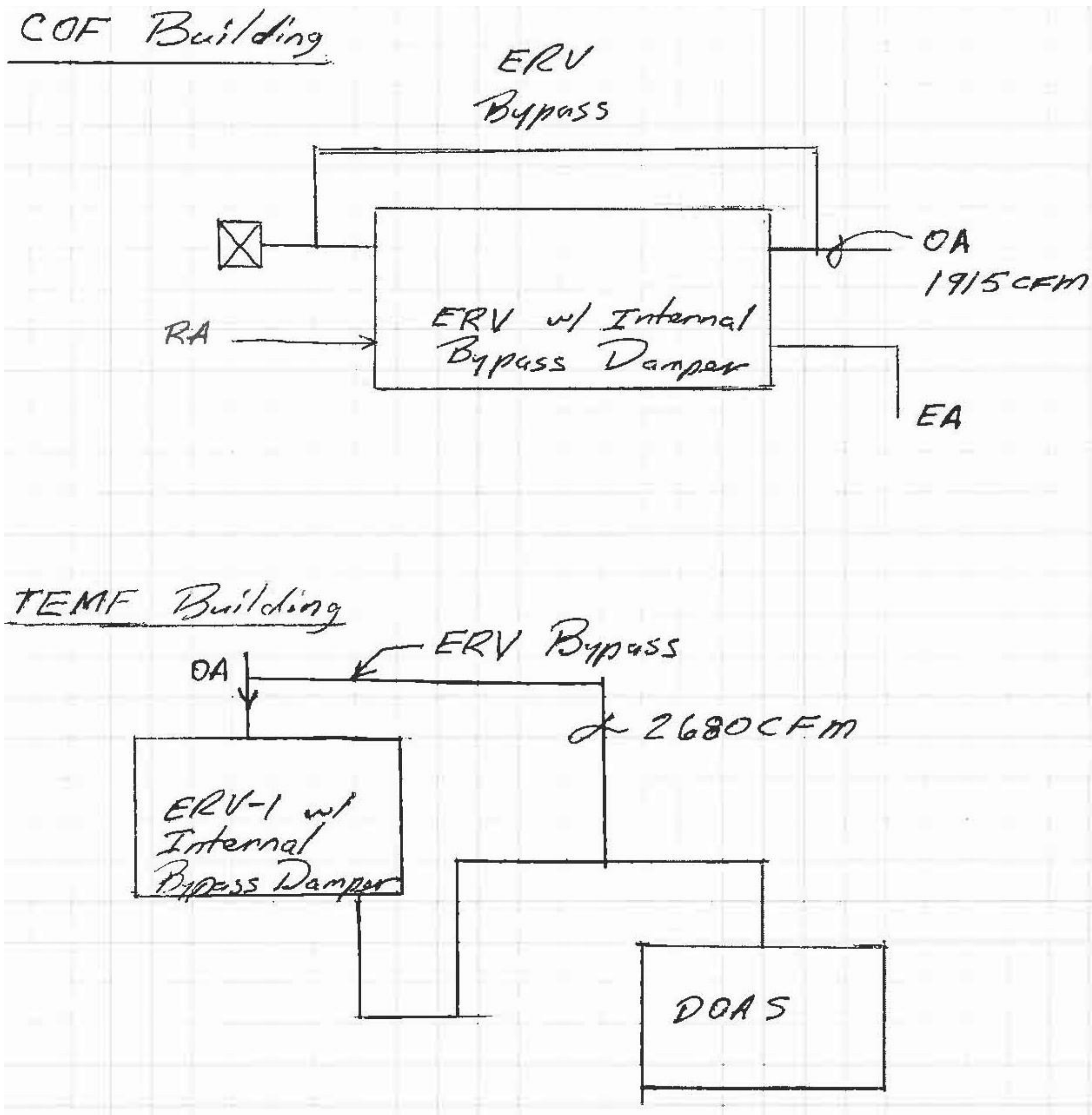
Alternative No.: RC-56

The buildings currently utilize an ERV unit in conjunction with air handlers for the admin areas. This proposal adds a bypass around the ERV when the outdoor temperature so warrants. This proposal applies to the COF admin building, the TEMF, and the battalion HQs. The Brigade headquarters building appears to already satisfy the intent of this proposal.

Sketch

Alternative No.: RC-56

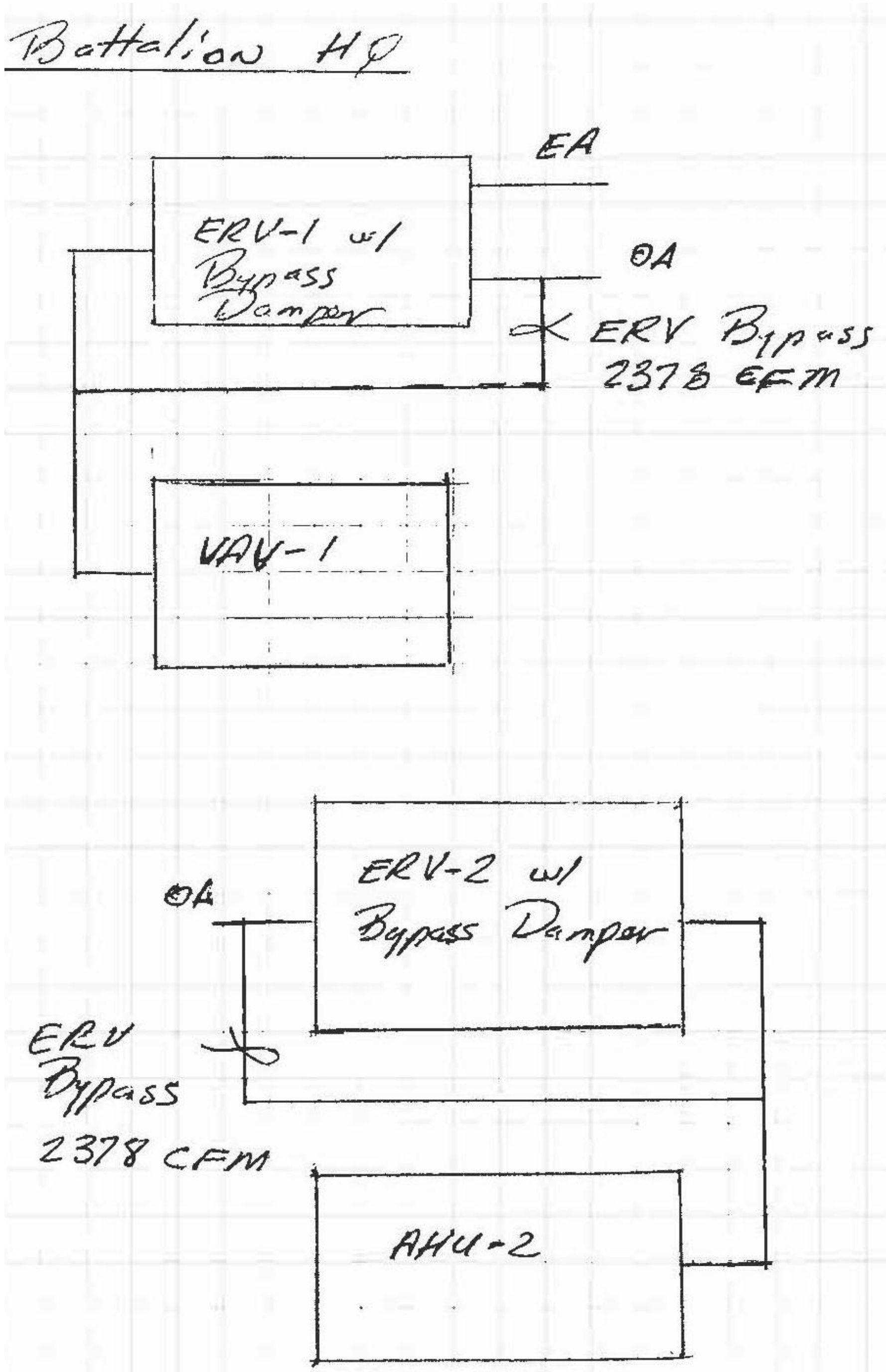
☐ Original ☑ Alternative



Sketch

Alternative No.: RC-56

☐ Original ☑ Alternative



Calculations

Alternative No.: RC-56

☐ Original ☑ Alternative

The size of the units remains the same. The air flow required to be handled by the proposed bypass ducts were taken from the equipment schedules and are as follows:

COF building, 1,915 cfm

TEMF building, 2,680 cfm

Battalion HQ, ERV-1 and ERV-2, 2,378 cfm

Proposed duct sizes based on these flow rates: COF, 15”X15”

All others, 18”x18”

Construction Cost Estimate

Alternative No.: RC-56

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
15" x 15" Duct	FT	50.00			10	$500
15" x 15" Duct Elbow	EA	350.00			2	$700
18" x 18" Duct	FT	77.00			30	$2,310
18" x 18" Elbow	EA	470.00			6	$2,820
Bypass damper for ERV	EA	360.00			4	$1,440
Total Current Contract Cost						$8,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%				$525
Subtotal						$9,000
Contingencies		5.00%				$450
Subtotal						$9,000
SIOH		5.70%				$513
TOTALS						$10,000
NET SAVINGS						($10,000)

Life Cycle Cost Analysis

Alternative No.: RC-56

LIFE CYCLE PERIOD 40 YEARS   ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST			ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			$0			$10,000		
Capital Cost Savings						($10,000)		
ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Energy		19.7928		6,164	122,000			
Generalized (% of Capital Cost)								
SUB-TOTAL			$122,000			$0		

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
SUB-TOTAL			$0		$0	
TOTAL PRESENT WORTH			$122,000		$0	
PRESENT WORTH SAVINGS ON O&M					$122,000	
LIFE CYCLE COST SAVINGS					$112,000	

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No: RC-89

Title:
Use Hot/Cold Aisles in Server Rooms

Description of Original Concept:

The original concept is to utilize direct-expansion (DX) Computer Room Air-Conditioning (CRAC) units with N+1 redundancy in the Sever rooms of the Brigade HQ Building.

Description of Alternative Concept:

The alternative concept is to arrange the server racks to share hot aisles and cold aisles. Servers have internal fans that pull cold air from the front of the rack to the back of the rack. Air on the back of the rack can be 20-30°F hotter than the inlet air. Most computer servers today can be supplied with 80°F air. In this arrangement, cold air would be supplied to the cold aisles and return/exhaust air would be removed from the hot aisles. To be conservative, this alternative proposes using 60°F supply air for the servers. The alternative also provides an option for an enthalpy economizer to gain additional energy savings.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 0
O&M Savings:	$ 61,000
Life Cycle Cost Savings:	$ 61,000

Advantages/Disadvantages

Alternative No.: RC-89

Advantages of Alternative Concept

- Less annual air conditioning required
- This arrangement can be used with either under floor or overhead air distribution
- This arrangement also allows the use of dedicated outside air at times when the outside air temperature is less than the higher return air temperature

Disadvantages of Alternative Concept

- Room would need to be arranged for hot and cold aisles. Hot aisles will be operated at approximately 80°F

Discussion

Alternative No.: RC-89

Using alternating hot and cold aisles promotes separation of the cool supply and warm return streams, which generally leads to greater energy efficiency. ASHRAE recently expanded the environmental envelope pertaining to air entering IT equipment and allows the inlet air temperature on the IT equipment to go as high as 80°F. The following chart shows the expanded environmental envelope.

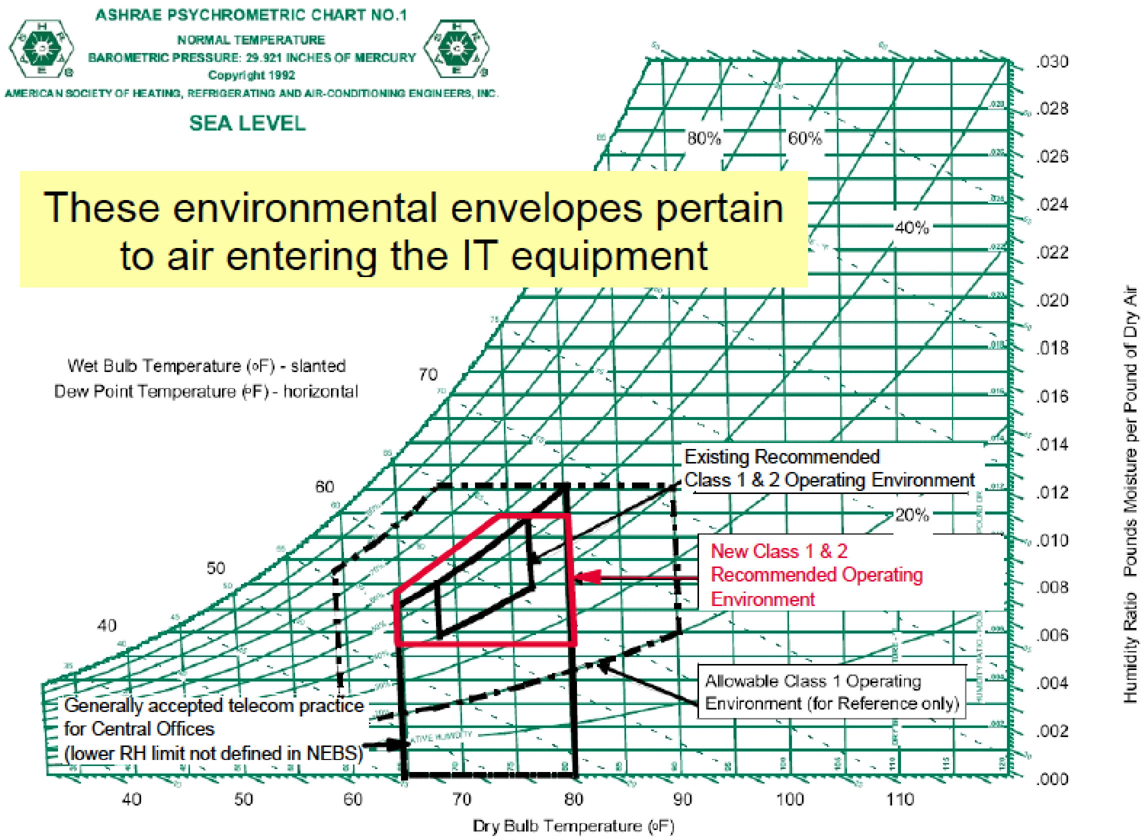
This arrangement would allow DX-based air conditioning units to operate with higher suction temperatures, resulting in lower energy usage. This arrangement could be coupled with connection to the building dedicated outside air system to allow free-cooling of the server rooms when the outside air temperature is below 58°F.

Server equipment today is built to withstand static electricity through grounding of the outer cabinet. Equipment is also rated to operate in 5-95% RH, non-condensing environmental conditions.

Sketch

Alternative No.: RC-89

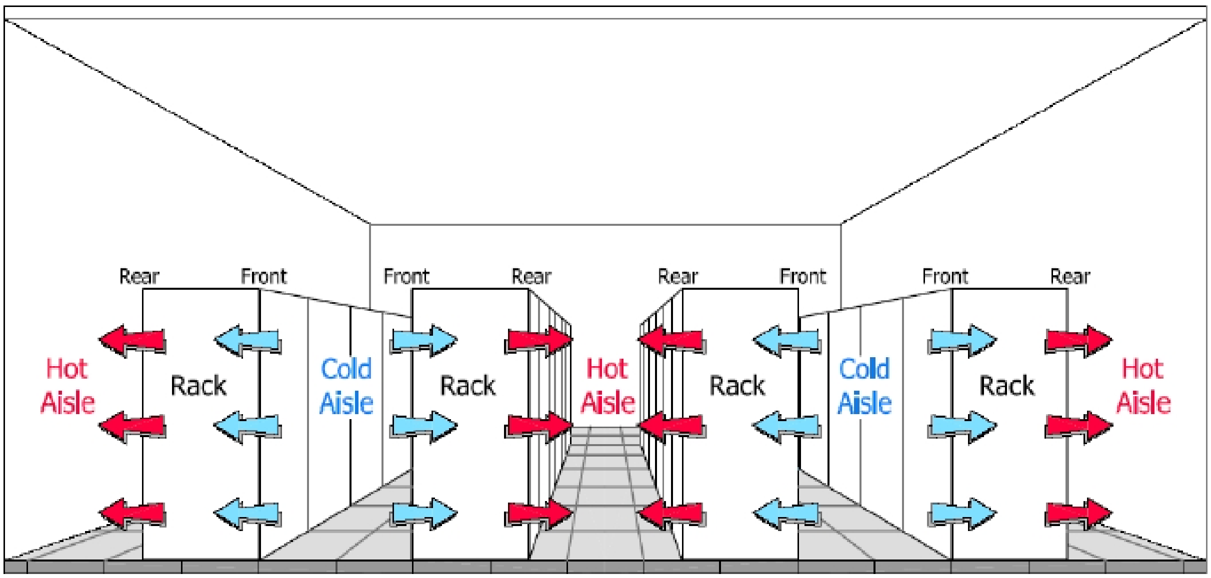
☑ Original ☐ Alternative



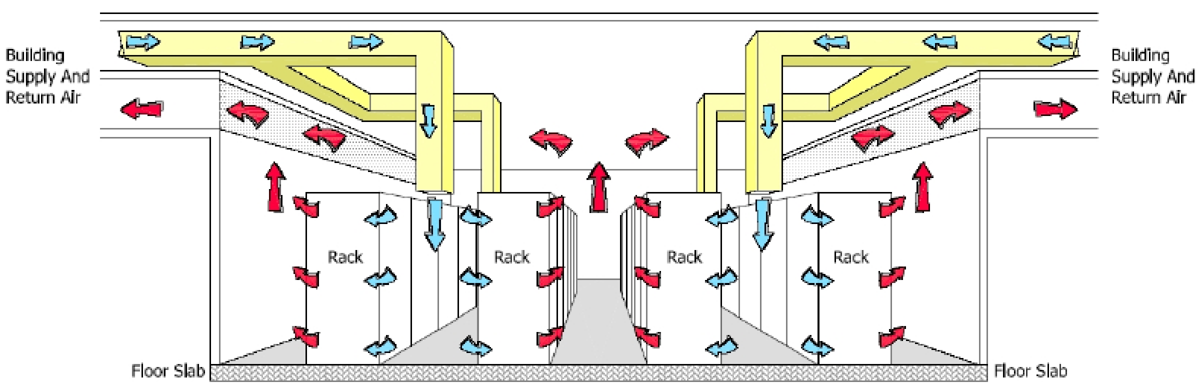
Sketch

Alternative No.: RC-89

☐ Original ☑ Alternative



Hot-Aisle/Cold-Aisle Under Floor Configuration



Hot-Aisle/Cold-Aisle Overhead Configuration

Calculations

Alternative No.: RC-89

☐ Original ☑ Alternative

The original base case assumed the CRAC units would supply 52°F air to the Server rooms. The internal loads in the Server rooms were assumed to be 0.9 W/ft^2 for lighting and 122,000 Btu/h for the server equipment in the Brigade HQ building. The rooms were modeled using Visual DOE v4.1.2.

Alternative 1 simply changed the supply air temperature to 60°F using the hot-aisle/cold-aisle server rack configuration. This resulted in annual energy cost savings of $1,100 over the original base case.

Alternative 2 evaluated potential additional savings from providing enthalpy based economizer cycles on the DX air conditioning equipment serving the Server rooms. This resulted in annual energy cost savings of $1,997 over the original base case.

Life Cycle Cost Analysis

Alternative No.: RC-89

LIFE CYCLE PERIOD 40 YEARS ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
Capital Cost Savings		$0

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Energy		19.7928		3,097	61,000			
Generalized (% of Capital Cost)								
		SUB-TOTAL			$61,000			$0

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
		SUB-TOTAL		$0		$0
		TOTAL PRESENT WORTH		$61,000		$0

PRESENT WORTH SAVINGS ON O&M	$61,000
LIFE CYCLE COST SAVINGS	$61,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
RC-109

Title:
Provide a central plant

Description of Original Concept:

The original concept is each building has it own water-cooled chiller plant. Currently, the Brigade HQ has 60-ton and 20-ton chillers. Each Battalion HQ Building has a 50-ton chiller.

Description of Alternative Concept:

The alternative concept is to provide a central chilled water plant with N+1 redundancy in either the Battalion or Brigade Building and pipe chilled water to the other two buildings.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	($ 77,000)
O&M Savings:	$ 476,000
Life Cycle Cost Savings:	$ 399,000

Advantages/Disadvantages

Alternative No.: RC-109

Advantages of Alternative Concept

- Provides for load diversity in that the central chiller plant does not need to be sized at the sum of the peak loads since all cooling loads do not occur simultaneously.
- Less maintenance in a single plant than with three separate plants
- Equipment redundancy can be provided at the central plant (The Battalion HQ buildings currently have no redundancy with one chiller in each building)

Disadvantages of Alternative Concept

- Underground piping will be required to connect the three buildings

Discussion

Alternative No.: RC-109

This alternative proposes to provide a central chiller plant for the Brigade and Battalion HQ Complex. Three high-efficiency, variable speed, high-efficiency chillers would be provided. Two chillers should be able to meet the block load of the three combined buildings with one redundant chiller. The chillers would be water-cooled with cooling towers to improve operating efficiency.

Currently, the Battalion HQ buildings have a 50-ton chiller in each building. The Brigade HQ building has a 60-ton and 20-ton chiller. The Brigade HQ also has four rooms served by DX-based computer room air-conditioning (CRAC) units totaling 17.5 tons. These CRAC units could also be converted to chilled water since a central plant could be configured with N+1 redundancy. The drawback with the current design is that there are three separate and individual chiller plants to maintain. The individual chiller plants do not allow optimum loading on the individual chillers to optimize kW/ton based on the varying cooling load through out the year.

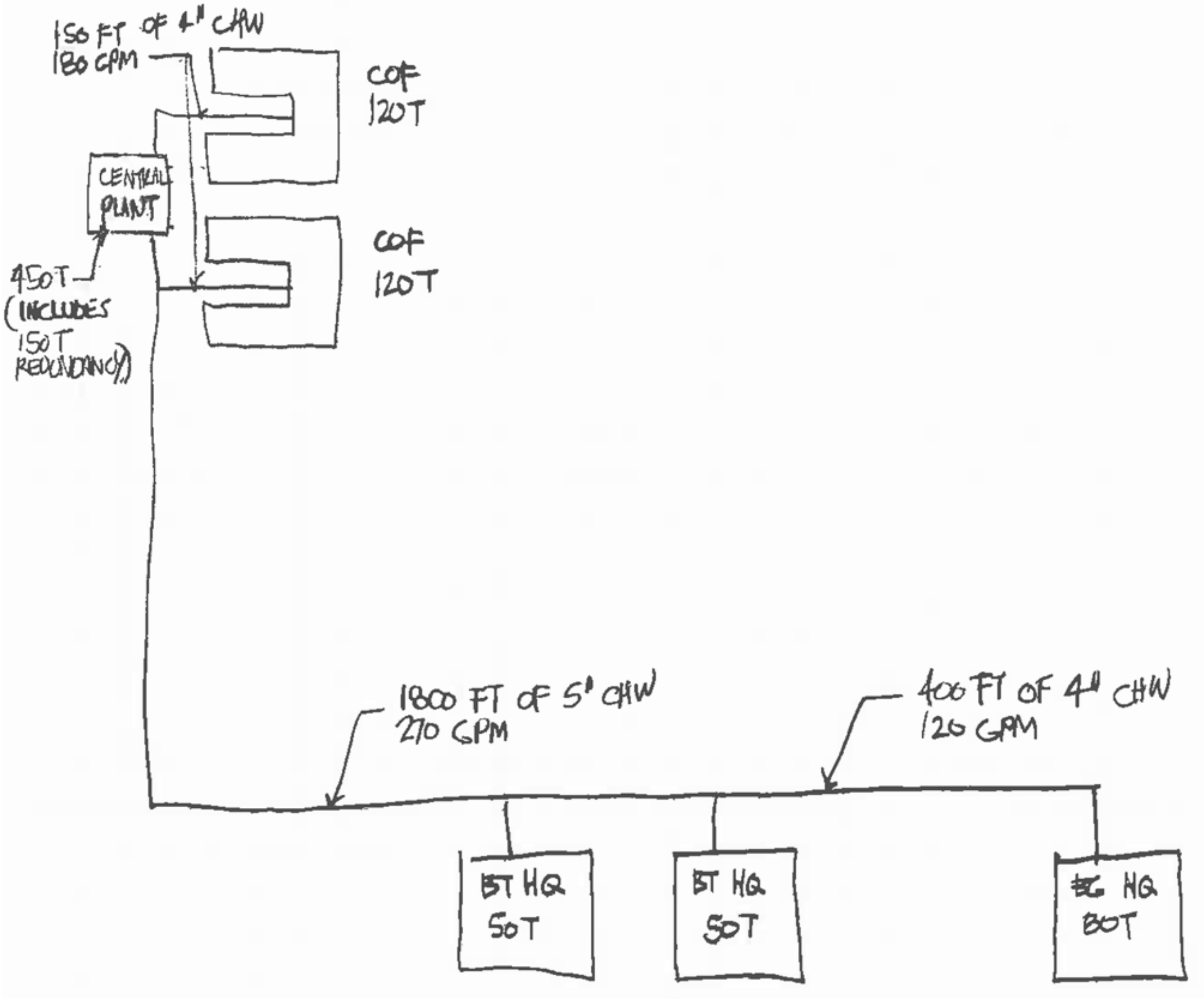
The central plant chilled water ΔT could be increased to 16°F (42/58) to reduce pumping horsepower and decrease piping size between buildings. The central plant could be programmed to use the additional cooling tower capacity at part load to reduce the chiller lift and take advantage of the variable speed compressors to achieve <0.4 kW/ton. The central plant could also include a free-cooling heat exchanger to take advantage of low ambient temperatures in the winter when chilled water is still required for cooling in the high-internal load building spaces (eg. Server rooms).

The type, number and arrangement of chillers for a central cooling plant definitely impacts plant energy performance and is dependent upon the cooling load profile for the system and the magnitude of cooling load to be supplied from the plant. For this size chiller plant, the best practice is generally to use chillers optimally sized for the annual cooling load profile, configured in a parallel-parallel flow, variable primary arrangement.

Sketch

Alternative No.: RC-109

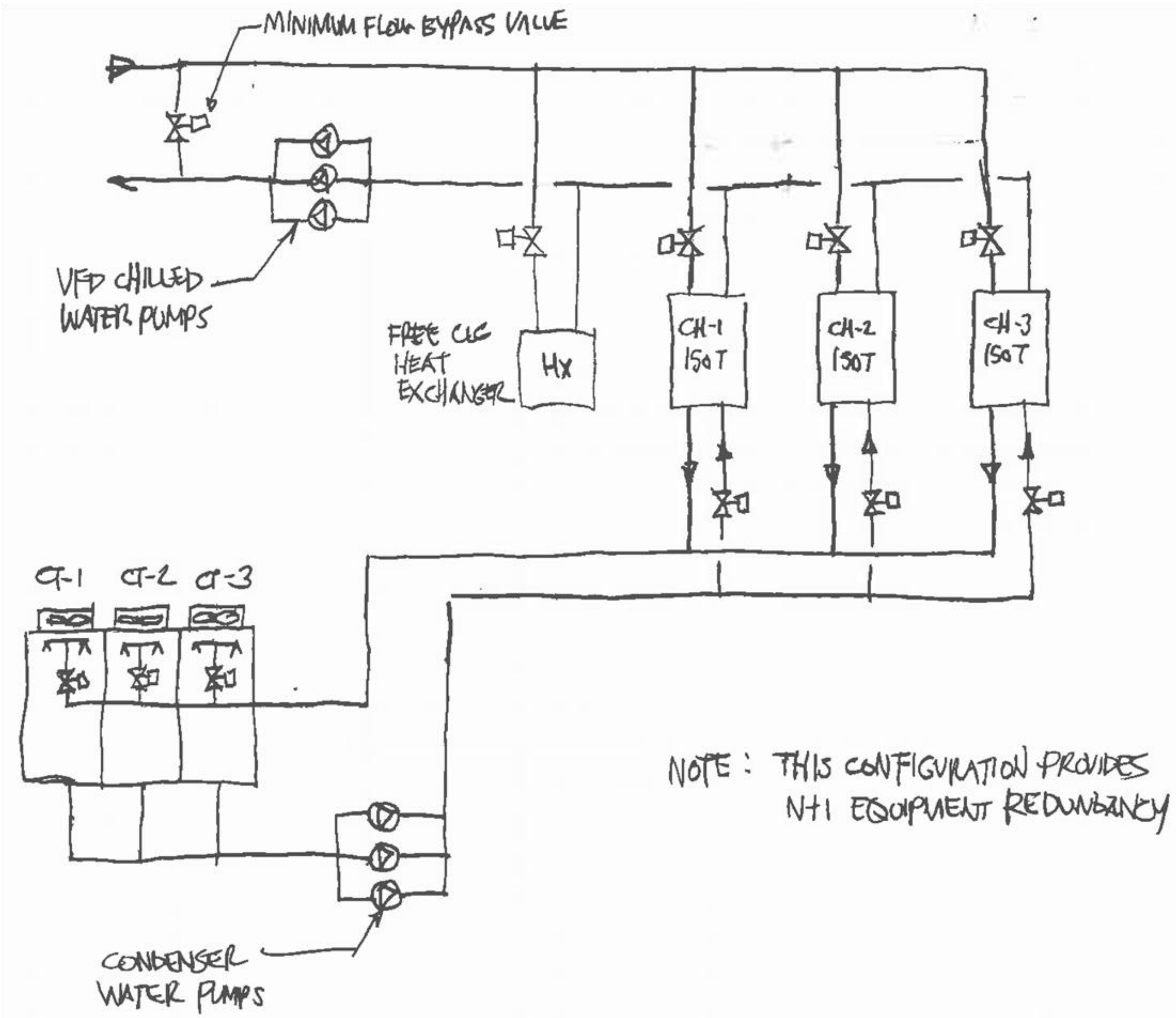
☐ Original ☑ Alternative



Sketch

Alternative No.: RC-109

☐ Original ☑ Alternative



Calculations

Alternative No.: RC-109

☐ Original ☑ Alternative

Central CHW plant

	base case	central plant	savings			
Two Battalion HQ and Brigade HQ only	1,500,007.00	1,405,032.00	94,975.00	kwh	elec	
	$ 124,100.00	$ 117,331.00	$ 6,769.00	$	cost	(electric only)
HQs above plus COF Admin and Readiness	2,053,768.00	1,894,603.00	159,165.00	kwh	elec	
Using one centrifugal chiller	$ 195,064.00	$ 173,101.00	$ 21,963.00	$	cost	(electric only)
HQs above plus COF Admin and Readiness	2,053,768.00	1,879,317.00	174,451.00	kwh	elec	
using one RTHD chiller	$ 195,064.00	$ 175,850.00	$ 19,214.00	$	cost	(electric only)
HQs above plus COF Admin and Readiness	2,053,768.00	1,854,411.00	199,357.00	kwh	elec	
Using two parallel centrifugal chillers sized 146.8 tons each	$ 195,064.00	$ 171,038.00	$ 24,026.00	$	cost	(electric only)

Construction Cost Estimate

Alternative No.: RC-109

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
50 Ton Water-Cooled Scroll Chiller	EA	63,000.00	2	$126,000		
60 Ton Water-Cooled Scroll Chiller	EA	65,000.00	1	$65,000		
20 Ton Water-Cooled Scroll Chiller	EA	32,000.00	1	$32,000		
120 Ton Water-Cooled Rotary Chiller	EA	113,000.00	2	$226,000		
50 Ton Fluid Cooler	EA	66,000.00	2	$132,000		
60 Ton Fluid Cooler	EA	8,000.00	1	$8,000		
20 Ton Fluid Cooler	EA	2,700.00	1	$2,700		
120 Ton Counter-flow Cooling Tower	EA	15,000.00	2	$30,000		
2 HP Close-Coupled Pump	EA	3,500.00	1	$3,500		
3 HP Close-Coupled Pump	EA	3,750.00	1	$3,750		
5 HP Close-Coupled Pump	EA	4,700.00	6	$28,200		
Cooling Tower Chemical Treatment System	EA	5,000.00	5	$25,000		
150 Ton WC Centrifugal VFD Chiller	EA	165,200.00			3	$495,600
150 Ton VFD Counterflow Cooling Towers	EA	16,700.00			3	$50,100
10 HP VFD CHW Pumps	EA	6,100.00			3	$18,300
7.5 HP CW Pumps	EA	6,000.00			3	$18,000
CT Chemical Treatment Systems	EA	10,000.00			1	$10,000
Underground 5" Pre-insulated Steel Pipe	LF	26.00			4,400	$114,400
Pipe Trenching and Backfill	LF	18.00			2,200	$39,600
Total Current Contract Cost				$682,000		$746,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$44,759		$48,959
Subtotal				$727,000		$795,000
Contingencies		5.00%		$36,350		$39,750
Subtotal				$763,000		$835,000
SIOH		5.70%		$43,491		$47,595
TOTALS				$806,000		$883,000
NET SAVINGS						($77,000)

Life Cycle Cost Analysis

Life Cycle Cost Analysis

Alternative No.: RC-109

Alternative No.: RC-109

LIFE CYCLE PERIOD 40 YEARS | ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
	$806,000	$883,000
Capital Cost Savings		($77,000)

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Energy		19.7928		24,026	476,000			
Generalized (% of Capital Cost)								
SUB-TOTAL					$476,000			$0

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
SUB-TOTAL				$0		$0
TOTAL PRESENT WORTH				$476,000		$0

PRESENT WORTH SAVINGS ON O&M	$476,000
LIFE CYCLE COST SAVINGS	$399,000

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No: HRC-40

Title:
Use District Energy System

Description of Original Concept:

The original concept is to provide high-efficiency water or air-cooled chillers and boilers at each building to provide chilled and heating hot water for each building.

Description of Alternative Concept:

The alternative concept is to provide water-to-water heat pumps at each building to provide chilled water and heating hot water. The water-to-water heat pumps would be connected to a common hydronic loop between the Brigade/Battalion HQ buildings. A fluid cooler and smaller boiler would be required to remove/add heat to the loop on extreme cooling or heating conditions.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:

O&M Savings: **No Cost Developed**

Life Cycle Cost Savings:

Advantages/Disadvantages

Alternative No.: HRC-40

Advantages of Alternative Concept

- Improves the energy utilization of the combined buildings HVAC and domestic water heating systems by repurposing heat from cooling loads that would otherwise be discarded. In other words this alternative allows extracted heat from cooling to be utilized by other connected buildings
- Improved energy efficiency by allowing heat to transfer between simultaneous heating and cooling loads.
- Heat pumps can also be used as water chillers, which means lower first-costs, because one piece of equipment does both cooling and heating
- Reduced CO_2 emissions from fossil fuel use; heat pumps are a highly efficient electric alternative
- Less maintenance than individual fluid coolers at each building.

Disadvantages of Alternative Concept

- An underground piping loop will be required between the connected buildings.

Discussion

Alternative No.: HRC-40

The district energy system allows buildings to repurpose heat that would otherwise need to be rejected though cooling towers and air-cooled condensers. Fort Campbell has a substantial amount of heating degree-days (HDD) from October through April. Base 65°F HDD typically are double the annual cooling degree-days (CDD). The Brigade HQ has numerous high internal load spaces (server rooms, UPS, etc.) that will require cooling year-round. The Brigade HQ building has over 200 MBH of heat rejection from these spaces that could be used to provide heating hot water and/or domestic hot water instead of being rejected from the building.

Water-to-water heat pumps (WTWHP) can be connected through a common water loop used to generate hot water up to 155 degrees F or produce chilled water for cooling. The common water loop can be used as a common heat source and heat sink. WTWHPs come in a variety of sizes from very small to very large. The water loop connected between the buildings would allow cooling heat rejection to be utilized for heating thus reducing the heat rejection requirements in the individual buildings. The water loop can vary in temperature from 40-85 degrees F.

The Server Room and UPS Computer Room Air Conditioning (CRAC) units would need to be either water-to-air heat pumps or chilled water units in order to utilize the waste heat from these spaces. The current design shows these units as DX units.

This system would require a heat pump hydronic loop between the buildings, recirculating pumps, a heating source (boiler) and a means of heat rejection (fluid cooler). The common water loop piping between the buildings could be direct-buried un-insulated pipe between the buildings, as long as the pipe is installed below the front line.

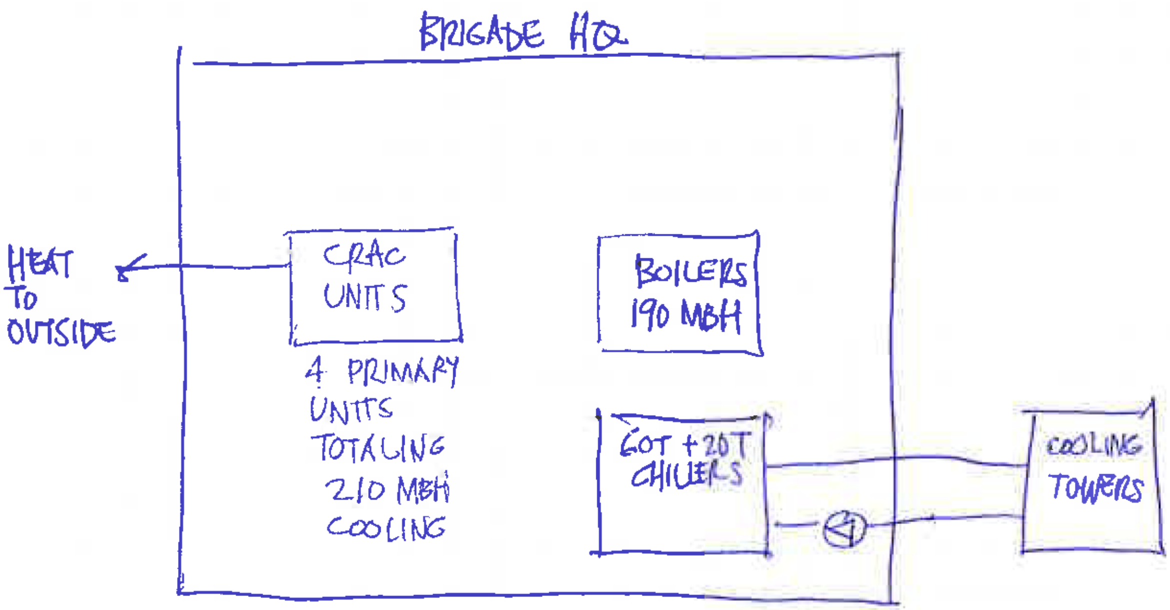
This type of system also allows for diversity of loads in the three buildings to be taken into account when sizing the heating source and heat rejection source.

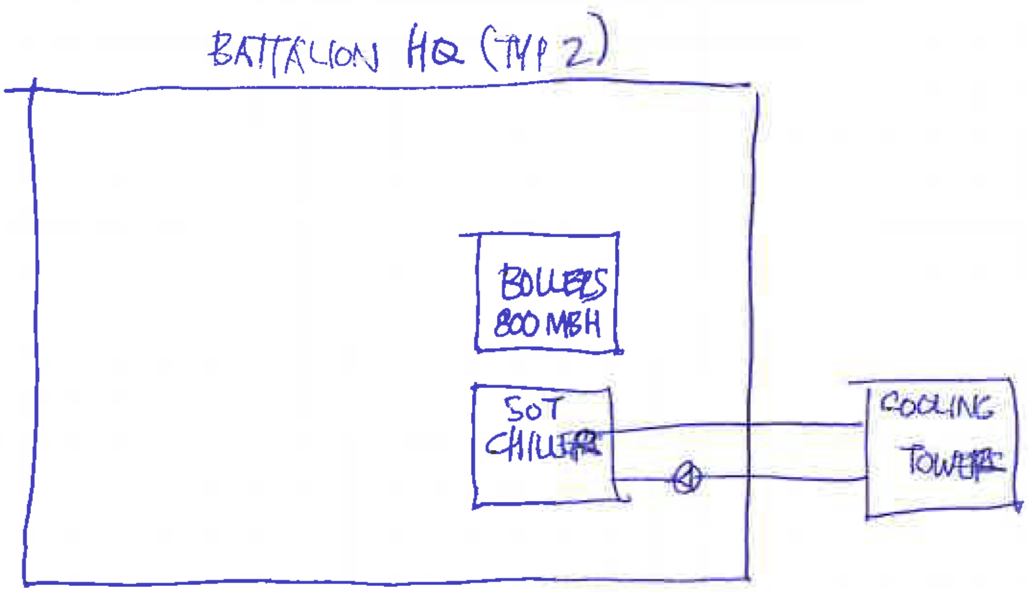
The WTWHP system would cost less per square foot for the equipment but we are assuming at this conceptual stage that the total installed system cost including piping between buildings would be equal to the base case. Life cycle savings will be recognized by being able to use waste (rejected) heat to heat areas calling for cooling.

Sketch

Alternative No.: HRC-40

☑ Original ☐ Alternative

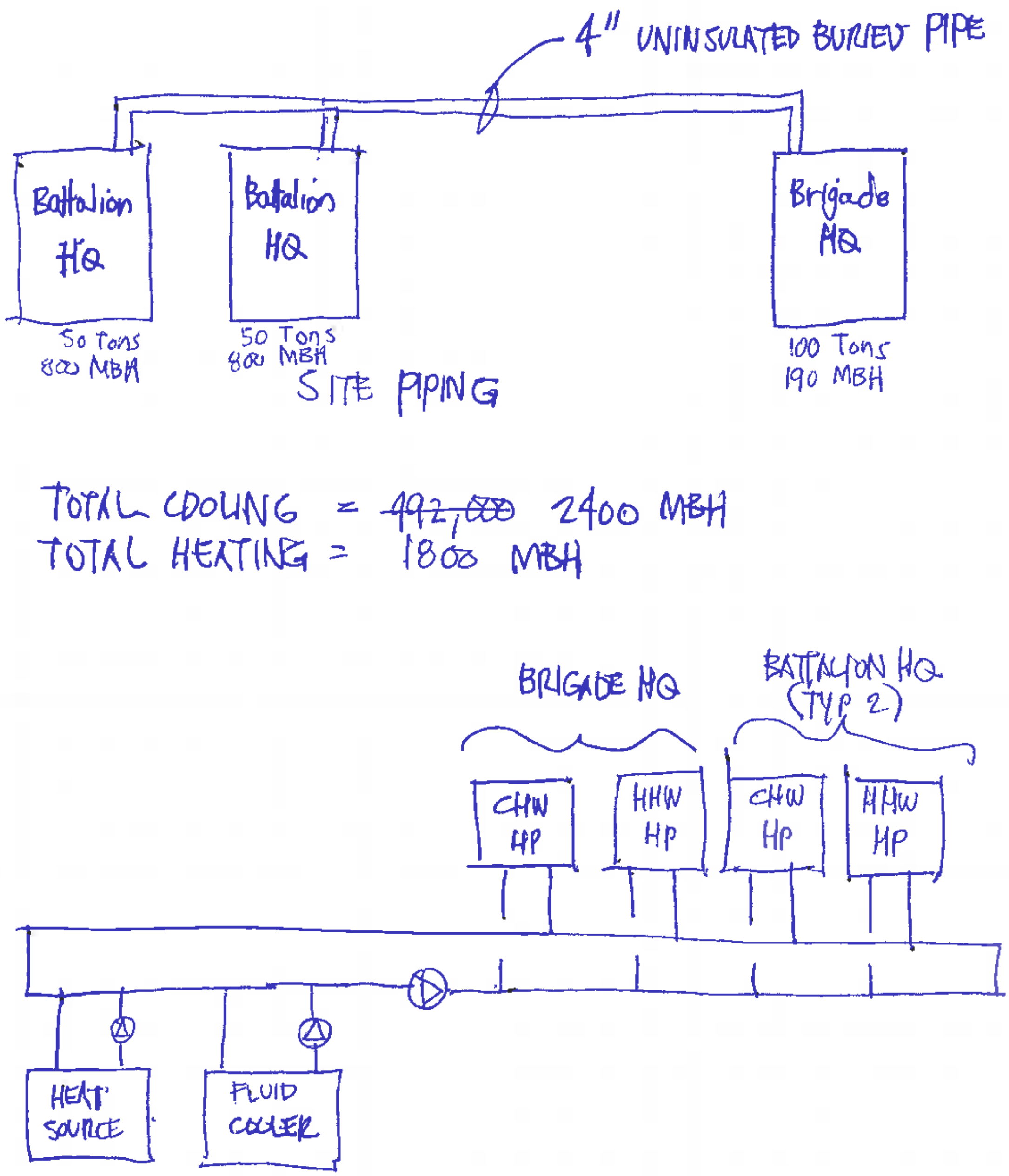




Sketch

Alternative No.: HRC-40

☐ Original ☑ Alternative



THIS PAGE INTENTIONALLY LEFT BLANK.

ELECTRICAL

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
RC-31

Title:
Reduce Lighting Power Density

Description of Original Concept:

The original lighting design concept is centered around the Lighting Design Guide published by Atelier Ten, Environmental Design Consultants, a summary of which is attached. The design utilizes T8 lighting with lighting power densities (LPD) varying by space as shown on page six of the attached guide. The current design attempts to reduce the LPD in each space by approximately 67% on average below the allowable LPD published in ASHRAE 90.1.

Description of Alternative Concept:

The alternative concept is to utilize T5 lighting to reduce the wattages associated with each linear fluorescent fixture for the same lumen output per fixture. This will allow us to achieve the same lighting levels with fewer watts, effectively reducing the LPD at the same time. We can also take advantage of the higher efficiencies of the T5 ballasts to further reduce the input watts to each fixture.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☑ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost Savings:

O&M Savings: **Design not sufficiently developed**

Life Cycle Cost Savings:

Advantages/Disadvantages

Alternative No.: RC-31

Advantages of Alternative Concept

- Low input wattages required per fixture
- T5 lamps are more efficient
- Coefficients of Utilization are higher for T5 lamps
- T5 lamps have a lower mercury content that T8 lamps
- T5 lamps have an approximately 25% longer life compared to T8 lamps

Disadvantages of Alternative Concept

- T5 lamps are approximately 3-4 times more expensive than T8
- T5 lamps take longer to reach peak brightness

Discussion

Alternative No.: RC-31

T5 fluorescent lamps are thinner, more efficient, and offer a higher intensity of light output than T8 lamps. The numerical designation refers to the diameter of the lamp in eighths of an inch—so the T5 lamp is five-eighths inch in diameter, compared to 1 inch for T8s and 1-1/2 inches for T12s. The narrower profile means that the lamps provide designers with better optical control and better fixture efficiency.

Characteristic	T5	T5HO	T8
Initial output (lumens)	2,900	5,000	2,950–3,200
Lamp power (watts)	28	54	32
Lamp efficacy (lumens/watt)	104	93	92–100
Color-rendering index (CRI)	82–85	82–85	75–85
Note: Data are for a nominal 4-foot lamp.			

In addition, the lamps are designed to provide maximum light output at an ambient temperature of 95° Fahrenheit (F) rather than the 77°F design point for most other lamps. Those characteristics allow the use of the lamps in more compact fixtures than would otherwise be possible, but also mean that steps must be taken to keep the lamps warm in colder environments, such as unheated warehouses. This characteristic also means that T5 fixtures may appear to have an efficiency of greater than 100 percent—bare lamps are tested at 77°F, but the lamp may experience higher temperatures in the fixture and therefore put out more light than it does at the lower temperature.

T5s are often applied in low-profile fixtures, such as those used for cove lighting and illuminating display cases. Indirect and indirect/direct fixtures also often feature T5 lamps—the thinness and high intensity of the lamps enable designers to place fixtures farther apart and closer to the ceiling than is possible with T8 lamps.

Manufacturers offer two types of T5 lamps: standard output and high output (HO). The HO versions put out almost twice as much light as a T8 lamp of the same length, and can therefore cut in half the number of fixtures required in a given space. However, some designers warn that HO lamps may be too bright, and care must be taken to avoid glare and the creation of hot spots on the ceiling. T5HO lamps are also less energy-efficient than standard T5s. T5s offer an efficacy of about 104 lumens/watt, whereas high-output T5s come in at about 90 lumens/watt—similar to the efficacy of a T8 lamp.

Discussion

Alternative No.: RC-31

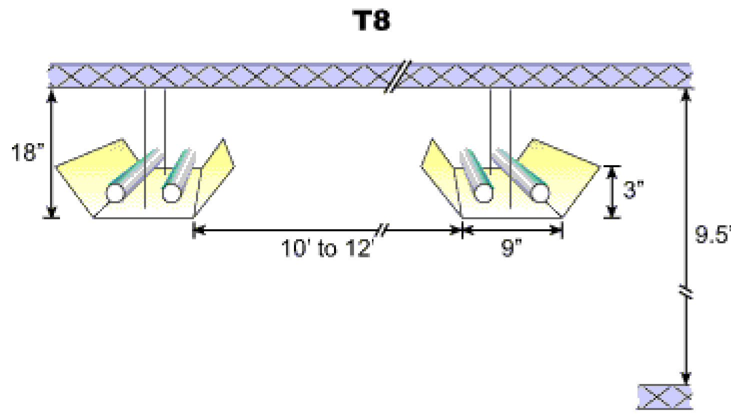
Both T5 and T5HO lamps offer better lumen-maintenance performance than T8 lamps. The T5 lamps retain about 95 percent of their output after 40 percent of their rated life, compared with less than 90 percent for T8 lamps.

This approach will lower the lighting power densities an average of 12.5% over the currently shown design strategy and could possibly, with increased spacing, allow a 15-20% reduction in the number of fixtures in open areas throughout the facilities.

Sketch

Alternative No.: RC-31

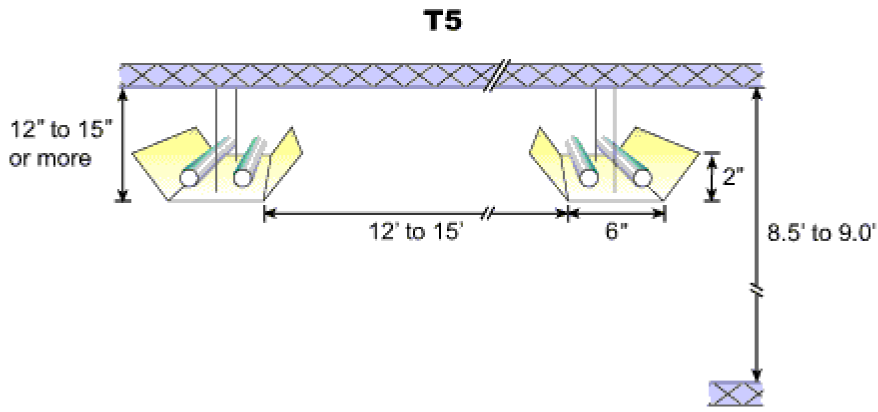
☑ Original ☐ Alternative



Sketch

Alternative No.: RC-31

☑ Original ☑ Alternative



The high intensity and small size of T5 lamps enable their use in smaller fixtures that can be spaced closer to the ceiling, in rooms with lower ceilings, and farther apart than fixtures using T8 lamps.

Note: These numbers are approximate, as different designers use different standards; actual figures will depend on ceiling reflectivity and on the proximity of other lamps. For example, higher ceilings allow wider spacing.

Calculations

Alternative No.: RC-31

☐ Original ☑ Alternative

Space	Illuminance	Target LPD	Allowable LPD	Alternate LPD	LPD Reduction from T8
Classroom/Training	40	0.75	1.4	0.66	
Conference Room	40	0.8	1.3	0.70	
Corridor	10	0.5	0.5	0.44	
Mechanical/Electrical	30	0.7	1.5	0.61	
Office (Open)	30-50	0.7	1.1	0.61	
Office (Enclosed)	30-50	0.9	1.1	0.79	
Restroom/Shower	20	0.8	0.9	0.70	
Server Room	30	0.85	1.5	0.74	
Stair	10	0.5	0.6	0.44	
Storage (General)	10	0.5	0.8	0.44	
Telcom/SIPRNET	50	1.2	1.5	1.05	
Averages		0.75	1.11	0.65	12.50%

Assuming 30,000 sf office space uses 7,200 kWh/month for lighting. Also assuming 10% open office area/building and reducing the fixtures by 20% saves nominally 144 kWh/month.

Because the 35% design did not provide a lighting plan, the number of fixtures eliminated cannot be calculated.

THIS PAGE INTENTIONALLY LEFT BLANK

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
CCR-1

Title:
Consolidate electrical service to COFs

Description of Original Concept:

The original design comprises of providing dedicated pad mount transformers to serve each of the COF facilities. The pad-mounted transformer for each facility in turn serves a dedicated 277/480V, 3 phase, 4 wire main distribution board in each facility that meets the power demands of each facility. 480V-120/208V, 3 phase, 4 wire distribution transformers located in the electrical room of each facility meet the 120V and 208V demands within each facility.

A dedicated pad-mounted transformer is also provided to serve the chiller and associated cooling tower serving each of the 'B' and 'E' facilities.

Description of Alternative Concept:

The alternative concept is to provide a single dedicated pad-mounted transformer with a main 277/480V distribution board serving facilities 'A', 'B' and 'C' and 'D', 'E' and 'F' respectively. This main distribution board will serve individual 277/480V distribution boards in each facility that will meet the power demands of the facility. Downstream distribution comprising of 480-120/208V distribution transformers and panelboards in the original concept will remain the same in this alternative concept.

A dedicated 277/480V distribution board served from the main 277/480V distribution board will be provided to serve mechanical loads (chiller and cooling tower/pumps) for each group of facilities.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☐ Increased	☐ Increased
☑ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 379,000
O&M Savings:	$ 78,000
Life Cycle Cost Savings:	$ 457,000

Advantages/Disadvantages

Alternative No.: CCR-1

Advantages of Alternative Concept

- Reduces number of pad-mounted transformers and associated medium voltage feeders to each of these transformers
- Consolidates services to a group of facilities (‘A’, ‘B’ ‘C’ and ‘D’, ‘E’ and ‘F’).
- Saves energy due to reduced losses in transformer due to consolidation
- Reduces overall transformer size due to diversity
- Reduces space requirements for placing transformers

Disadvantages of Alternative Concept

- In event of a failure of a transformer, power will be lost to the group of buildings served by the affected transformer.

Discussion

Alternative No.: CCR-1

The proposed concept presented in this alternative consolidates the medium voltage transformers to serve the proposed COF facilities.

The consolidation of these transformers help reduce the amount of medium voltage duct banks required in the original concept along with associated medium voltage feeders, requires less space to house the proposed transformers and reduces energy losses occurring in multiple transformers. Sketches showing the existing and proposed concepts are attached for reference.

The existing concept has multiple 12.47kV-277/480V transformers housed outside each facility that serve 277/480V distribution boards in each of the facilities. These 277/480V distribution boards in each facility meet the power demands of the facility.

15kV feeders originating from a manhole on the north side of these facilities serve these individual transformers.

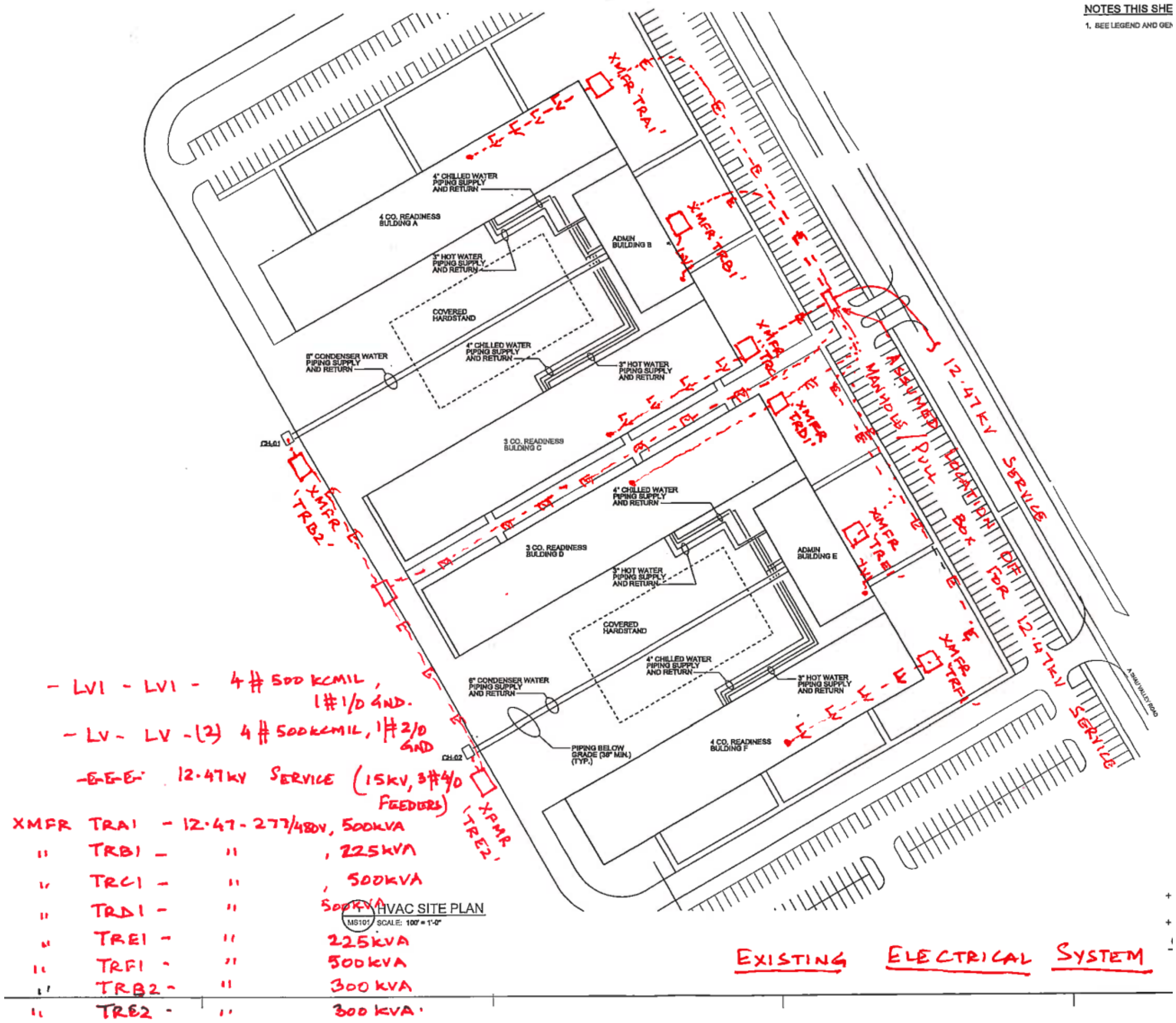
The proposed concept proposes a single dedicated 12.47kV-277/480V transformer and a 2000A 277/480V main distribution board to serve facilities ‘A’, ‘B’ and ‘C’ and another dedicated 12.47kV-277/480V transformer and a 2000A 277/480V main distribution board to serve facilities ‘D’, E‘’ and ‘F’. Low voltage feeders originating from this main distribution board will serve 277/480V distribution boards currently planned in each of the facilities. A dedicated low voltage feeder originating from the main distribution board will also serve chillers and associated equipment for each group of facilities.

The proposed concept significantly reduces the a) number of transformers and thus space required to house these transformers, b) medium voltage ductbanks and associated 15kV feeders and c) energy losses within transformers.

The only drawback of the proposed concept is that if one of the transformers fail, there will be a loss of power to the group of facilities served from the affected transformer. In the original concept if one of the transformers fails, it will affect power to only one of the facilities that is being served from the affected transformer. However, since these are not mission critical facilities, failure of the transformer to group of facilities should not have a major impact on the operation of these facilities.

Alternative No.: CCR-1

☑ Original ☐ Alternative



Sketch

Alternative No.: CCR-1

☐ Original ☑ Alternative

Calculations

Alternative No.: CCR-1

☑ Original ☐ Alternative

kVA CAPACITY REQUIREMENT

Facility Name	Area in Gross sqft	Use	Required Capacity in kVA
COMPANY OPERATIONS FACILITIES			
Building 'A'	34,894	Office/Storage	500
Building 'B'	16,558	Office	225
Building 'C'	36,958	Office/Storage	500
Building 'D'	34,894	Office/Storage	500
Building 'E'	16,558	Office	225
Building 'F'	36,598	Office/Storage	500
Central Plant	36,598	Utility	600
Sub Total	**176,460**		**3,050**

Calculations

Alternative No.: CCR-1

☐ Original ☑ Alternative

kVA CAPACITY REQUIREMENT

Facility Name	Area in Gross sqft	Use	Required Capacity in kVA
COMPANY OPERATIONS FACILITIES			
Building 'A'	34,894	Office/Storage	1000
Building 'B'	16,558	Office	Included
Building 'C'	36,958	Office/Storage	Included
Building 'D'	34,894	Office/Storage	Included
Building 'E'	16,558	Office	1000
Building 'F'	36,598	Office/Storage	Included
Central Plant	36,598	Utility	Included
Sub Total	**176,460**		**2000**

WORST CASE VOLTAGE DROP CALCULATIONS

Conductor Size	Resistance in Ohms/1000ft	Voltage	Current	Distance	VD in %
500kcmil	0.0265	480V, 3phase	320	900	2.75388

Calculations

Alternative No.: CCR-1

☐ Original ☑ Alternative

TRANSFORMER ENERGY SAVINGS CALCULATIONS

Transformer Designation	Area in Gross sqft	Use	Required Capacity in kVA	Demand In kVA	Loss in kWH
ORIGINAL CONCEPT					
TRA1	34,894	Office/Storage	500	250	27,965
TRB1	16,558	Office	225	112.5	12,584
TRC1	36,958	Office/Storage	500	250	27,965
TRD1	34,894	Office/Storage	500	250	27,965
TRE1	16,558	Office	225	112.5	12,584
TRF1	36,598	Office/Storage	500	250	27,965
TRB2, TRE2	36,598	Utility	600	300	33,558
Sub Total	**176,460**		**3,050**	**1,525**	**170,588**
ALTERNATE CONCEPT					
TR1	34,894	Office/Storage	1000	500	55,931
	16,558	Office	0	0	0
	36,958	Office/Storage	0	0	0
TR2	34,894	Office/Storage	1000	500	55,931
	16,558	Office	0	0	0
	36,598	Office/Storage	0	0	0
Sub Total	**176,460**		**2,000**	**1,000**	**111,861**
TOTAL kWh Savings per year					**58,727**
Utility Blended Rate					**0.067**
TOTAL Savings in $ per year					**$3,941**

Construction Cost Estimate

Alternative No.: CCR-1

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Pad Mount Transformers	EA	25,000.00	8	$200,000		
15kV feeders 4/0 EPR	FT	45.00	9,500	$427,500	2,500	$112,500
500kcmil 600V feeders	FT	20.00	7,500	$150,000	12,500	$250,000
Trenching and Backfill 3'X20"W (Incl/wDB)						
4" Medium Voltage Underground Duct Banks - Concrete Encased	FT	50.00	3,200	$160,000	800	$40,000
4" Low Voltage Underground Duct Banks	FT	20.00	1,000	$20,000	2,200	$44,000
Main Distribution Board 2000A, 277/48V	EA	40,000.00			2	$80,000
Pad Mount transformers	EA	55,000.00			2	$110,000
Total Current Contract Cost				$958,000		$637,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$62,872		$41,805
Subtotal				$1,021,000		$679,000
Contingencies		5.00%		$51,050		$33,950
Subtotal				$1,072,000		$713,000
SIOH		5.70%		$61,104		$40,641
TOTALS				$1,133,000		$754,000
NET SAVINGS						$379,000

Life Cycle Cost Analysis

Alternative No.: CCR-1

LIFE CYCLE PERIOD 40 YEARS

ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST			ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
					$1,133,000			$754,000
Capital Cost Savings								$379,000
ANNUAL EXPENDITURE	**%**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Reduction in losses - electrical		19.7928		3,941	78,000			
Generalized (% of Capital Cost)								
SUB-TOTAL					$78,000			$0

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
SUB-TOTAL				$0		$0
TOTAL PRESENT WORTH				$78,000		$0
PRESENT WORTH SAVINGS ON O&M						$78,000
LIFE CYCLE COST SAVINGS						$457,000

OPERATIONS

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No: RC-67

Title:
Provide building dashboards for occupants

Description of Original Concept:

No real-time building energy use is provided to building occupants.

Description of Alternative Concept:

The alternative concept is to provide real-time building energy use to building occupants. To provide this information, energy use must be metered, collected, and subsequently processed to display in a format which will be easily understood by building occupants. Energy use metering and collection is already being done at Fort Campbell through their EMCS. Software would be needed to process and display the information. Displays such as touchscreen monitors or kiosks would be necessary in common areas of the buildings, or on each floor of the barracks. The system would require internet connectivity between the displays and the EMCS.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	($ 57,000)
O&M Savings:	$ 170,000
Life Cycle Cost Savings:	$ 113,000

Advantages/Disadvantages

Alternative No.: RC-67

- Educates building occupants of energy use, allowing them to modify their habits and reduce building energy use
    - This education would help to change the culture of our country and these habits would likely extend beyond the work environment.
- Can reduce energy use of building by 5-10%
- Can allow building managers to quickly see where efficiency efforts should be focused (lighting, servers, HVAC, plug loads) and make real-time adjustments

Disadvantages of Alternative Concept

- Building occupants may not be motivated to change habits based on information provided, since they are not directly responsible for the energy costs
- Procurement method to purchase necessary software and equipment may not be included in MILCON dollars
- Limited space to put displays in maintenance buildings

Discussion

Alternative No.: RC-67

Energy-use feedback systems provide real-time information to building occupants about the building's energy use. The systems range from inexpensive, simple devices in residential homes that cost approximately $200, to complex systems and software starting at $10,000 for commercial buildings. These systems enable building occupants to make immediate changes to their energy use in the building based on the feedback from the system.

The alternative concept proposed is a system which would collect energy use information and display it in a way which is appealing and easy to understand for the building occupants. This type of display is termed a dashboard, modeled after the dashboard of an automobile where only necessary information is displayed in a large easy to read and understand format. Similar to the speedometer in an automobile which allows the operator to quickly see their speed and adjust it accordingly based on the posted speed limit, the building dashboard would allow occupants to adjust their energy consumption based on the information received. The dashboard can also be customized to educate the occupants on ways that they can reduce the energy consumption of the building. The dashboard could be further customized to relate the energy savings to the occupants in units which would make the most impact on them (for soldiers perhaps barrels of oil not imported, relating reduced reliance on foreign oil, and more energy independence for the US--less likely to be involved in foreign conflicts).

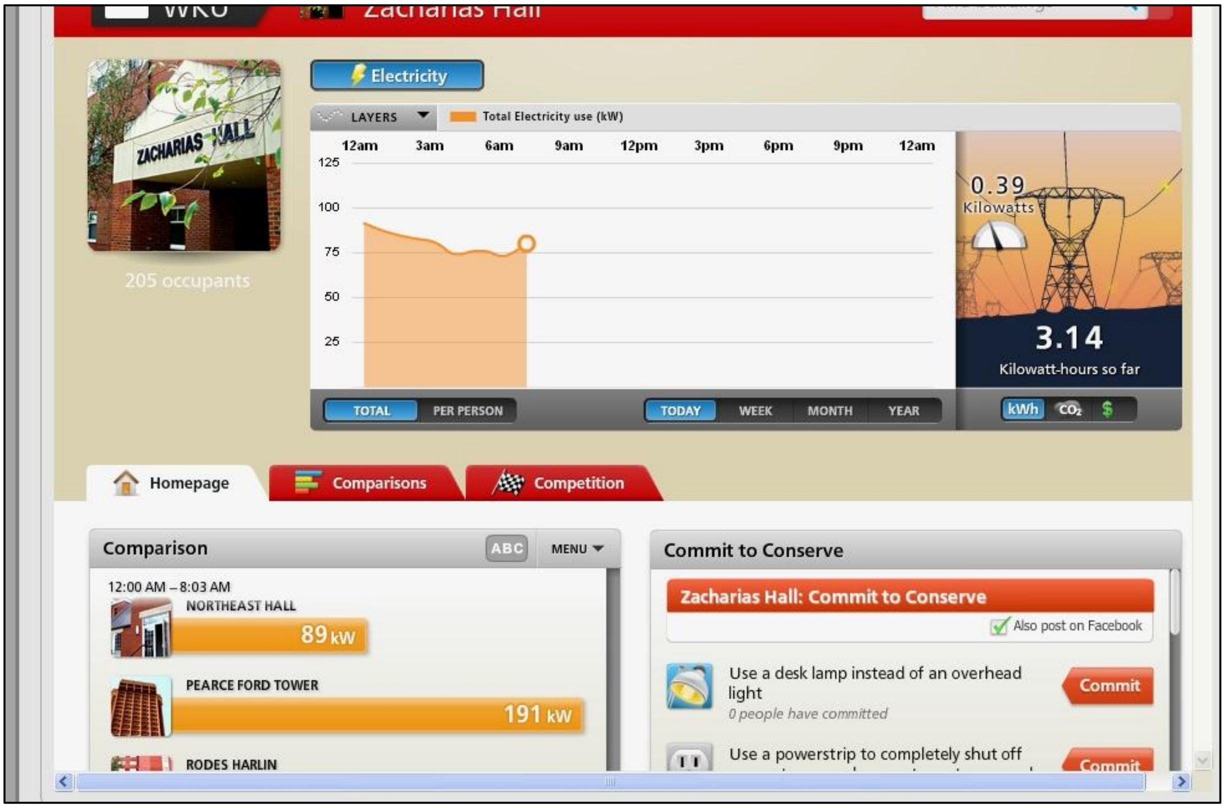
Fort Campbell already has an EMCS system in place, where utilities are metered, and consumption data is collected. To install a building dashboard, software would be purchased which could be configured to accept this data and then display in graphical, eye-catching ways. Commercial software is available such as Building Dashboard by LucidDesign Group and IBPortal Dashboard by Quality Attributes Software. Large electronic displays, such as touchscreen flat panels, or free-standing kiosks would be provided in common areas of the buildings. These displays would require internet connectivity to access the energy use information.

At a minimum one display would be necessary in each building. The system can be configured to monitor and display consumption for each floor of the building, depending on the metering. This could be used both to identify areas which require more efficiency measures, and as a competitive measure for similar buildings or perhaps floors in a barracks to compete against each other.

Sketch

Alternative No.: RC-67

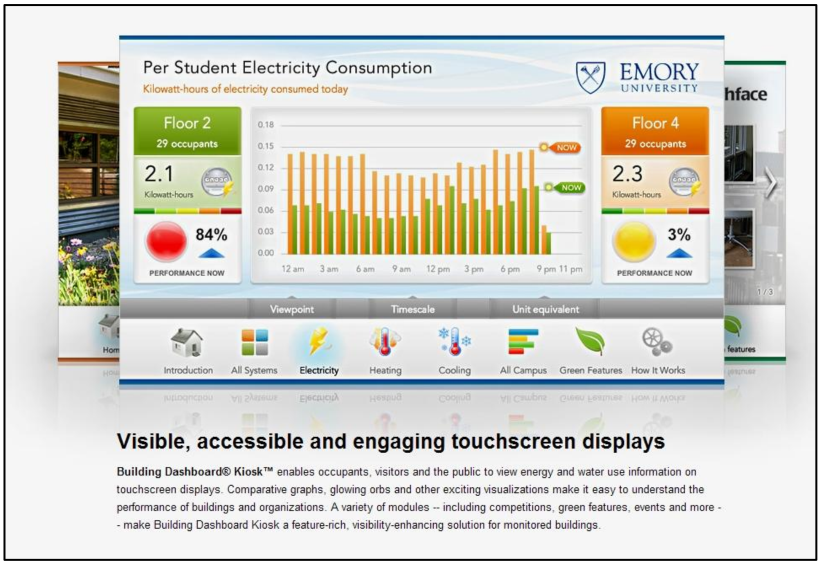
☐ Original ☑ Alternative



Building Dashboard Display from Western Kentucky University website

Alternative No.: RC-67

☐ Original ☑ Alternative



Example Building Dashboard from LucidDesign Group

Calculations

Alternative No.: RC-67

☐ Original ☑ Alternative

Estimated savings is 5% to 12% of building energy use per year.

Reference:
Employee Engagement and Energy Information Software Supporting Carbon Neutrality by Tom Owen, Pulse Energy, Andrew Pape-Salmon and Brooke McMurchy, BC Ministry of Energy, Mines and Petroleum Resources

©2010 ACEEE Summer Study on Energy Efficiency in Buildings

Fischer (2008) researched how improved feedback to building occupants about electricity consumption may provide a tool for customers to better control their consumption and ultimately save energy, analyzing which kind of feedback is most successful (p. 79). Feedback includes energy consumption, as well as its costs and environmental impacts. Energy savings have been demonstrated from the use of feedback with usual savings ranging from 5 to 12% (Ibid., 87).

Fischer, C. (2008). **Feedback on Household Electricity Consumption: A Tool for Saving Energy?** *Energy Efficiency (2008)* 1, 79–104. DOI 10.1007/s12053-008-9009-7.

Construction Cost Estimate

Alternative No.: RC-67

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
Dashboard software	EA	15,000.00			1	$15,000
42" Ruggedized touchscreen flat panel unit 1 per building floor	EA	1,000.00			13	$13,000
Configuration of dashboard software	HR	250.00			80	$20,000
Total Current Contract Cost						$48,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%				$3,150
Subtotal						$51,000
Contingencies		5.00%				$2,550
Subtotal						$54,000
SIOH		5.70%				$3,078
TOTALS						$57,000
NET SAVINGS						($57,000)

Life Cycle Cost Analysis

Alternative No.: RC-67

LIFE CYCLE PERIOD 40 YEARS

ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST			ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
			$0	$57,000
Capital Cost Savings				($57,000)

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
HQ Electric and gas		19.7928		172,100	3,406,000		163,485	3,236,000
Generalized (% of Capital Cost)								
		SUB-TOTAL			$3,406,000			$3,236,000

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
		SUB-TOTAL		$0		$0
		TOTAL PRESENT WORTH		$3,406,000		$3,236,000
				PRESENT WORTH SAVINGS ON O&M		$170,000
				LIFE CYCLE COST SAVINGS		$113,000

Life Cycle Cost Analysis

Alternative No.: RC-67

LIFE CYCLE PERIOD 40 YEARS — ANNUAL PERCENTAGE RATE 4.000%

Basewide

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
	$0	$0
Capital Cost Savings		$0

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT CAPITAL COST	ORIGINAL CONCEPT ANNUAL COST	ORIGINAL CONCEPT PRESENT WORTH	ALTERNATIVE CONCEPT CAPITAL COST	ALTERNATIVE CONCEPT ANNUAL COST	ALTERNATIVE CONCEPT PRESENT WORTH
Staff ($75/hr; half time)		19.7928					75,000	1,484,000
Promotional Materials		19.7928					8,000	158,000
FTC electric and gas		19.7928		24,500,000	484,923,000		23,275,000	460,677,000
Generalized (% of Capital Cost)								
		SUB-TOTAL			$484,923,000			$462,319,000

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT ESTIMATE	ORIGINAL CONCEPT PRESENT WORTH	ALTERNATIVE CONCEPT ESTIMATE	ALTERNATIVE CONCEPT PRESENT WORTH
Salvage Value at End of Economic Life						
		SUB-TOTAL		$0		$0
		TOTAL PRESENT WORTH		$484,923,000		$462,319,000
				PRESENT WORTH SAVINGS ON O&M		$22,604,000
				LIFE CYCLE COST SAVINGS		$22,604,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No: RC-99

Title:
Create incentive program to encourage energy reduction (energy smackdown)

Description of Original Concept:

The original concept does not account for any energy savings due to behavior changes by the tenant.

Description of Alternative Concept:

The alternative concept is to develop and institute an incentive competition program between tenants of similar building types to promote energy conservation. Top performers would receive some form of non-monetary reward. Energy usage or savings would be monitored and compared on a unit basis of measure, at regular intervals, perhaps every 6 months.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 0
O&M Savings:	$ 170,000
Life Cycle Cost Savings:	$ 170,000

Advantages/Disadvantages

Alternative No.: RC-99

Advantages of Alternative Concept

- Develops behaviors within the individual users of the facilities to take an active role in reducing their energy consumption on a daily basis.
- This program can be implemented on a smaller scale if desired, using minimal resources on a pilot program basis, and then expanded base-wide if desired.
- This program can be implemented and categorized for buildings of various types and use. For example, a competition category could be limited to TEMF's, and another to HQ facilities, or for facilities of one era or another. Or it can also be scaled to measure savings as compared to the facility's historical baseline operations.
- Such a program has a potentially tremendous trickle-down effect beyond the limits of the fort's facilities wherein it educates the occupants in a hands-on manner that encourages them and teaches them to internalize energy conservation behaviors. These are potentially are carried beyond the limits of the base and into their lives off base and beyond the limits of their service in the army, thereby further reducing our country's energy consumption and promoting energy independence.
- This concept can also be expanded to use of water resources as well.

Disadvantages of Alternative Concept

- Not all facilities may be currently metered in such a manner as to allow comparison.
- Requires a portion of a staff member's time to monitor, administer, and promote the program.

Discussion

Alternative No.: RC-99

The total energy and water used at the base is substantial. Even a small percentage of savings in current energy usage resulting from occupant behaviors will result in tremendous cost savings, reduced energy consumption, and reduced carbon emissions. Such a program can easily be adapted to an entire fort or base, and is scalable.

Metrics of the measurement can be altered to promote different behaviors at different times, or to focus on different aspects of conservation – such as energy, water, or solid waste. For example, rather than comparing the total energy used at a facility on a square foot basis, one could compare percentage improvements from the facility's historical baseline usage – which would perhaps be an applicable form of comparison across all facility types regardless of use, age or construction type.

The goal of such a program is to alter an individual's behavior so they will incorporate energy conservation measures as a routine part of their daily lives. By implementing a healthy competition program, this promotes increased attention on activities that each individual can incorporate into their daily activities that make a difference, and provides direct feedback that they can measure and see. The competition aspect also puts into play a healthy component of peer pressure and accountability that further encourages changes in human behavior.

Individuals will better begin to adopt small daily changes in behavior that are relatively easy but force us to change our old habits. These may include such simple actions as turning out lights (even lights with motion sensors) when they leave a room, placing computers in standby or hibernation mode when not in use, not turning on lights at all when sufficient daylighting exists, taking shorter showers, washing clothes in cold and/or cooler water, closing doors and windows, and accepting a wider range of thermal comfort zones and thermostat settings such as perhaps 68 to 78 degrees rather than 70 to 75 degrees in winter and summer respectively.

This type of program has been successfully implemented in other areas. Just one such example includes the recent incentive program implemented in the Medford, MA school district. In this competition, something as simple as a reward of a pizza party to top performing schools encouraged teachers and students to engage in energy conserving principles, and to take a hands-on approach to energy conservation rather than simply learning such behavior in a theoretical environment.

Adults will of course need some other form of incentive to maintain interest in the program until such behavior is internalized and becomes commonplace. Ideas include rewards of special events or other privileges, traveling trophies, honors and recognitions, preferred parking, and the like.

This strategy in order to be effective must include monitoring and supply direct feedback to building tenants. This could be adopted with other suggested design ideas, such as the notion of adding dashboard technologies to facilities, wherein building occupants can see real-time data on building energy consumption as they arrive at their place of work. It would seem to be a

Discussion

Alternative No.: RC-99

simple matter to graph such real-time data against historical baseline information and prior year's consumption.

Several case studies and research efforts related to the impact of this type of program have already been conducted. For example, Dr. Doug McKenzie-Mohr, an environmental behavioral psychologist, has tracked several of these efforts, and has several guidelines for developing such programs at cbsm.com. One example instituted in Iowa City demonstrated energy savings ranging from 10% to 20% across a variety of households. For purposes of the calculations used here, a conservative estimate of only 5% is utilized.

Sketch

Alternative No.: RC-99

☐ Original ☑ Alternative

Calculations

Alternative No.: RC-99

☐ Original ☑ Alternative

Conservatively estimate that the energy savings resulting from such a program will only be 5%. In actuality, it is believed the savings are potentially greater than this:

Case 1: Applicable to the new three HQ facilities only:

Total energy usage currently estimated in the PDR:

Battalion HQ:	Electric:	$44,880 x 2 facilities
	Gas:	$ 4,309 x 2 facilities
Brigade HQ	Electric:	$71,889
	Gas:	$ 1,822
	Total:	$172,089.00/year

Estimated annual energy savings: =5% x $172,089 = $8,604.00/year

Case 2: Expand program to the entire fort:

Total annual energy costs on the base (as provided by Mr. John Register)

Electric = $16,000,000

Gas = $8,500,000

Total = $24,500,000/year

Estimated annual energy savings: = 5% x $24,500,000 = $1,225,000.00/year

Construction Cost Estimate

Alternative No.: RC-99

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
1/2 staffing Person Salary	1/2 salary	50,000.00			1	$50,000
promotional materials and events	total/yr	8,000.00			1	$8,000
Case 1: HQ's only						
electric and gas annual costs	$/yr	172,089.00	1	$172,089	1	$163,485
Case 2: Fort wide						
electric and gas annual costs	$/yr	24,500,000	1	$24,500,000	1	$23,275,000
TOTALS						
NET SAVINGS						

Life Cycle Cost Analysis

Alternative No.: RC-99

LIFE CYCLE PERIOD 40 YEARS — ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
Capital Cost Savings		$0

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITA L COST	ANNUA L COST	PRESENT WORTH
HQ Electric and gas		19.7928		172,100	3,406,000		163,485	3,236,000
Generalized (% of Capital Cost)								
SUB-TOTAL					$3,406,000			$3,236,000

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
SUB-TOTAL				$0		$0
TOTAL PRESENT WORTH				$3,406,000		$3,236,000
PRESENT WORTH SAVINGS ON O&M						$170,000
LIFE CYCLE COST SAVINGS						$170,000

Life Cycle Cost Analysis

Alternative No.: RC-99

LIFE CYCLE PERIOD 40 YEARS | ANNUAL PERCENTAGE RATE 4.000%

Basewide

CAPITAL COST			ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
Capital Cost Savings								$0
ANNUAL EXPENDITURE	**%**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITA L COST	ANNUAL COST	PRESENT WORTH
Staff ($75/hr; half time)		19.7928					75,000	1,484,000
Promotional Materials		19.7928					8,000	158,000
FTC electric and gas		19.7928		24,500,000	484,923,000		23,275,000	460,677,000
Generalized (% of Capital Cost)								
		SUB-TOTAL			$484,923,000			$462,319,000

SINGLE EXPENDITURE (REPLACEMENT)	**YEAR**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**		**ALTERNATIVE CONCEPT**	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Salvage Value at End of Economic Life						
		SUB-TOTAL		$0		$0
		TOTAL PRESENT WORTH		$484,923,000		$462,319,000
				PRESENT WORTH SAVINGS ON O&M		$22,604,000
				LIFE CYCLE COST SAVINGS		$22,604,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
RD-6

Title:
Expand Thermal Comfort Zones

Description of Original Concept:

The original concept for most of the areas devoted to creature comfort have indoor design dry bulb temperatures of 75 deg F for the summer and 70 degrees F for the winter.

Description of Alternative Concept:

The alternative concept proposes to use indoor design dry bulb temperatures of 78 deg F for the summer and 68 degrees F for the winter.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 0
O&M Savings:	$ 150,000
Life Cycle Cost Savings:	$ 150,000

Advantages/Disadvantages

Alternative No.: RD-6

Advantages of Alternative Concept

- Reduces energy consumption
- Reduces equipment sizing and hence, project first cost

Disadvantages of Alternative Concept

- Slightly lowers creature comfort
- May require higher airflows to comply with ASHRAE 55

Discussion

Alternative No.: RD-6

Most of the rooms dedicated to admin functions have indoor design temperatures of 75 degrees F for the summer and 70 degrees for the winter. This proposal addresses the energy conservation benefits of increasing the summer indoor design temperature to 78 degrees F dry bulb, and the winter indoor design temperature to 68 degrees F dry bulb. The server room in the Brigade headquarters building and the comm. Room units will retain the current indoor dry bulb settings of 72 deg F.

Expanded thermal comfort zones

	base case	expanded setpoints	savings		
COF Readiness	294,598.00	21,022.00	273,576.00	kwh	elec
	24,211.00	21,022.00	3,189.00	kbtu	gas
	$ 37,190.00	$ 35,918.00	$ 1,272.00	$	cost
COF Admin	129,132.00	127,953.00	1,179.00	kwh	elec
	884,256.00	874,256.00	10,000.00	kbtu	gas
	$ 20,344.00	$ 20,140.00	$ 204.00	$	cost
Two Battalion HQ and Brigade HQ	1,513,924.00	1,489,974.00	23,950.00	kwh	elec
	464,534.00	431,926.00	32,608.00	kbtu	gas
	$ 129,962.00	$ 125,274.00	$ 4,688.00	$	cost

Life Cycle Cost Analysis

Alternative No.: RD-6

LIFE CYCLE PERIOD 40 YEARS — ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST	ORIGINAL CONCEPT	ALTERNATIVE CONCEPT
	$0	$0
Capital Cost Savings		$0

ANNUAL EXPENDITURE	%	PRESENT WORTH FACTOR	ORIGINAL CONCEPT CAPITAL COST	ORIGINAL CONCEPT ANNUAL COST	ORIGINAL CONCEPT PRESENT WORTH	ALTERNATIVE CONCEPT CAPITAL COST	ALTERNATIVE CONCEPT ANNUAL COST	ALTERNATIVE CONCEPT PRESENT WORTH
Energy Consumption - COFS		19.7928		74,380	1,472,000		71,836	1,422,000
Energy Consumption - COFS Admin		19.7928		40,688	805,000		40,280	797,000
Energy Consumption - HQ Buildings		19.7928		129,962	2,572,000		125,274	2,480,000
Generalized (% of Capital Cost)								
		SUB-TOTAL			$4,849,000			$4,699,000

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT ESTIMATE	ORIGINAL CONCEPT PRESENT WORTH	ALTERNATIVE CONCEPT ESTIMATE	ALTERNATIVE CONCEPT PRESENT WORTH
Salvage Value at End of Economic Life						
		SUB-TOTAL		$0		$0
		TOTAL PRESENT WORTH		$4,849,000		$4,699,000

PRESENT WORTH SAVINGS ON O&M	$150,000
LIFE CYCLE COST SAVINGS	$150,000

ALTERNATIVE ENERGY

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
UR-4

Title:
Use a solar collector field to serve buildings

Description of Original Concept:

Utilize roof space on the proposed COF, Brigade Headquarters and Barracks buildings on Fort Campbell to generate power using an array of thin film photovoltaic modules.

Description of Alternative Concept:

Utilize capped landfills within the vicinity of the proposed COF, Brigade Headquarters and Barracks to generate power using PV modules placed a racking assembly that does not penetrate the cap.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	($ 15,966,000)
O&M Savings:	$ 71,463,000
Life Cycle Cost Savings:	$ 55,467,000

Advantages/Disadvantages

Alternative No.: UR-4

Advantages of Alternative Concept

- Capped landfills are areas of the base that cannot be used for any purpose.
- There are at least six capped landfill sites within 4,000 ft of the proposed high-performance buildings that could generate renewable power for these LEED Certified (or LEED "ready") buildings.
- Such a system would showcase how high efficiency construction with on-site power generation can achieve the Army's goal of building "net-zero" buildings with respect to the use of fossil fuel.

Disadvantages of Alternative Concept

- The cost of this power source is considerably higher than what Fort Campbell currently pays with respect to electricity.
- Potential glare associated with solar fields during certain times of day within 1 mile of the airport.

Discussion

Alternative No.: UR-4

It has become clear during this VE Study that even high performance, high-efficiency buildings will have difficulty achieving the long-term goals of reducing their use of fossil fuels as stipulated by the Energy Independence and Security Act of 2007 (EISA). With respect to Fort Campbell, the loads associated with overall energy use in a facility (i.e. heating, cooling, and lighting) represent anywhere from 35-50% of a building's consumption. In some specialized facilities, plug loads associated with electronic equipment can represent the largest single use of energy. Therefore, the electricity purchased from outside utilities and its associated emissions profile (based on fuel source) are critical to achieving the net-zero goals required under Section 433 of EISA. If the power used by a facility is generated using fossil fuel, EISA goals will remain elusive. Therefore, onsite power generation using renewables is one important strategy for fully complying with the regulations and the long-term goals established by the Department of Defense's *Strategic Sustainability Performance Plan*.

Within 4,000 feet of the proposed Company Operations Facility (COF), Battalion Headquarters, Brigade Headquarters and Barracks are six capped landfills totaling 121 acres. One of the sites is a 9.4 acre capped site containing construction debris. The remaining sites are classified as "sanitary." All are more than 20 years old and one is currently used in part as a motorcycle track.

This analysis recommends generating "onsite power" for all of the proposed projects except the TEMF by placing PV arrays on one of the nearby landfill sites. There are special racking systems (the structures that hold the PV modules in place) that do not penetrate the cap of a landfill and are secure and lightweight. In addition, amorphous silicon (Am Si or "Thinfilm") modules can be used that are lighter per square foot than other module types, though they have lower power densities. Even so, Am Si modules have some of the lowest prices per watt of any conventional panel type on the market and are the industry standard for large-scale deployment of PV. It should be noted that many states including California, New Jersey and Massachusetts, have instituted specific programs that target the development of landfill sites for PV power generation.

In this study, we identified the nearby closed landfills on the base and estimated the generation potential of each site using conservative assumptions about panel generation and array coverage. For the sake of this estimate, we selected a Kaneka 60W Thinfilm module, a well established manufacturer and product. (See attached for specifications.) Of particular importance was evaluating interconnection points to the existing electrical substations in the area. This was critical since there are no net metering provisions in Kentucky or Tennessee state policy, meaning all power should feed a load in the grid area. Next, we estimated the power needs of the 11 buildings being proposed in this area of the base that are a part of this study. Our analysis indicated that these buildings in aggregate will require 2.05 MW of power <u>before</u> any additional energy reduction strategies are implemented; i.e. this used standard baseline assumptions about power requirements per square foot <u>not</u> assuming any of the improved energy efficiency measures and load reduction strategies that are a part of these projects. With a 65% reduction, the total load is estimated to be 1.34 MW.

Discussion

Alternative No.: UR-4

Based on this potential load profile and looking at the potential size and proximity of nearby closed landfills, we recommend installing a PV system on Site 6 and connecting to the 12 kV line that runs along Ashua Valley Road. Using conservative assumptions about coverage (80% of area) and capacity (% of solar radiation converted) we estimate that the 9.4 acre site would generate 1.94 MW of power and 1.54 MWh of electricity over the course of one year (as calculated using *PV Watts*).

While there are other parts of the country with better solar resources, there are other areas with worse insolation rates that are nonetheless financing and building PV systems. There is sufficient resource here at Fort Campbell to merit consideration of this project, especially if energy independence is one objective.

It should be noted that there is an additional 20.8 MW of potential PV generation on top of other landfill sites within 3,500 feet of the proposed projects, again using conservative assumptions. (See table summary of landfill sites.)

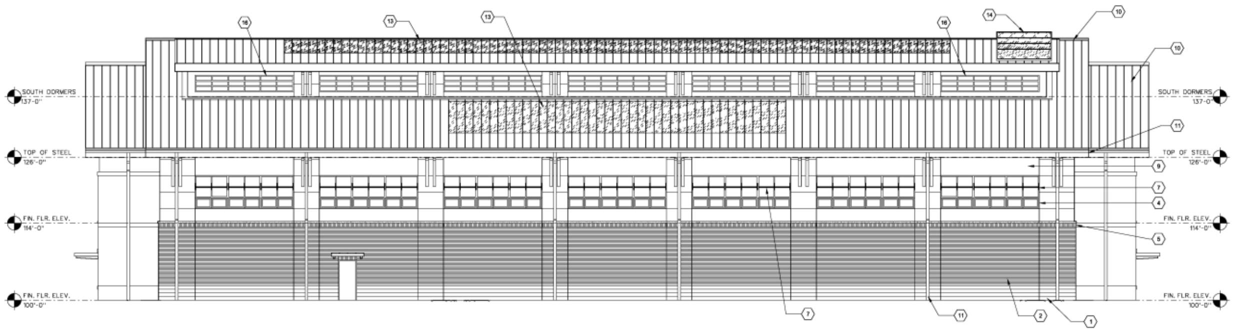
Relatively speaking, this project would be expensive, since Fort Campbell pays an average rate of $0.0671/kWh for its electricity, an extremely low rate by national standards. Using well developed rates for PV projects, we decided to estimate a $7.00 per watt installed cost. The actual cost per watt may be less. This assumes the use of less expensive amorphous silicon panels (as specified above) and specialized racking systems. This unit price also includes all design and contractor costs as well as the balance of system (BOS) components (including inverters, charge controllers, junction boxes, and wiring).

It should be noted that while the payback for this project will be near or exceed the 40 year life cycle cost window for this study, there are significant opportunities and benefits here nonetheless. This project and others like it can provide a real hedge against a future and significant escalation in energy prices. Since 70% of the Tennessee Valley Authority's generation portfolio is coal, this is a major consideration over the next ten years. This project also allows for the generation (and potential storage at a later date) of onsite energy that can be dispatched on a moment's notice, providing a secure and independent back-up system for mission critical operations.

Sketch

Alternative No.: UR-4

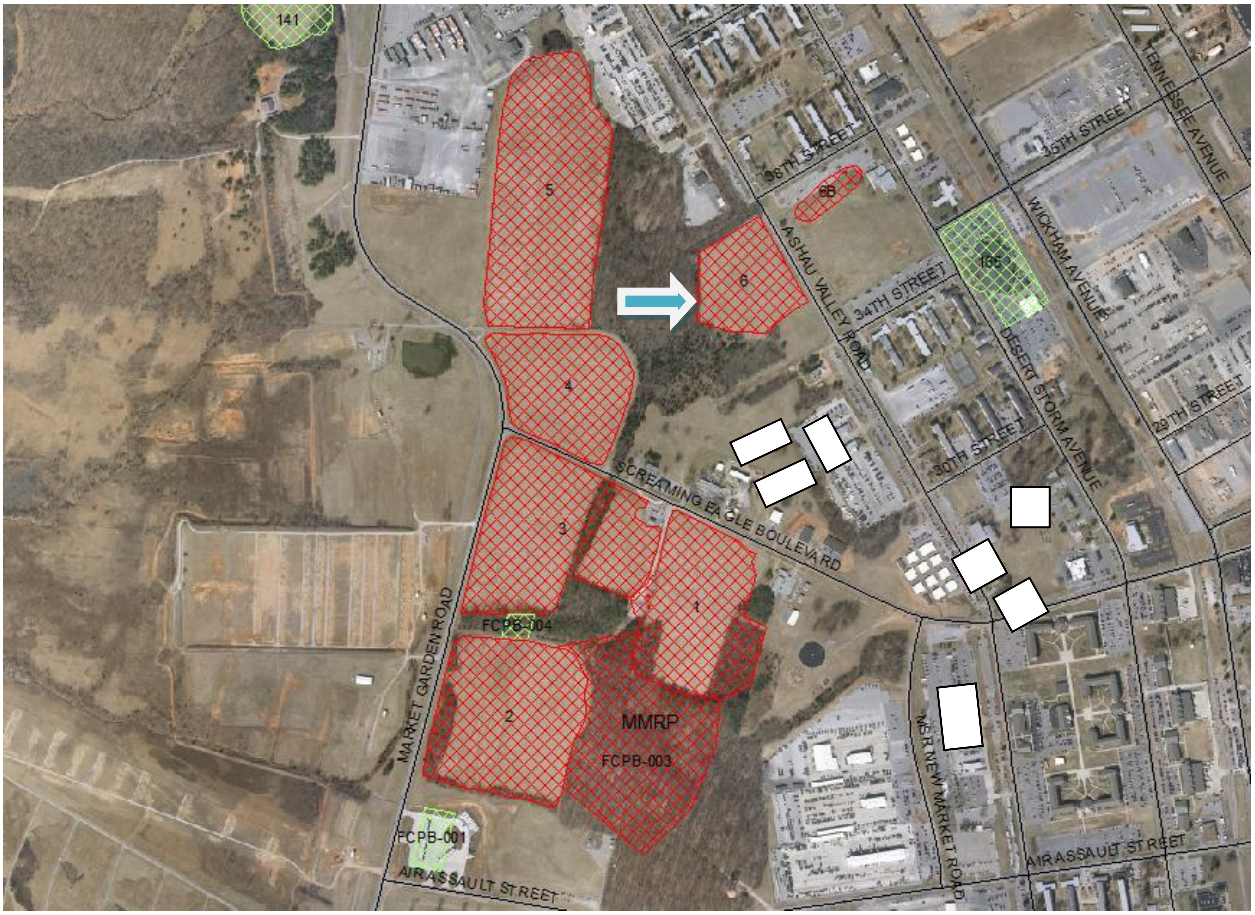
☑ Original ☐ Alternative



Sketch

Alternative No.: UR-4

☐ Original ☑ Alternative

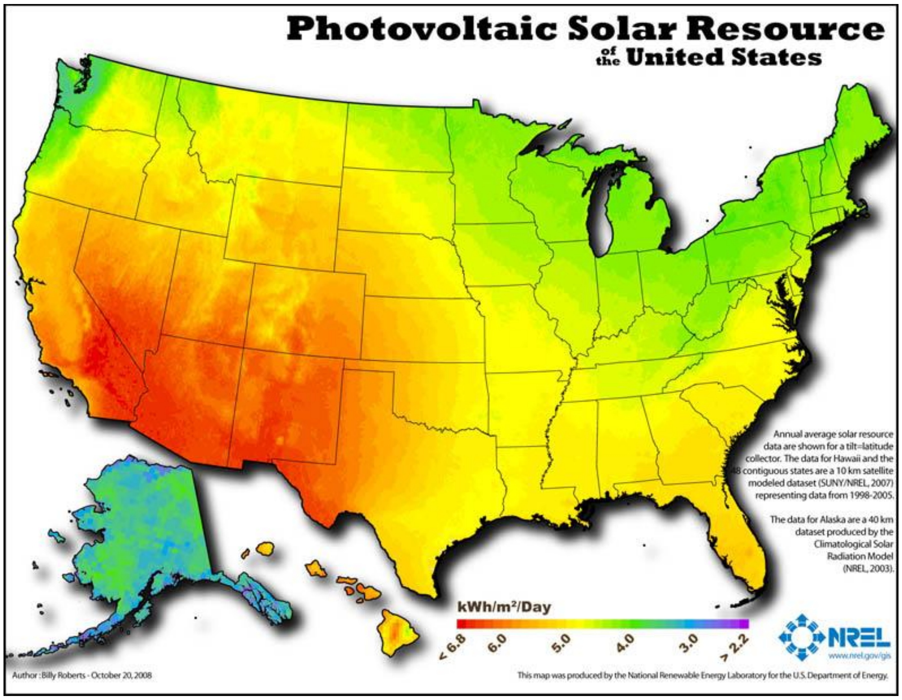


Fort Campbell Landfill sites near proposed construction projects. Note location of Site 6. Building projects are indicated but not drawn to scale or scope.

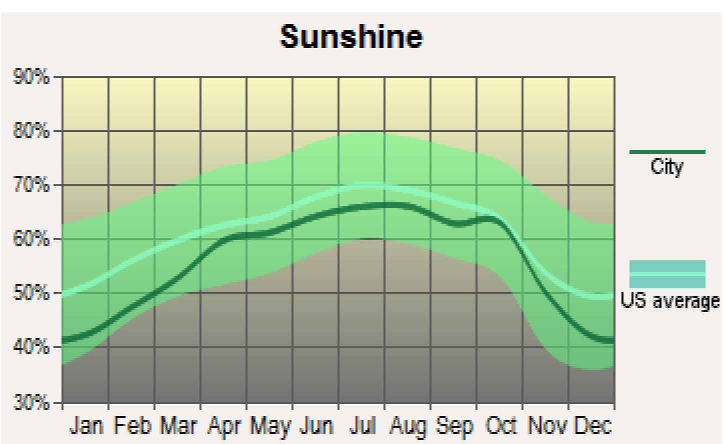
Sketch

Alternative No.: UR-4

☐ Original ☑ Alternative



Average Insolation Resource (kW/m^2/day) across the Continental U.S. Source: NREL



Insolation Resource at Fort Campbell compared to US average.

Calculations

Alternative No.: UR-4

☐ Original ☑ Alternative

Landfill Sites within 4000 ft of Proposed Projects at Fort Campbell

,

Landfill	Acres	Types	~ Dis from COF in ft	kW/site	Total Cost ($/w installed)	AC Output kW (77%)
5	30.08	Sanitary	3,000	6,148	$ 43,036,358	4,734.00
4	14.7	Sanitary	1,500	3,005	$21,031,731	2,313.49
3	24.7	Sanitary	1,500	5,048	$35,339,031	3,887.29
1 *	19.3	Sanitary	600	1,972	$13,806,545	1,518.72
6	9.4	Con Debris	1,000	1,921	$13,448,862	1,479.37
2	23.02	Sanitary	2,500	4,705	$32,935,405	3,622.89

*Assumptions: 205 kW per acre / A Si 60 W panels / * Assumes 50% of Site 1*

Calculations

Alternative No.: UR-4

☐ Original ☑ Alternative

Facility Name	Area in Gross sqft	Use	Req Capacity in kVA	Demand In kVA @25% of Installed Capacity	Demand In kWh - From Energy Model	kWh per sq ft- From Energy Model
COMPANY OPERATIONS FACILITIES						
Building 'A'	34,894	Office/Storage	500	125	285,670	2
Building 'B'	16,558	Office	225	56		
Building 'C'	36,958	Office/Storage	500	125	Incl in 'A'	Incl in 'A'
Building 'D'	34,894	Office/Storage	500	125	Incl in 'A'	Incl in 'A'
Building 'E'	16,558	Office	225	56		
Building 'F'	36,598	Office/Storage	500	125	Incl in 'A'	Incl in 'A'
Central Plant	36,598	Utility	600	150	Incl in 'A'	Incl in 'A'
Sub Total	**176,460**		**3,050**	**763**	**285,670**	
BATTALION/BRIGADE HEADQUARTER FACILITIES						
Battalion Headquarters	22,321	Office	300	75	252,970	11
Battalion Headquarters	22,321	Office	300	75	252,970	11
Brigade Headquarters	43,130	Office	500	125	1,135,645	26
Sub Total					**1,641,585**	
BARRACKS						
Barracks Housing Facility	146,654	Housing	1,500	375	900,000	6
Sub Total					**900,000**	
TOTAL kWh					**2,827,255**	
TOTAL kW					**2,052**	
TOTAL kWh with 65% reduction per EISA					**1,837,716**	
TOTAL kW, revised					**1,334**	

Construction Cost Estimate

Alternative No.: UR-4

Item	Unit of Meas.	Unit Cost	Original Concept (Deletions) Qty	Original Concept (Deletions) Total	Alternative Concept (Additions) Qty	Alternative Concept (Additions) Total
PV Array with racking system installed	Watts	7.00			1,928,571	$13,500,000
Total Current Contract Cost						$13,500,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%				$885,987
Subtotal						$14,386,000
Contingencies		5.00%				$719,300
Subtotal						$15,105,000
SIOH		5.70%				$860,985
TOTALS						$15,966,000
NET SAVINGS						($15,966,000)

Life Cycle Cost Analysis

Alternative No.: UR-4

Escalation thru Year 10	1.50%
Escalation thru Year 11-40	0.50%
Escalation for CF & REC	0.50%

Year	$/kwh	Annual Electric Savings	Savings on Carbon Footprint	Renewable Energy Credits		Cumulative Cost
0	$0.07	$103,180	$5,852			$109,032
1	$0.07	$104,728	$5,881			$219,641
2	$0.07	$107,893	$5,940			$333,474
3	$0.07	$112,821	$6,030			$452,326
4	$0.08	$119,745	$6,151			$578,221
5	$0.08	$128,999	$6,307			$713,527
6	$0.09	$141,053	$6,498			$861,078
7	$0.10	$156,547	$6,729			$1,024,354
8	$0.12	$176,349	$7,003			$1,207,706
9	$0.13	$201,636	$7,324			$1,416,666
10	$0.15	$234,006	$7,699			$1,658,372
11	$0.16	$247,203	$8,133	$61,600		$1,975,309
12	$0.17	$262,450	$8,635	$65,399		$2,311,793
13	$0.18	$280,031	$9,213	$69,780		$2,670,818
14	$0.20	$300,283	$9,880	$74,827		$3,055,807
15	$0.21	$323,610	$10,647	$80,640		$3,470,704
16	$0.23	$350,493	$11,532	$87,338		$3,920,066
17	$0.25	$381,506	$12,552	$95,067		$4,409,191
18	$0.27	$417,341	$13,731	$103,996		$4,944,260
19	$0.30	$458,824	$15,096	$114,333		$5,532,513
20	$0.33	$506,953	$16,679	$126,326		$6,182,471
21	$0.37	$562,930	$18,521	$140,275		$6,904,197
22	$0.41	$628,215	$20,669	$156,543		$7,709,624
23	$0.46	$704,575	$23,181	$175,571		$8,612,952
24	$0.52	$794,169	$26,129	$197,897		$9,631,147
25	$0.58	$899,631	$29,599	$224,177		$10,784,554

Year	$/kwh	Annual Electric Savings	Savings on Carbon Footprint	Renewable Energy Credits		Cumulative Cost
26	$0.67	$1,024,194	$33,697	$255,216		$12,097,661
27	$0.76	$1,171,833	$38,555	$292,006		$13,600,055
28	$0.88	$1,347,459	$44,333	$335,770		$15,327,617
29	$1.01	$1,557,153	$51,232	$388,023		$17,324,025
30	$1.17	$1,808,478	$59,501	$450,650		$19,642,653
31	$1.37	$2,110,868	$69,450	$526,002		$22,348,973
32	$1.61	$2,476,139	$81,468			$24,906,580
33	$1.90	$2,919,141	$96,043			$27,921,764
34	$2.25	$3,458,607	$113,792			$31,494,163
35	$2.67	$4,118,256	$135,495			$35,747,914
36	$3.20	$4,928,237	$162,144			$40,838,295
37	$3.85	$5,927,013	$195,005			$46,960,313
38	$4.65	$7,163,846	$235,698			$54,359,856
39	$5.65	$8,702,071	$286,307			$63,348,235
40	$6.90	$10,623,438	$349,522			$74,321,195
	NPV =	$71,462,688				
		$55,497,000				

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No: UR-16

Title:
Use small modular nuclear reactors

Description of Original Concept:

No nuclear concept included in any of the original construction projects. Electric power for each project listed is to be provided by the existing service available at Fort Campbell.

Description of Alternative Concept:

The alternative concept is to install a Small Modular Reactor (SMR) on the installation to provide all required electrical power for the entire installation. SMR will be sized to accommodate growth of the installation for the next twenty years based on 2% demand increase per year. Installation of one 125 Megawatt mPower Small Modular Reactor by Babcock & Wilcox will meet the current demand of 62 Megawatt for the installation and the projected demand for the next twenty years. Operating life of the SMR is 60 years.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	($ 179,295,000)
O&M Savings:	$ 432,065,000
Life Cycle Cost Savings:	$ 252,770,000

Advantages/Disadvantages

Alternative No.: UR-16

Advantages of Alternative Concept

- Complete independence from electric grid, less risk to nation of “brown outs”
- Energy Security for mission critical installation, i.e., power within installation boundaries
- Mature Light Water Reactor Technology.
- 100% Clean Energy
- Compliance with Greenhouse Gas Reduction laws/executive order
- Compliance with fossil fuel reduction in buildings (laws/executive order)
- Reduction in energy cost.
- Excess power may be sold to TVA per Public Utility Regulation Act of 1978 at cost that TVA experiences to produces same amount of power

Disadvantages of Alternative Concept

- Requires strategy for handling, storage, and disposal of nuclear waste.
- Initial capital cost.
- Unique or dedicated equipment.
- Risk of rupture, negative perception today due to Japan issue
- Real risk of rupture being measured now.

Discussion

Alternative No.: UR-16

Fort Campbell depends entirely on TVA for electrical power at the installation. Surveys conducted by Pacific Northwest National Labs and other organizations determined Fort Campbell may have limited opportunities for renewable energy sources such as wind and solar due to the Installation's geographical location. Energy Security is critical to the Installation. Any major disruptions in electrical power due to terrorism, nature disasters, or equipment failures for extended periods would severely impact Fort Campbell mission. Installation of the Small Modular Reactors could establish a completely independent energy source to meet the Installation's electrical demand, increasing security and supporting the military's mission.

Small Modular Reactor (SMR) Technology is being developed by various government and private organizations. Installation of six 125 megawatt SMR units at Oak Ridge National Lab is in process and should be completed by 2019. Other technologies such as NuScale, IRIS, 4S are also being developed using LWR and non-LWR technology.

Fort Campbell spends roughly $25 million for energy annually ($24.5 million in FY10), and this cost continues to escalate. Additionally, power supplies in the southeast continue to struggle to meet growing energy demands. Continued growth is forecast for the installation energy cost and demand. This project is proposed to reduce annual energy cost while also increasing Army Energy Security.

We propose installation of a 125 megawatt Babcock and Wilcox mPower Small Modular Reactor or similar technology within the installation's boundaries to provide all electrical energy for the installation.

Sketch

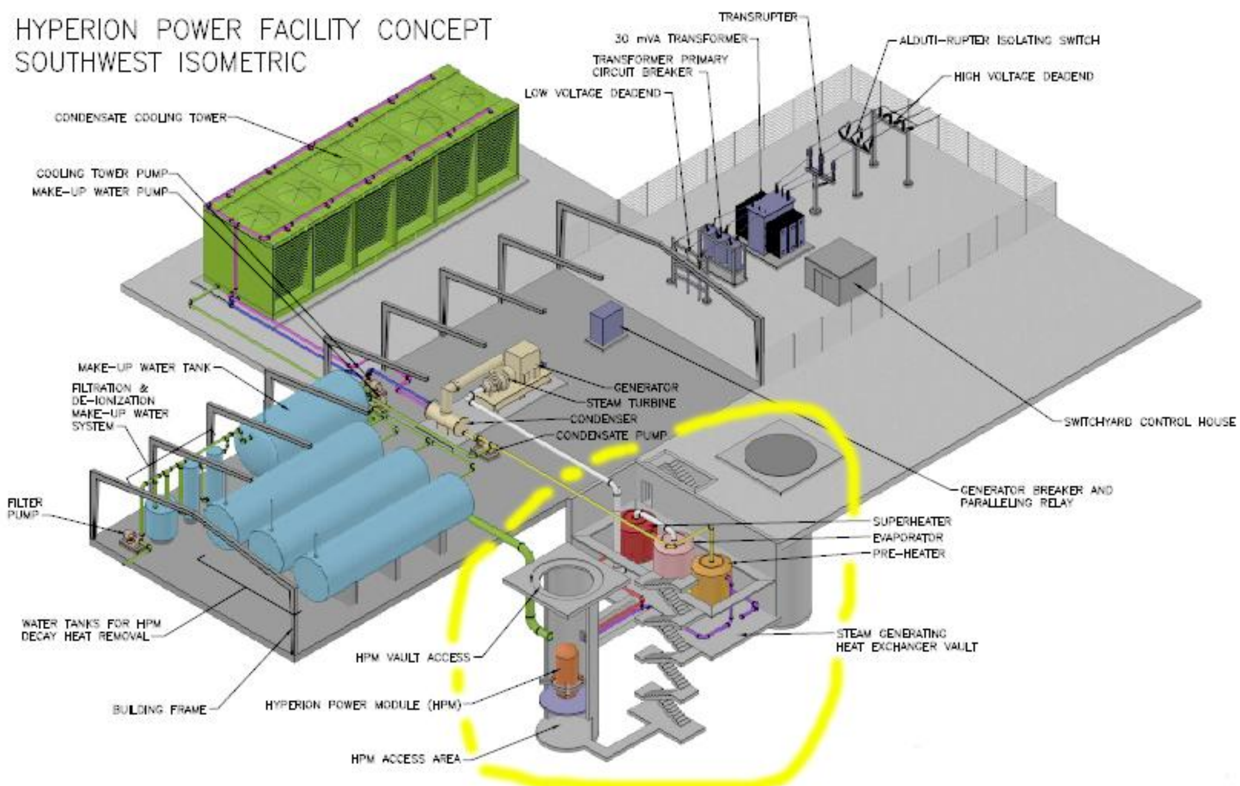
Alternative No.: UR-16

☐ Original ☑ Alternative

Sketch

Alternative No.: UR-16

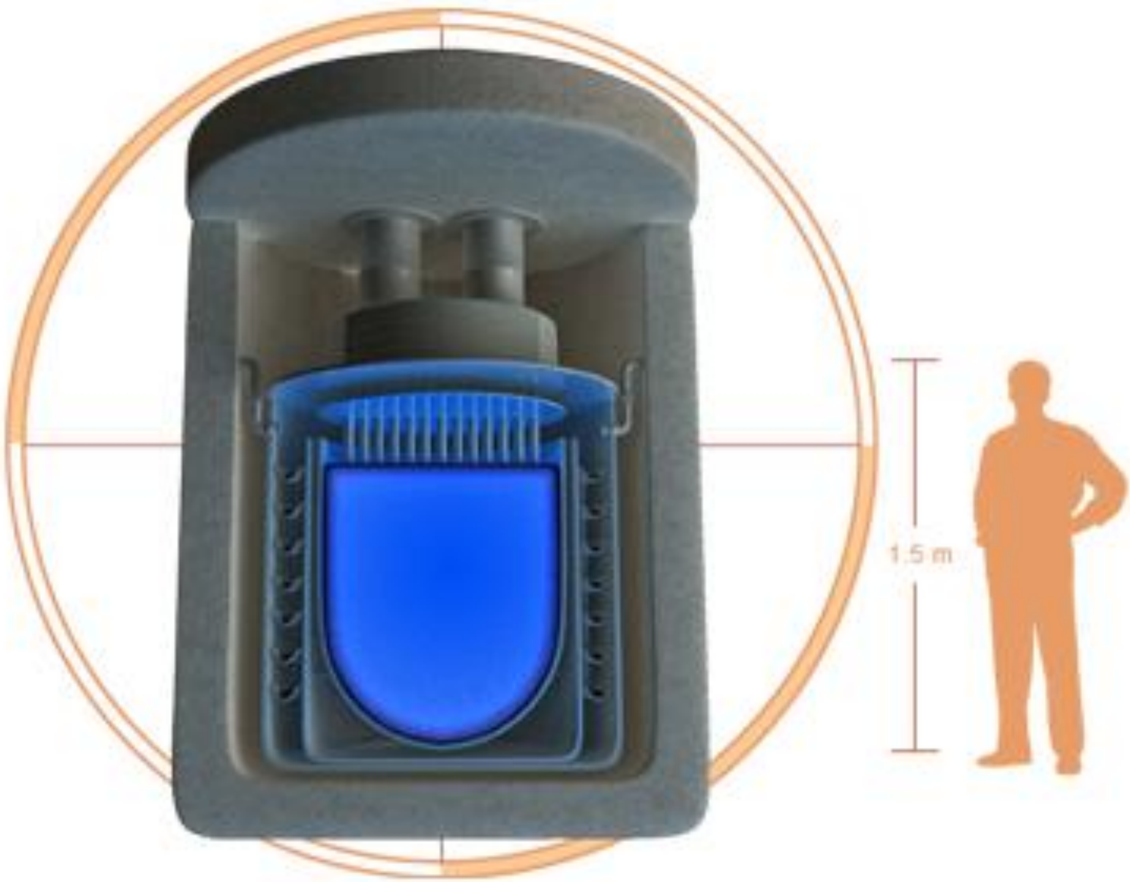
☐ Original ☑ Alternative



Sketch

Alternative No.: UR-16

☐ Original ☑ Alternative



Calculations

Alternative No.: UR-16

☐ Original ☑ Alternative

FY10 Energy Cost Fort Campbell - $24.5 M

Electric - $16.5M

Gas - $8.0M

One SMR 125 Megawatt mPower unit - $151.6M

Includes the cost of SMR, building, turbines, and condenser, etc.

O&M Annual Cost - $1.8M

Electric Escalation Rate – 3.87%

Refueling Cost – Unknown

Refueling Cycle - 5 years

Time to Refuel – 3 weeks

Operating Life – 60 years

Construction Cost Estimate

Alternative No.: UR-16

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Power Plant	EA	151,600,00			1	$151,600,000
Total Current Contract Cost						$151,600,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%				$9,949,306
Subtotal						$161,549,000
Contingencies		5.00%				$8,077,450
Subtotal						$169,626,000
SIOH		5.70%				$9,668,682
TOTALS						$179,295,000
NET SAVINGS						($179,295,000)

Life Cycle Cost Analysis

Alternative No.: UR-16

LIFE CYCLE PERIOD 40 YEARS

ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST			ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
					$0			$179,295,000
Capital Cost Savings								($179,295,000)
ANNUAL EXPENDITURE	**%**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Annual FTC Energy Consumption		19.7928		24,500,000	484,923,000			
Maintenance of Nuclear Plant		19.7928					1,800,000	35,627,000
Generalized (% of Capital Cost)								
SUB-TOTAL					$484,923,000			$35,627,000

SINGLE EXPENDITURE (REPLACEMENT)	YEAR	PRESENT WORTH FACTOR	ORIGINAL CONCEPT		ALTERNATIVE CONCEPT	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Refueling Cost	5	0.8219		0	5,000,000	4,110,000
Refueling Cost	10	0.6756		0	5,000,000	3,378,000
Refueling Cost	15	0.5553		0	5,000,000	2,776,000
Refueling Cost	20	0.4564		0	5,000,000	2,282,000
Refueling Cost	25	0.3751		0	5,000,000	1,876,000
Refueling Cost	30	0.3083		0	5,000,000	1,542,000
Refueling Cost	35	0.2534		0	5,000,000	1,267,000
Salvage Value at End of Economic Life						
SUB-TOTAL				$0		$17,231,000
TOTAL PRESENT WORTH				$484,923,000		$52,858,000
PRESENT WORTH SAVINGS ON O&M						$432,065,000
LIFE CYCLE COST SAVINGS						$252,770,000

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No: UR-20

Title:
Use a public-private partnership to finance a large scale program for renewable energy

Description of Original Concept:

There are no appropriated funds for Ft. Campbell to accomplish the Renewable Energy recommendations and directives of current laws and executive orders. The installation has significant waste (and subsequent disposal costs). Energy costs are reasonable, but there is security threat of blackout from events outside the installation boundaries.

Description of Alternative Concept:

This proposal recommends the utilization of Private Funding for first cost of any desired renewable energy projects or energy conservation programs (or at a minimum, a workshop to assess the feasibility of such).

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☑ Maintained
☐ Decreased	☐ Decreased

Cost Savings Summary

First Cost Savings:

O&M Savings: **No Cost Developed**

Life Cycle Cost Savings:

Advantages/Disadvantages

Alternative No.: UR-20

Advantages of Alternative Concept

- Building renewable energy facilities on Ft. Campbell now will INCREASE BASE SECURITY, even if economics indicates that 100% of base energy can't be cost-effectively constructed "within the fences". This is accomplished thru less dependence on outside sources.
- At least partial compliance with unfunded laws and executive orders can be accomplished.
- At least partial compliance with Army's unfunded "Net Zero" initiative can be accomplished.
- Constructing renewable energy source now will reduced load on the National energy grid, again reducing likelihood of power loss on base.
- Significant funding for renewable energy can be made available relatively fast (in relation to normal appropriation funding for Ft. Campbell), and would NOT be dependent upon currently-stressed Congressional appropriations.
- Cost of Installation waste removal will be reduced.
- Cost of Installation energy has potential to be reduced over time (life cycle).
- The 30% Federal Treasury tax grant (plus 5% of project first cost) for deals awarded by 12/31/11, makes such investment immediately rewarding for private investors, and installations.
- For an Energy Conservation Program, no Environmental Assessment nor Environmental Impact Statement would be required, speeding implementation even further.

Disadvantages of Alternative Concept

- Unless Treasury is able to extend the tax grants into calendar year 2012, there is risk that a significantly compressed schedule will diminish the chances for success.
- There is always risk that a renewable energy project might not perform as well as hoped, but this risk has proven to be low to negligible.

Advantages/Disadvantages

Alternative No.: UR-20

- Taking advantage of the 30% + tax grant means that timely environmental approvals are critical. An Environmental Assessment is workable within time frame for complete success, but a full Environmental Impact Statement would add a more serious impediment to success.
- Project planning/management/implementation capability within Ft. Campbell may be an impediment to quick turnaround/full benefit of partnership. Outside assistance may be needed from an experienced part of the private sector to “fast track” & meet objectives.
- If deadlines can’t be met for the 12/31/2011 deadlines, benefits will be reduced.
- Tax Grants and/or benefits might not apply to an Energy Conservation Program.

Discussion

Alternative No.: UR-20

Ft. Campbell has significant amounts of waste, and waste-disposal costs: (1) cooking oil; (2) sludge from waste water treatment; (3) tires; (4) 13 tons of mixed solid waste/week which has a tipping fee of $32/ton (cost to place in landfill); (5) construction & demolition waste which has a tipping fee of $15/ton; etc. The Base has expressed interested in biomass and co-generation projects, as a minimum. It also has farm land on installation which might lend itself to renewable use. Base preference would be to have any such project pay for itself in less than 10 years, but legal/regulatory requirements allow 40 years for economic determinations.

There is an Installation security threat from terrorist-caused loss of power from outside the base, and/or brown-outs from grid failure (thru no fault or control of installation.

The National Energy Conservation Policy Act of 1978 and the Energy Policy Act of 1992 recommended Federal use of Renewable Energy. The Energy Policy Act of 2005, the Energy Independence and Security Act of 2007, and Executive Order 13514 direct use of Renewable Energy. It will be difficult if not impossible to meet the legal and directed renewable energy goals without private funding for construction first cost.

It will be difficult, if not impossible, to meet legal and directed reductions in greenhouse gas emissions and fossil fuel energy use in buildings, directed by Executive Orders 13423/13514 and EISA 2007, without accomplishing the above-mentioned renewable energy recommendations/directives.

Ft. Campbell is already working with Huntsville (USACE), regarding renewable energy contracts, so there is interest at the Installation to build such.

There is in place a 30% Federal Treasury Tax Grant to private investors who invest in renewable projects by 12/31/2011, plus 5% of the total renewable project cost allocated. This is an outright grant instead of a tax credit, making this program all the more attractive for owner and investor. Investment Tax Credits and Production Tax Credits will continue after 12/31/11, and will make green power more attractive but the costs will be greater comparing cash to a tax credit. Structured properly, investors/banks can keep these projects and their financing off public and non-profit balance sheets. The transaction ends up on the private investor's sheets, as they are an owner of convenience.

There is a web site dsireusa.org that provides all state Renewable Energy Credits (RECs), Renewable Portfolio Standards (RPS) and rebates.

The current Ft. Campbell blended Kilowatt-hour cost is $0.067. The base rate ranges from $0.032-$0.037 and the Demand charge is $13.12/KW. Demand load contracted with TVA is 62 megawatts to provide all needs. The installation seldom utilizes this amount.

Energy created at Ft. Campbell will reduce its demand load with TVA, lowering this component's portion of the energy rate.

Discussion

Alternative No.: UR-20

Rough estimates indicate that Ft. Campbell's utility rate could double (from currently blended $0.067 to $0.10-$0.13) under current conditions if the Installation attempted to provide all of its own power.

A better solution would likely be to create a smaller project such as a co-generation plant built in conjunction with the soon-to-be-upgraded Waste Water Treatment Plant. A unit like this would generate electricity on the site of one of the largest users of power on the base and provide a source of heat for the treatment plant's processes. In addition, methane from the plant could be used to fuel the generator resulting in a plant-waste-by-product being used to power the facility. Such a $3-million to $5 million project is much more likely to be life-cycle cost effective, and there are numerous investors available wishing to fund such a government venture.

Rough estimates indicate that $500,000 invested on an Energy Conservation Program has the potential to result in $1 million to $2 million in energy savings on the Installation per year.

THIS PAGE INTENTIONALLY LEFT BLANK.

Value Alternative

Project: EISA Demonstration Project-Brigade Combat Team 3 Complex
Location: Ft. Campbell, KY

Alternative No:
UR-36

Title:
Use Solar Powered Site and Street Lighting

Description of Original Concept:

The original concept is to light the site using LED fixtures. There are currently 106 fixtures shown for the BCT3 complex using a total of approximately 35,000 watts of power. Although there is no circuiting shown, I am assuming that they are planning on obtaining their source of power from the local utility.

Description of Alternative Concept:

The alternative concept is to use photovoltaics (PV) to power the LED fixtures. Each light will be fixed with a PV panel to supply power to each fixture.

Value Improvement

$$\text{Value} \approx \frac{\text{Function}}{\text{Resources}}$$

Function	Resources
☑ Increased	☐ Increased
☐ Maintained	☐ Maintained
☐ Decreased	☑ Decreased

Cost Savings Summary

First Cost Savings:	$ 213,000
O&M Savings:	$ 262,000
Life Cycle Cost Savings:	$ 475,000

Advantages/Disadvantages

Alternative No.: UR-36

Advantages of Alternative Concept

- Independent power source
- Lighting works even during power outage
- Completely renewable power source
- Low maintenance
- Ease of installation, no need for underground wiring
- Offers a return on the investment

Disadvantages of Alternative Concept

- High up front cost
- Does not work well in inclement/snowy weather
- No return on investment

Discussion

Alternative No.: UR-36

The approach here is to replace the conventional way of feeding site lighting with PV cells. The obvious advantages are tapping into free energy. The higher upfront costs can be greatly offset when not only considering the monthly energy cost savings, but the savings in material and labor for trenching/backfill, conduit, wiring, branch breakers, and maintenance cost of all of the above.

In order to justify why there is so much technological and monetary effort going into solar power and the development of new solar energy facilities it might be worthwhile going over a few of the significant benefits that are achieved from using solar energy. Some of these may seem obvious, some may be debatable and some may be surprising to some, but make no mistake, regardless of the detractors, solar energy is a valuable resource to develop and to refine.
So here are the benefits of solar energy.

1. Solar energy is not only sustainable, it is renewable and this means that we will never run out of it. It is about as natural a source of power as it is possible to generate. Not only are we able to refuel our vehicles with it we can heat our water and light our homes.

2. We can generate our own source of electricity via solar panels. In other words we need not be dependent on the public utility companies to supply our power and we also won't be required to pay for out power.

3. The creation of solar energy requires little maintenance. Once the solar panels or troughs have been installed and they are brought up to maximum efficiency there is little else to do to ensure they are in working order.

4. They are a silent producer of energy. There is absolutely no noise made from photovoltaic panels as they convert sunlight into usable electricity.

5. The creation of solar power is unobtrusive.

6. The advancements in technology used to create solar energy are continuing to improve making it even more cost effective. As it becomes cheaper to install new solar energy generators the price of solar electricity will continue to drop bringing it more into line with traditional, fossil-fuel generated electricity.

7. Solar panels produce zero emissions and make no adverse mark on the environment.

Sketch

Alternative No.: UR-36

☑ Original ☐ Alternative

Sketch

Alternative No.: UR-36

☐ Original ☑ Alternative

Figure 3-2. Pathway PV lighting system at Brevard Community College.

Figure 3-3. PV pier lighting (Panama City Beach, FL).

Figure 3-4. PV security lighting (Florida Keys).

Figure 3-5. PV park lighting (Lakeland, FL).

Calculations

Alternative No.: UR-36

☑ Original ☐ Alternative

Assume 400W fixtures x 209 fixtures

= 83.6 kW

Assume 10 hrs/day operation

= 83.6 ks x 10 hrs/day – 836 kWh/day

=305,104 kWh/year

At $0.067/kWh

= $305,104 kWh/year x $0.067/hWh

=$20,500/year in energy cost

Figure 75% savings: 75% x $20,500 = $15,375

Construction Cost Estimate

Alternative No.: UR-36

			Original Concept (Deletions)		Alternative Concept (Additions)	
Item	**Unit of Meas.**	**Unit Cost**	**Qty**	**Total**	**Qty**	**Total**
Lighting Conductors	LF	1.00	135,260	$135,260		
Lighting Conduit	LF	5.00	30,162	$150,810		
PV Cell Package	EA	500.00			209	$104,500
Total Current Contract Cost				$286,000		$105,000
Escalation Const Midpoint (Mar 11 to Oct 13)		6.56%		$18,770		$6,891
Subtotal				$305,000		$112,000
Contingencies		5.00%		$15,250		$5,600
Subtotal				$320,000		$118,000
SIOH		5.70%		$18,240		$6,726
TOTALS				$338,000		$125,000
NET SAVINGS						$213,000

Life Cycle Cost Analysis

Alternative No.: UR-36

LIFE CYCLE PERIOD 40 YEARS

ANNUAL PERCENTAGE RATE 4.000%

CAPITAL COST			ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
					$338,000			$125,000
Capital Cost Savings								$213,000
ANNUAL EXPENDITURE	**%**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
			CAPITAL COST	ANNUAL COST	PRESENT WORTH	CAPITAL COST	ANNUAL COST	PRESENT WORTH
Energy		19.7928		15,3750	261,250			
Generalized (% of Capital Cost)								
		SUB-TOTAL			$261,250			$0

SINGLE EXPENDITURE (REPLACEMENT)	**YEAR**	**PRESENT WORTH FACTOR**	**ORIGINAL CONCEPT**		**ALTERNATIVE CONCEPT**	
			ESTIMATE	PRESENT WORTH	ESTIMATE	PRESENT WORTH
Replace solar panel	20	0.4564		0	125,000	57,000
Salvage Value at End of Economic Life						
		SUB-TOTAL		$0		$57,000
		TOTAL PRESENT WORTH		$406,000		$57,000
				PRESENT WORTH SAVINGS ON O&M		$261,250
				LIFE CYCLE COST SAVINGS		$475,000

APPENDICES

APPENDIX
A – VE TEAM

Value Team Roster

Value Team Leader

John L. Robinson, PE, CVS-Life	Strategic Value Solutions, Inc.
Michael Holt, PE, CVS-Life	Strategic Value Solutions, Inc.

Value Team Members

Name	Organization
Andy Anderson	
Michael Barry, Corps, Louisville	US Army, Ft. Campbell
Aravind Batra, PE, LC, LEED AP	P2S Engineering, Inc.
Faron Bean, PE, LEED AP	Gresham, Smith and Partners
Duke Bitsko, RLA	BioEngineering Group
Chevron Blond	US Army Corps of Engineers, Ft. Worth
Brent Bonham, PE, SE, LEED AP	HNTB Corporation
Trudy Carr	US Army, Ft. Campbell
Michael Cochrane, PE	Gresham, Smith and Partners
Rachel Cook, PE, LEED AP	Terrastructure Engineering Corporation
Thomas Darwin	US Army Corps of Engineers, Ft. Worth
Andrew Dettmer, PE	US Army Corps of Engineers, Louisville
Hope Evans	US Army Corps of Engineers, Louisville
Todd Evans, AIA	Black & Veatch
Verle Heindselman	US Army Corps of Engineers, Louisville
Cliff Hoelzer, AIA	US Army Corps of Engineers, Louisville
Frank King, PE	US Army Corps of Engineers, Savannah
Jeffrey Hooghouse, AIA, CVS	US Army Corps of Engineers, HQ
Jim Martin, PE	US Army Corps of Engineers, HQ
Robert Neville, PhD	BioEngineering Group
Jeremy Nichols	US Army Corps of Engineers, Louisville
Kent Peterson, PE, LEED AP	P2S Engineering, Inc
Ted Reece	US Army, Ft. Campbell
John Register	US Army, Ft. Campbell
Ben Robertson, PE, AVS	US Army Corps of Engineers, Louisville
Jeff Snell	BioEngineering Group
Hank Spaulding, PE	HA Spalding Engineers, Inc.

Value Team Members

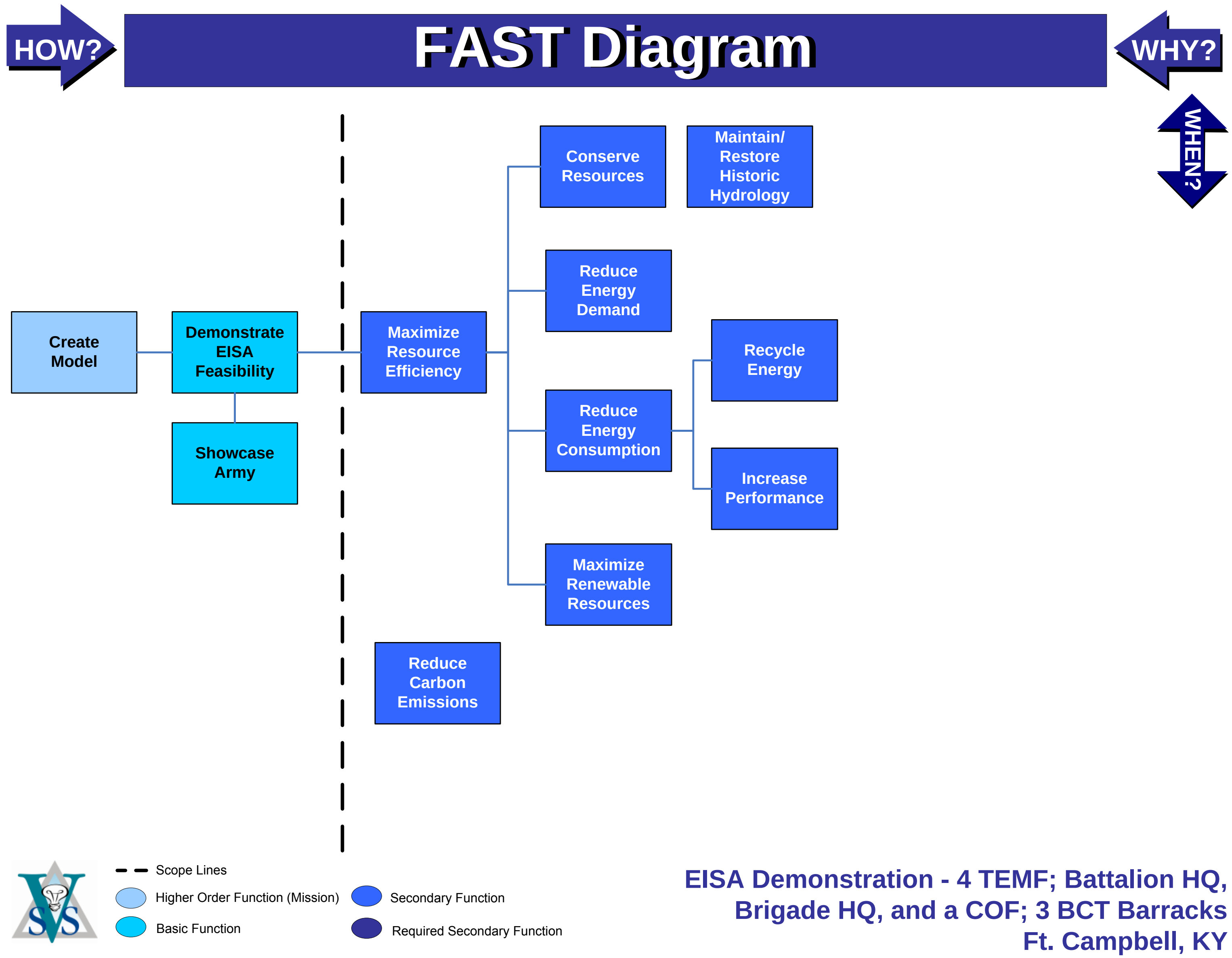
Cecil Stegman, CET	Black & Veatch
Steve Thibaudeau	US Army Corps of Engineers, Louisville
David Thomas, AIA, LEED AP	HDR, Inc.
Steve Toney	US Army Corps of Engineers, Savannah
Fred Williams	US Army, Ft. Campbell

Value Team Support Staff

Korene V. Robinson, PE, LEED AP	Strategic Value Solutions, Inc.	Technical Assistant
Megan Holland	Strategic Value Solutions, Inc.	Administrative Assistant

APPENDIX
B – FUNCTION ANALYSIS

FAST Diagram



EISA Demonstration - 4 TEMF; Battalion HQ, Brigade HQ, and a COF; 3 BCT Barracks
Ft. Campbell, KY

APPENDIX
C – CREATIVE IDEA LISTING

CREATIVE IDEA LISTING

Idea No.	Description	Votes
Reduce Demand - COF's		
CRD-1	Use big ass fans in Readiness Building	R/R
Use Renewable - COF's		
CUR-1	Use PV to cover hardstand	2
Conserve Resources - COF's		
CCR-1	Consolidate electrical service to COFs	13
Reduce Consumption - COF's		
CRC-1	Use Task Lighting	8
CRC-2	Use compacted clay floor or RCC with structural foam board topping and floor covering	0
CRC-3	Combine COF's; go vertical with Readiness	2
CRC-4	Combine Admin Building into one building	9
CRC-5	Recover heat from shower drains	0
CRC-6	Eliminate mezzanine of Readiness building - lower roof	0
CRC-7	Use shed roof to reduce building volume	9
CRC-8	Use clerestory to reduce volume	7
CRC-9	Use solar tubes to increase daylighting	7
CRC-10	Build racking system on roof for (PV	1
CRC-11	Co-locate Rear Detachment in common contiguous admin space	3
CRC-12	Put mezzanine area over admin area	0
Reduce Consumption - HQ's		

Idea No.	Description	Votes
HRC-1	Use underfloor air distribution	0
HRC-2	Heat pumps with boilers and cooling towers	1
HRC-3	Use task lighting	8
HRC-4	Minimize general lighting ; use LED lighting for all general lighting	9
HRC-5	Recover heat from data center	0
HRC-6	Use compacted clay floor or RCC with structural foam topping and floor covering	10
HRC-7	Combine the two Battalion Headquarters into one building	10
HRC-8	Combine the two Battalion Headquarters and the Brigade Headquarters into one building	14
HRC-9	Use solar tubes to light the corridors	8
HRC-10	Co-locate server function/room	0
HRC-11	User clerestory windows to improve daylighting	2
HRC-12	Use return air for restrooms	2
HRC-13	Eliminate drop ceiling and lower wall height	2
Reduce Demand - HQ		
HRD-1	Use thermal storage with water cooled chiller	2
Conserve Resources - HQ		
HCR-1	Move Battalion HQ to PT site and move PT site to tree cover site	10
HCR-2	Consolidate all admin on top of parking garage with a green roof	6
Reduce Consumption - All buildings		
RC-1	Provide training for individual responsibility	DS
RC-2	Optimize Daylight	9

Idea No.	Description	Votes
RC-3	Orient for prevailing winds	3
RC-4	Orient for solar	9
RC-5	use true green roof	4
RC-6	use white roof	6
RC-7	use supply fan pressure reset	5
RC-8	Use high efficiency fixtures	7
RC-9	Use Energy Star -EPEAT appliances	10
RC-10	Use automatic switching on plug loads	8
RC-11	Maximize efforts on building envelope	4
RC-12	Increase R-values for roof and walls	1
RC-13	Use flat roofs to facilitate solar; combined with pre-stressed concrete slabs	15
RC-14	Use exterior shading	4
RC-15	Use thermal mass	2
RC-16	Use air barriers	3
RC-17	Use phase change material	1
RC-18	Use natural ventilation	2
RC-19	Maximize roof insulation; optimize wall insulation	2
RC-20	On small buildings, use thermal bridging	1
RC-21	Use vegetation for shading	7
RC-22	Zone HVAC by use	1
RC-23	Use ground source heating and cooling	6
RC-24	Use a highly reflective brown roof	1

Idea No.	Description	Votes
RC-25	Use wood construction for barracks	3
RC-26	Use triple pane windows	1
RC-27	Use demand controlled ventilation	9
RC-28	Use low flow fixtures	2
RC-29	Use dedicated outside air system	7
RC-30	Use LED fixtures	2
RC-31	Reduce lighting power density	10
RC-32	Use solar exterior lighting	2
RC-33	Increase translucent wall area	6
RC-34	Add skylights	2
RC-35	Use fiberglass windows	1
RC-36	Use North facing skylights	0
RC-37	Pump up flyash and slag in concrete	4
RC-38	Install green roof wherever 1st floor roofs abut 2nd floor	2
RC-39	Eliminate transformers; bring 208V to buildings	3
RC-40	Use district energy system	10
RC-41	Low x-ergy systems	3
RC-42	Use radiant slabs	7
RC-43	Building and system energy monitoring	3
RC-44	Not used	8
RC-45	Not used	4
RC-46	Install fuel cell for 400 kW power	2
RC-47	Use higher efficiency distribution transformers	1

Idea No.	Description	Votes
RC-48	Reduce square footage in buildings	1
RC-49	Use auto shutoff or hibernation for computers with inactivity	10
RC-50	Use rain screen walls	6
RC-51	Optimize face velocity on AHU's	10
RC-52	Do not A/C or heat mechanical rooms	6
RC-53	Use modular and construction systems for interior	10
RC-54	Use variable speed drives	1
RC-55	Build vertical	9
RC-56	Provide bypasses for ERV's when free cooling	10
RC-57	Use VRF (variable refrigerant flow)	6
RC-58	Use window specification based on exposure	8
RC-59	Enhanced inspection for air infiltration	3
RC-60	Use variable window shading	0
RC-61	Use different exterior shell material	2
RC-62	Use special inspectors for unique/innovative construction	DS
RC-63	Use translucent walls on North exposure and minimize windows on East and West	1
RC-64	Explore use of LED lighting in repair bays	1
RC-65	Use solar tubes on one-story buildings	8
RC-66	Maximize use of LED lighting in general lighting areas	5
RC-67	Provide building dashboards for occupants	15
RC-68	Provide enhanced training for maintenance personnel and include in commissioning	DS
RC-69	Provide more permanent signage for maintenance and operations	0

Idea No.	Description	Votes
RC-70	Provide apprenticeship program for O&M staff	5
RC-71	Video documentation of training procedures	8
RC-72	Install wood furnaces	1
RC-73	Use waste food oil for fuel source	4
RC-74	Revise building configuration for function vs. efficiency	8
RC-75	Co-locate based on occupancy	1
RC-76	Increase roof overhangs	5
RC-77	Use modular construction	0
RC-78	Provide periodic commissioning with additional training	ds
RC-79	Use UPS with flywheel in data center	3
RC-80	Improve building proximity based on heating requirements	1
RC-81	Use 4-inch slabs-on-grade	1
RC-82	Optimize underslab insulation	3
RC-83	Use earth for insulation where possible	8
RC-84	Locate equipment below grade	1
RC-85	Locate any appropriate parts of building under grade to reduce footprint	3
RC-86	Eliminate stools and use onsite incinerator	0
RC-87	Not used	0
RC-88	Locate rooms with high loads to the external walls	9
RC-89	Use hot/cold aisles in server rooms	17
RC-90	For conflicts between AT/FP and EISA, follow EISA	2
RC-91	Use operable transoms for natural ventilation	4

Idea No.	Description	Votes
RC-92	Use technology to make "smart" building	6
RC-93	"Smart" building controls tie back to EMCS	2
RC-94	Put basement in buildings(s) and use passive barrier	5
RC-95	Move dayrooms (in barracks) to roof - create green roof/garden	0
RC-96	Use ultra high efficiency variable flow chiller	9
RC-97	Require use of LED monitors	1
RC-98	Use water to water heat pumps	9
RC-99	Create incentive program to encourage energy reduction (energy smack down)	16
RC-100	Use clotheslines for drying clothes	4
RC-101	Review finish schedule to delete or materials or finishes	0
RC-102	Recover heat from shower drain to heat cold water	9
RC-103	Use temperature control valve for showers to limit temp	4
RC-104	Use demand water heaters	10
RC-105	Build racking system for photovoltaic on roof	3
RC-106	Install flat roofs	6
RC-107	Slope roof for Optional solar	1
RC-108	Maximize tree canopy in proximity of buildings	9
RC-109	Provide a central plant	16
RC-110	Maximize use of light colored finishes to reduce lighting loads	15
RC-111	Maximize use of translucent panels to allow light to flow through buildings	8
RC-112	Use transfer air to heat restrooms	4
RC-113	Eliminate drop ceilings	3

Idea No.	Description	Votes
RC-114	Eliminate drop ceilings and lower floor to floor height	7
RC-115	Use operable windows	8
Use Renewable - All buildings		
UR-1	Building a screen wall with integrated wind pods	9
UR-2	Use a geothermal field for several buildings	2
UR-3	Uses small solar thermal generation field	5
UR-4	Use a solar collector field for multiple buildings	11
UR-5	Use crystalline panels instead of amorphous silicon	2
UR-6	Put large inverters for PV outside	3
UR-7	Use micro-inverter for PV	3
UR-8	Use solar walls for transpirating (pre-heat air)	2
UR-9	Use walls for thermal massing	1
UR-10	Purchase renewable energy from another source	3
UR-11	Develop a renewable center for research of technology using landfill space	4
UR-12	Use thin film solar on closed landfill	2
UR-13	Methane capture on landfills	3
UR-14	Pull heat out of west stream process to feed district heating	0
UR-15	Build ethanol plant	0
UR-16	Use small modular nuclear reactors	10
UR-17	Use small Hydro package	0
UR-18	Use pump/storage for hydro	0
UR-19	Use fuel cell for UPS and rejected heat for buildings	7

Idea No.	Description	Votes
UR-20	Use a public-private partnership to finance a large scale program for renewable energy	12
UR-21	Develop renewable as a separate piece (contract)	5
UR-22	Use PV in combination with POV parking	8
UR-23	Use larger (100 kW) wind units	6
UR-24	Install small turbine at headworks of WWTP	8
UR-25	Install small packaged wind turbines at high exhaust locations	3
UR-26	Use kinetic plates in parking areas to generate power	4
UR-27	Use portable regenerative equipment to capture lost rotational energy	0
UR-28	Use concentrated solar	8
UR-29	Uses solar heated water for showers/restrooms	4
UR-30	Use waste food products for energy	5
UR-31	Use SWMU as geothermal heat sink	1
UR-32	Use lake for heat sink	4
UR-33	Use retention areas for heat exchange	0
UR-34	Use stormwater discharge for energy capture	0
UR-35	Use concentrated PV for higher energy generation	9
UR-36	Use solar powered site and street lighting	15
Reduce Demand - All Buildings		
RD-1	Use thermal storage with district cooling	7
RD-2	Use thermal storage	1
RD-3	Use radiant cooling - HQ & Admin	7
RD-4	Adjust work schedules to level demand	1

Idea No.	Description	Votes
RD-5	Change set points in conditioned spaces based on use	5
RD-6	Expand thermal comfort zones	11
RD-7	Use big ass fans	6
RD-8	Use ceiling fans	8
RD-9	Use occupancy controls for unitary systems	6
RD-10	Expand thermal comfort zone during the hottest/coolest days	6
RD-11	Turn off non-essential equipment during peak hours	9
RD-12	Work construction hours adjust for peak heat	0
RD-13	Allow washer/dryer use only during non-peak hours	5
RD-14	Use operable windows	8
RD-15	Install switch controls on windows to shut off HVAC when windows are open	5
RD-16	Put vegetation on walls to reduce heat gain	6
RD-17	Expand demand controlled ventilation with occupancy sensors	9
RD-18	Switch-controlled outlets based on occupancies	3
RD-19	Uses programmable panel boards	8
RD-20	Survey actual loads - design to a lesser load	4
RD-21	Forced shutdown of power	1
RD-22	Install demand meters for water usage	9
RD-23	Adopt arid climate water usage concepts	2
RD-24	Install timers on showers	9
Conserve Resources - All Buildings		
CR-1	Maintain natural vegetative cover over soils (minimize disturbance)	11

Idea No.	Description	Votes
CR-2	Reduce vehicle parking by 20%	10
CR-3	Rearrange facilities to create shared parking	4
CR-4	Replace most of the surface parking with a parking garage	18
CR-5	Build parking based on actual demand	6
CR-6	Use grass pavers to expand parking	1
CR-7	Recycle paving materials	3
CR-8	Maximize use of recycled materials	2
CR-9	Capture rainwater for domestic (toilets)	15
CR-10	Use evaporative cooling on roofs	3
CR-11	Construct a centrally located parking area with bus service	2
CR-12	Reuse existing site in lieu of undisturbed site	4
CR-13	Co-locate HQ & Barracks and reuse existing parking and hardstand	2
CR-14	Reduce access lanes and combine circulation paths	0
CR-15	Uses minimum roadway widths to reduce pavement	3
CR-16	Relocate modular facilities and use for ancillary/storage	0
CR-17	Use porous pavement in parking stalls	8
CR-18	Use more vegetative soils to reduce storm drain piping	8
CR-19	Collect water from pavement to porous and nonporous cisterns	1
CR-20	Infiltrate rainfall close to where it falls	12
CR-21	Reuse all natural materials to greatest extent	2
CR-22	Increase chilled water (delta T)	6
CR-23	Use bio retention to clean pavement runoff	5

Idea No.	Description	Votes
CR-24	Collect roof runoff at top of wall or roof; use vegetation to cool; distribute	2
CR-25	Collect leaf litter for composting	0
CR-26	Use native plants for landscaping	2
CR-27	Ignore AT/FP-tighten site	8
CR-28	Use more bio retention	0
CR-29	Minimize use of stormwater infrastructure in favor of LID	7
CR-30	Use smart controls for irrigation	0
CR-31	Eliminate irrigation	0
CR-32	Use vegetation and trees to reduce the heat island effect around the buildings	14
CR-33	Require Ops manual and ongoing training for site features	ds
CR-34	Allow only certified lumber	1
CR-35	Use wood composites	0
CR-36	Connect project to streetscapes/walks	9
CR-37	Eliminate curb & gutter when near bio-retention (sheet flow)	7
CR-38	Use design-bid-build contract	6
CR-39	Maximize opportunities with combining retention and shading	2
CR-40	Use a performance specification for the hardstand pavement to increase competition	0
CR-41	Require slag in concrete to increase reflectance	2
CR-42	Use topping on concrete to increase reflectivity	1
CR-43	Use flyash fill	0
CR-44	Use Styrofoam pellets for fill	0

Idea No.	Description	Votes
CR-45	Designate an area of lower activity (paving/parking) and make porous	8
CR-46	Use porous asphalt/concrete in lieu of pavers	2
CR-47	Use large concrete pavers	6
CR-48	Use rain chains	1
CR-49	Provide electrical charging stations with priority parking	DS
CR-50	Use kinetic plates in sidewalks	1
CR-51	Use open stairwells (make an accent)	4
CR-52	Utilize modular electric	3
CR-53	Use low-height raised floor	3
CR-54	Use RELOC connectors in lighting fixtures	1
CR-55	Specify low mercury content lamps	2
Reduce Consumption - TEMF		
TRC-1	Demand Control Ventilation	10
TRC-2	High efficiency makeup air	0
TRC-3a	Recover heat from air compressors	1
TRC-4	Use waste oil and fuel as heating source	DS
TRC-5	Use LED lighting in Repair bays	0
TRC-6	Recover heat off vehicle exhaust	3
TRC-7	Combine small TEMF into larger TEMF	3
TRC-8	Utilize hill slope - place building into slope use gunite for walls	6
TRC-9	Use shallow earth tube under pavement to capture warm air for heating	2
TRC-10	Use motion sensors in repair bays for overhead doors (to keep them closed)	1

Idea No.	Description	Votes
TRC-11	Eliminate drive through function for overhead door	4
TRC-12	Use air curtains	6
TRC-13	Use high speed coiling doors	9
TRC-14	Reduce number of overhead doors creating internal drive lane	5
TRC-15	Use sectional doors instead of coiling doors	2
TRC-16	Co-locate TEMF; use centralized admin area for all repair bays	8
TRC-17	Use translucent doors in repair bays	12
TRC-18	Use slow slope shed style roof to reduce volume	2
Use Renewable - TEMF		
TUR-1	PV to cover hardstand	0
Conserve Resources - TEMF		
TCR-1	Use multi-layer geogrid and aggregate pavement design for vehicle storage area	10
TCR-2	Harvest rain water for vehicle wash	9
TCR-3	Use perimeter rock for infiltration	10
TCR-4	Forget AT/FP; consolidate site	6
TCR-5	Use tree canopy in parking areas	8
Reduce Demand - TEMF		
TRD-1	Use big ass fans in repair bays	9
TRD-2	Use light color floor to increase reflectance	9
TRD-2	Gravity feed to oil/fluid storage building	2

DS – Indicates the Idea was selected to be written as a Design Suggestion and is included in the Design Suggestion Section of this report

RR – Indicates the Idea received enough votes by the Value Team to be developed. However, during the Development Phase the team found that the Idea was not feasible. Therefore, it has been designated RR indicating that it was Reviewed and Rejected by the Value Team.

APPENDIX
D – MATERIALS PROVIDED

MATERIALS PROVIDED

Document	Prepared by	Date
ENG Form 3086 – PN 63641	Louisville District	3/8/2011
Construction Cost Estimate(Site), BCT-3 Complex	Louisville District	3/16/2011
Concept Cost Estimate (Buildings), BCT-3	Savannah District	3/23/2011
Project Definition Report BCT-3, PN 63641	Louisville District	Dec 2010
MILCON Energy Enhancement and Sustainability Study of Five Army Buildings	HQ, USACE, ERDC, Ft Worth District, Savannah District, Norfolk District, Pacific NW Regional Lab and National Renewable Energy Lab (DOE)	Feb 2011
Project Definition Report, TEMF, PN 64296	Louisville District	Dec 2010
ENG Form 3086, TEMF, PN 64296	Savannah District	3/25/2011
Narrative, Volume 1 of 4, TEMF, PN 64296	Savannah District	3/11/2011
Appendix L: EPACT Energy Analysis, Volume 4 of 4, TEMF, PN 64296	Savannah District	3/11/2011
Concept Drawings, TEMF, PN 64296	Savannah District	3/18/2011
35% Submittal, Narrative and Design Analysis (without Appendix I, L, M, and N, BCTC-3, PN 63641	Savannah District	3/18/2011
Overview, COF, BCTC, PN 63641	Unknown	
ENG 3086, BCTC, PN 63641	Louisville District	2/22/2011
ENG 3086, TEMF, PN 64296	Louisville District	2/22/2011
Narrative and Design Analysis, Volume 1 of 4, BCTC, Company Operations Facility	Savannah District	03/18/2011
Appendix G, Calculations, Volume 2 of 4, TEMF, PN 64296	Savannah District	3/11/2011
Narrative and Design Analysis, BCTC, COF, PN 63641, Volume 2 of 2	Savannah District	3/18/2011
Concept Drawings, BCTC, Brigade/Battalion HQ, PN 63641	Savannah District	3/18/2011
35% submittal, BCTC, Brigade/Battalion HQ, PN 63641, Volume 1 of 1	Savannah District	3/18/2011

APPENDIX
E – MODULAR INTERIOR CONSTRUCTION

DIRTT

Materials & Production

DIRTT offers finishes and materials never seen before in the industry. A full description of the recycled content in each wall type is available from your local DIRTT Representative or Partner. DIRTT is accredited to go beyond their standard offering materials with more recycled content and/or rapidly renewable resources.

WATER-BASED FINISHING

DIRTT's **water-based finishes** and UV curing process eliminates the use of large electricity intensive ovens. DIRTT is the first to use this technology on all surfaces. This means the DIRTT Wood Shop does not have toxic hazards or huge air/heat exchange units, which use a lot of energy and emit a lot of air pollution. DIRTT employees and the surrounding community are safer and so are our clients. Conventional finishing processes lead to weeks and even months of hazardous off gassing in their clients' spaces. DIRTT finishes are applied in-house and do not off-gas on-site.

VENEER WRAPPING

This patent pending process takes the finest quality thinly sliced veneer and wraps it directly onto aluminum extrusions, which is then finished with a water-based finish. The process allows for beautiful wood finishing without using extra wood or other substrate materials. (Global wood consumption is projected to increase by 50 percent by the year 2050 – National Resources Defense Council.) The adhesive is a non-hazardous, non-flammable, micro-emission **PUR** (polyurethane reactive). It is free of VOC (volatile organic compounds) and HAP (hazardous air pollutants) and does not require ovens for curing.

FOREST STEWARDSHIP COUNCIL (FSC)

DIRTT Environmental Solutions attained Forest Stewardship Council (FSC) Chain-of-Custody accreditation. We can source FSC certified veneers and medium density fiberboard (MDF). As these materials go through the production facility, DIRTT guarantees it will maintain a tracking and handling system ensuring the FSC products are not mixed in with other materials.

DIRTT's official certification code: SCS-COC-00848

UREA FORMALDEHYDE FREE/FSC CERTIFIED MDF

DIRTT is the first manufacturer in this industry to use the world's only supplier producing Forest Stewardship Council certified and urea formaldehyde-free Medium Density Fiberboard (MDF). Until now, clients striving for LEED certification had to choose between the point for urea formaldehyde free or FSC certified. For the first time they can have both.

POWDER COATING

Where liquid finishes contain solvents with pollutants known as volatile organic compounds (VOCs), powder coating contains no solvents and releases negligible amounts of VOCs into the atmosphere. Powder coat lines generally use 50% less energy than conventional systems.

CHROMA-COAT

This is DIRTT's paint. It too is water-bourne lacquer pigment with lower VOCs than even LEED requires. It is applied in DIRTT's factory, which dramatically reduces the time painters must be on-site. (Only the base building will need paint and the painters will be working in a wide-open space for fast application.)

ALUMINUM

We generally use virgin **aluminum** as our structural wall elements because of its strength and consistency. It is a durable, lightweight material that doesn't require extra finishes to protect it. On balance, we feel aluminum is the best environmental choice in spite of its negative aspects. We do offer aluminum with approximately 25% pre-consumer recycled content, any higher and the aluminum loses strength and consistency, making anodizing impossible due to the mixed metal base. Clients are welcome to specify this aluminum on their project. It may, however, extend lead-times to ensure non-contamination.

Companies saying they provide higher recycled content are forced to over-design extrusions, resulting in more material use even though it is recycled – so it is not particularly environmentally friendly even though they may get points for it.

Companies using steel, as their structural material, must have it coated or plated. Often it is done with harmful and environmentally destructive materials. They must further clad the steel with cosmetic materials for aesthetic purposes. Steel is also much heavier which results in more transportation pollution.

Though mining for aluminum and processing it is energy intensive and greenhouse gas heavy, in 2002 the aluminum industry received an EPA Climate Change Award for reducing perfluorocarbons by 45%. Aluminum also has several downstream environmental benefits:

- **Recyclable** - Aluminum is completely recyclable. The recycling rate of aluminum is currently approximately 50%, and awareness programs should increase this number.
- **Less Waste –** When aluminum is used in design, there is minimal material waste (as the component can be created virtually to exact size), reducing waste for landfills. Where manufacturing of components cannot be done to exact size, the leftover portions can still be recycled, eliminating waste entirely.
- **Energy Efficiency of Recycled Aluminum –** The recycling process consumes very little energy (about 5% of energy required to create primary aluminum). The more it is recycled, the more energy efficient it becomes.

- **Common resource –** Aluminum is the most common metal in the world; found in mica, feldspar, clay and is primarily extracted from bauxite.
- **Sustainable –** Strong, light (saving energy in some applications) and enduring, aluminum products will often outlast their initial application.
- **Lightweight –** aluminum, versus steel, requires much less fuel to transport

GLASS

Joel Berman Glass works beautifully with DIRTT's wall products. Their Editions™ glass is 20% post-industrial recycled materials and they can offer 100% post-consumer glass through reclamation of demolished office spaces. (This product is available on request and has some size restrictions.) www.bermanglasseditions.com

FACTORY LIGHTING

DIRTT uses Philips Alto Silhouette T5 lamps with low mercury content. Each one lasts 20,000 hours. They are *TCLP (Toxicity Characteristic Leaching Procedure) compliant and are much smaller than conventional factory lights. Plus we need fewer of them to get excellent light quality. Their energy efficiency means we are also lessening the pollution pumped out by our local electricity provider, which we are sad to say is mostly coal powered. When they do finally burn out we recycle them. November 2009 we received a certificate congratulating us for diverting 9000 mg of mercury from the landfill. * http://www.tclpcompliantbulbs.com

PACKAGING

Of course products need to be packaged properly for safe, damage-free shipping, but packaging quickly becomes trash on the job-site. Initially, like many other companies, DIRTT was using cut lengths of 2 x 4 lumber to keep the walls from damaging each other. It was an expensive, labor intensive, wasteful method. Since then DIRTT developed a solution that protects the walls, creates 10% more room in the trucks and is infinitely reusable. It is affectionately called *The Cookie. The Cookie is a plastic molded piece that is lightweight, strong and is mailed back to DIRTT in a self-addressed 'Cookie Box' for the next shipment. The installation team member who sends the Cookies back gets an "I never toss my Cookies" t-shirt.

**It is called The Cookie because someone in Product Development thought it looked like a little Dutch girl carrying a tray of Cookies. In spite of this, he still insists on naming things.*

POWER

DIRTT has the largest corporate solar PV array in the city on its roof. This isn't saying much for the city, as 60 panels isn't that big, but it does power all our office computers and when there's no action in the office (like the weekends) it runs machines in the Wood Shop. The array generates enough power to displace approximately 13 tons of carbon dioxide each year.

PHYSICAL FOOTPRINT

Because of the elimination of large ovens and separate explosion proof areas and because of DIRTT's front-to-back software system, the footprint of our manufacturing is a fraction of a conventional manufacturing facility. The ICE® software coordinates inventory, project assembly and shipping details, helping to make the floor as efficient as it can be and allowing for less real estate to light, power, heat and cool.

COMMUTING

DIRTTbags who cycle, take public transportation or carpool are entered into a monthly draw for cash. Those who drive Hybrids and Smart Cars have company-branding put on their vehicles and are given a stipend each month.

SAVANNAH

DIRTT opened a second production facility in Savannah, GA in the summer of 2009. This proximity to our major markets of Eastern North America means our products have to travel fewer miles and can do so via a selection of transportation options such as rail and ship.

Thank you for choosing movable walls for your project. While all movable walls are better than studs and drywall, there are a few things about DIRTT Walls to keep in mind while making this important decision.

43 Things DIRTT

Some wall manufacturers may have one or more of these benefits. Some manufacturers even try to replicate the look and function of drywall. We ask, "What is the point of mimicking bad?" These 43 Points aren't just for the sake of being different. These are true unique benefits for you, now and in the future. By choosing DIRTT you will contribute to improved environmental sustainability, the corporate bottom-line and a productive and flexible workspace ready for whatever changes come your way.

SUSTAINABILITY

1. DIRTT Walls integrate seamlessly and cleanly with existing and new buildings, helping to extend their life cycle. The Walls' flexibility and superior and enduring construction mean they can be adapted and reused. Life cycle performance is one of the single most important attributes of sustainability.
2. The parametric engineering of DIRTT Walls means you can create the perfect module size for your space. Modules can fit together in a myriad of configurations over their lifetime. This assures you a long life cycle and best reconfiguration practices without extra assets and asset management.
3. Our parametric approach also allows for an infinite combination of finishes, angular or curved installations, and the ability to make radical change in the future
4. Face-tiled walls support power, data and security cabling and components. The plenum is easily accessible for small adds, moves and changes without damage or waste.
5. Expandable and flexible connections adapt to different building angles and curves, making for fewer parts and pieces and a more efficient use of real estate.
6. Wall design allows for stacking initially or in the future so you can keep your initial investment intact even if your wall height requirements change.
7. Horizontal support extrusions, placed anywhere on the face-tiled Walls, allow you to hang any new or legacy furniture, appliances and storage.
8. DIRTT uses exclusively non-toxic, water-based finishes,which are UV cured. You receive a product that is good for the wider environment and for the air quality in your facility.
9. Sliding doors save real estate sprawl. Ours are non-handed, easily installed, have pneumatic slow-downs, are lockable and come in several styles and finishes. They can be easily reconfigured so you do not have to buy extras to suit new locations.

10. Glass for butt-joint elevations can be sourced locally, eliminating shipping over long distances and attendant pollution.

11. Packaging is kept to a minimum and designed for reuse. Repatriation system in place.

12. Veneer wrapping directly onto aluminum frames saves thousands of board-feet of lumber typically needed as a substrate. Our approach is in the process of being patented.

13. Intelligent, graphical, interactive 3D software called ICE® eliminates waste from human error and the need for mock-ups.

14. ICE software means no paper catalog and a smaller factory footprint.

15. ICE cancels out the need for paper marketing materials. Why look at an artifact when we are making you something completely unique and new?

DESIGN FREEDOM

16. The intelligence of ICE software allows designers to provide the best solution functionally and aesthetically without wasting precious time finding out if it can build it or not. ICE results in shop drawings in days instead of weeks.

17. ICE offers full, real-time integration with AutoCAD™.

18. Wall sizes are infinite within the minimum and maximum parameters of each part of the wall (tiles/skins, frames, doors, glass).

19. Support extrusions offer functionality when in use and are an aesthetic bonus when left open and unused in the interim.

20. The support is also open-source. You can freely choose any manufacturer's furniture, accessories or millwork. Even legacy elements can be supported on the Walls.

21. Clean, elegant corners of any angle.

22. Every space can be designed to suit the exact needs of the inhabitants. Tiles come in all sizes and finishes. For instance, back-painted glass tiles and "Write Away" film turns any wall into a dry-erase board. Tiles can be switched out if needs change.

23. Tiles/skins can be sized for individual module frames or run across adjacent frames.

24. Sides of face-tiled Walls are completely independent aesthetically and functionally, giving designers lots of latitude in addressing different conditions either side of the Wall.

25. Low-profile base with 2.25" of height adjustment facilitates installation.

26. All Walls integrate with each other and the base building, such as columns, sills, mullions and bulkheads.

27. Single-sided face tiled walls open up new design opportunities and additional usable real estate, with power and data support, when clad over perimeter hard-walls.

28. Flexible connections offer facetted curves up to 15-degrees in either direction for inexpensive design statements. Can be incorporated initially or retroactively.

29. Mass-customization means walls can be designed to suit all kinds of applications in all kinds of industries – even residential applications.

TECHNOLOGY SUPPORT

30. Flat screen (LED and LCD) technology, iPod docking stations and USB portals integrate with the Wall plenum and remain accessible for technicians.

31. Glass tiles are designed to cover and protect screens.

32. Exposed horizontal extrusion also supports monitors, monitor arms, speakers, accessories, etc. on the face of the Wall.

33. Bracketry is specially designed to support rear screen projection units in smaller spaces.

34. Accessible plenum provides plenty of room for power, data, plumbing and medical gasses. Tiles can also act as cabinet doors.

35. Ventilation system is integral to the DIRTT system for cooling of technologies.

36. When technology changes – as it inevitably will – the Walls are ready for accepting new components and wiring.

37. Horizontal support extrusions and brackets make electronic sit/stand solutions simple to implement and alter.

COMMUNICATION/INFORMATION

38. ICE software takes care of the entire specification minutiae while you design the perfect space and stay on budget. ICE delivers instant elevations, interactive/real-time 3D experiences of the whole project and photorealistic renderings in moments, simultaneously updating price, parts and production information with every modification.

39. ICEvision allows all stakeholders to share and understand the project. You can upload the design for all or a select few to see without any software on their end. They will fully absorb and sign-off or request changes quickly and confidently. It empowers those who cannot read a technical drawing and instantly updates colleagues as to the project's progress.

40. ICEberg gives all clients the hard, cold numbers to help them compare the dollar- and environmental-cost between conventional construction and DIRTT. Every finish and square foot is calculated using 3rd party statistics. ICEberg's data can even be modified to suit your local contractor's own numbers.

41. Using ICE ensures your design is directly translated into production information. There is no opportunity for human error to compromise the product. The result is the shortest lead-time in the industry; four weeks is the longest lead time we typically require.

42. ICE allows for the evolution of the product line without concern for the typical documentation nightmare that ensues. Whether for a solution wide change or for a single project, ICE provides the platform that supports rapid change.

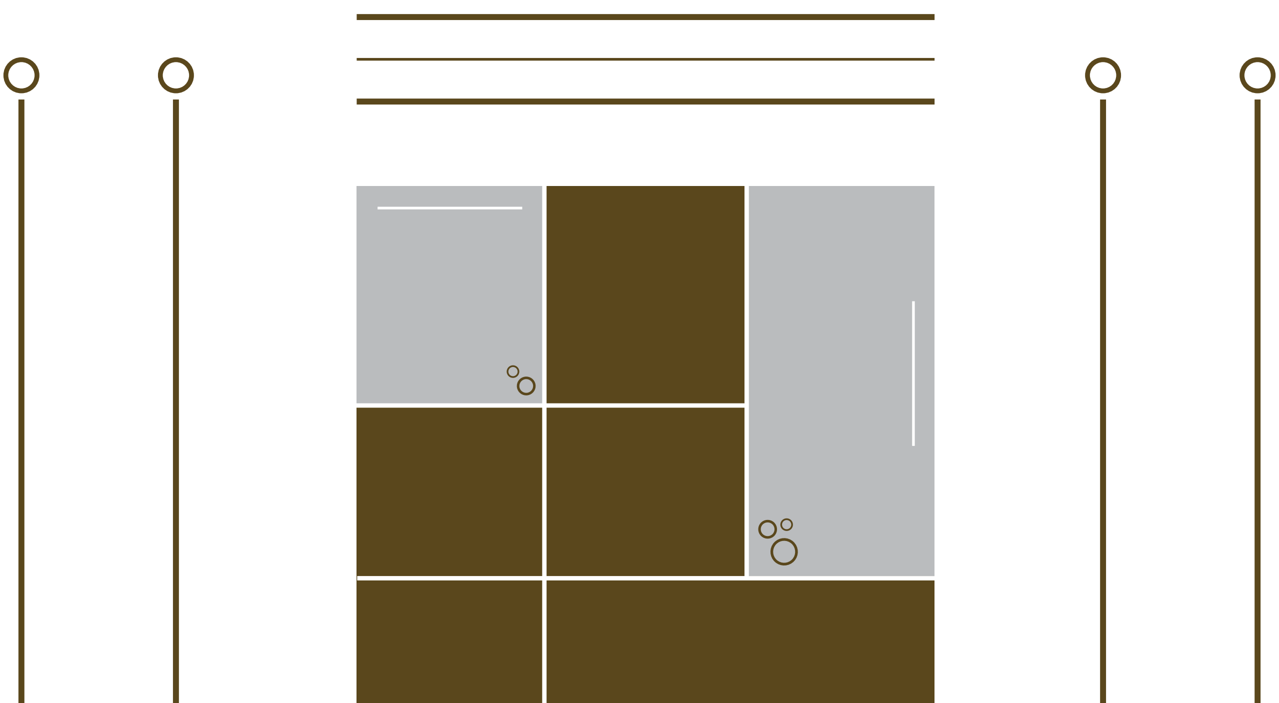
MISCELLANEOUS

43. DIRTT is a leader in sustainable design for pre-engineered walls. It was the first company in the modular interior industry ever to receive "Excellence in Partnership Award for Green Contractor Award" from the Coalition for Government Procurement (2006). The award was due to the ability of DIRTT Walls to support any new or legacy furniture for government agencies, and because the horizontal support means all furniture module sizes are still viable after reconfigurations.

We're not resting on our laurels. We are constantly innovating in our efforts to produce cost-effective, beautiful and environmentally responsible architectural solutions. Those efforts have made us North America's leading manufacturer of modular walls.

DIRTT

Java Centers



“IF THIS IS COFFEE,
PLEASE BRING ME SOME TEA;
BUT IF THIS IS TEA, PLEASE
BRING ME SOME COFFEE.”

– *Abraham Lincoln*

Create a destination spot in your office. A place that shows you are a client-driven business and a desirable employer – without breaking your budget or extending your construction schedule. Create it with DIRTT Java Centers.

A Java Center gives you a perfect in-house space to effortlessly host clients and create a pleasant refreshment area to attract and keep great employees. The DIRTT Walls support wiring, plumbing, furniture and appliances, resulting in a hospitable area that integrates elegantly with the rest of your space.

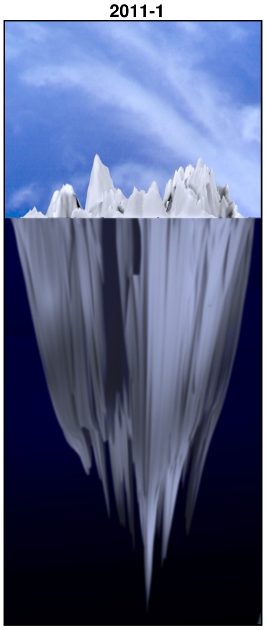
DIRTT ENVIRONMENTAL SOLUTIONS

You are free to choose handcrafted cabinetry or modular caseworks. Add dishwashers, sinks, fridges, coffee makers, TVs, granite countertops. . .you create the perfect response to your needs using ICE® software to design it. Interactive, intelligent and in graphical 3D, ICE lets you quickly design, specify and price the perfect space for your corporate culture.

In conventional construction the refreshment area often becomes a casualty of cost and/or schedule overruns. Then it is downgraded or eliminated. By choosing DIRTT Walls for this aspect of your project you ensure results are on budget, on time and exactly what you wanted. On top of it all, they are as agile and accessible as every other DIRTT application.

Select State/Province/City **KY - Ownsboro**

2011-1



An ICEberg®. What you see is only a small portion of all there is to see.

The same is true when building out your office interior.
An upfront cost comparison of options is only the tip of the ICEberg.

COSTS		Cost		Cost/SF.	
		DIRTT	Conventional	DIRTT	Conventional
Details	Interior Space	$617,873	$683,342	$34.33	$37.96
	Total Installed Cost	$617,873	$683,342	$34.33	$37.96

Cost Premium or (Savings)	($65,469)	-9.58%

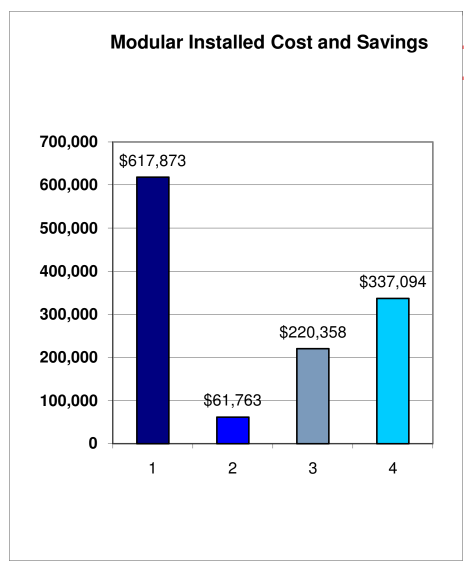
Reconfigurations, construction schedule, overhead, energy savings, tax recovery, can all save you time and money during install and in the years to come.

Let's go deeper to see what ICEberg really looks like.

ICEberg demonstrates possible cash benefits of Sustainable Modular Interiors versus Conventionally Constructed Interiors.

Cost Premium or (Savings)	($65,469)	-9.58%

SAVINGS		Cash savings/recovery by going movable			
		After 1 year	After 3 years	After 5 years	Settings
Details	Churn	$ 10,742	$ 33,265	$ 57,513	24%
Details	Reconfigurations	$ 24,441	$ 75,852	$ 131,460	5%
Details	Tax Benefits	$ 26,580	$ 111,241	$ 148,121	40%
Details	Construction Schedule	-	-	-	-
Details	Contractor Overhead	$ -	$ -	$ -	10%
	Cumulative Cash Savings	$61,763	$220,358	$337,094	
	Per Square Foot Savings	$ 3.43	$ 12.24	$ 18.73	
	% of Total Project Cost Recovered	10.00%	35.66%	54.56%	
	Other Savings*	$231,782	$36,736	$956,468	



*There are many other benefits to a modular interior. We have seperated these items into their own section since their calculation requires some assumptions to be made. Check out this section for information on, Renovation Soft Costs, Cost of Wasted Space, What Happens When You Move, etc.

Interior Space Installed Cost

Back to: [Top]

	Installed Cost		Cost/Unit		%	Settings
	DIRTT	Conventional	DIRTT	Conventional	% Difference	Factor 106.09%
Details Interior solid walls	$ 271,917	$ 110,635	$224.41 / LF.	$91.31 / LF	146%	Year 2011
Details Interior glazing	$ 57,033	$ 150,378	$130.93 / LF.	$345.21 / LF	-62%	Month Jun-11
Details Perimeter walls	$ -	$ -	$0.00 / LF.	$0.00 / LF	-	Contract $ Less than 1M
Details Doors w trim/hardware	$ 62,669	$ 176,856	$1,253.37 / EA.	$3,537.12 / EA	-65%	Seismic No
Details Refreshment centers	$ -	$ -	$0.00 / LF.	$0.00 / LF	-	GSA Yes
Details Electrical in walls	$ 11,415	$ 16,564	$0.63 / SF.	$0.92 / SF	-31%	Level 3
Details Raised access floor	$ -	$ -	$0.00 / SF.	$0.00 / SF	-	
Details Floor covering	$ 75,315	$ 94,144	$37.66/ SYD.	$47.07 /SYD	-20%	Type Rolled
Details Ceilings	$ 36,864	$ 36,864	$2.05 /SF.	$2.05 /SF	0%	
Details Acoustics	$ 17,685	$ 17,685	$0.98 / SF.	$0.98 / SF	0%	Not Specified
Freight	$ 28,320	$ -	$1.57 / SF.	$0.00 / SF	100%	% Total Cost 5.31%
Contingencies	$ 3,365	$ 18,094	$0.00 / SF.	$0.00 / SF	-81%	Rate of Ctgcs 3.00%
Details Conditions & Fees	$ 53,290	$ 62,122	$2.96 / SF.	$3.45 / SF	-14%	Rate of C&F 10.00%
Total	$617,873	$683,342	$34.33 / SF.	$37.96 / SF	-9.58%	

US Army Corps of Engineers

Fort Campbell, KY

Brigade Headquarters

A Structured Zone Cabling Cost Survey:

by Axios Networks a DIRTT Environmental Solutions company

31 March, 2011

March 31, 2011

US Army Corps of Engineers
Attn: Jeff Hooghouse, AIA, CVS
441 G Street
Washington, DC 20314

Re: Modular Zoned Data Cabling Cost Survey for the new Fort Campbell Brigade Headquarters.

Dear Mr. HoogHouse:

We are pleased to submit our cost survey for the voice/data cabling of the new Brigade Headquarters facility at Fort Campbell, KY. The following survey reviews the cost impacts of using a modular zones cabling system in accordance with the UFC-3-580-01 and legacy “homerun” cabling methods to include environmental impacts and cost of ownership associated with the cabling system if designed and deployed using modular and legacy methods.

This study is based upon the following documentation and factors:

Reference Documents

- Unified Facilities Criteria UFC-3-580-01 22JUN07.
- BICSI Telecommunications Distribution Methods Manual, 12th Edition.
- TIA/EIA 568B.1, B.2, B.3, 569A, 570A, 606A
- Drawings, Brigade Combat Team Complex, Brigade Headquarters, I-101,102; Dated 11MAR11

Building Synopsis

- Two story open office brigade headquarters operations facility
- First Floor
    - SCIF, (20) private offices, (221) modular work stations, (9) large conference rooms, (7) small conference/team rooms, (5) print/copy/fax stations, (18) wall phone / convenience locations.
- Networks Operations Center (NOC), (2) SiPR telecom rooms, (2) NiPR telecom rooms, server room.

Statement of Work - General

- Provide telecommunications cabling system according to applicable design, building, installation specifications and standards.
- Provide (5) “black” network ports and (2) “red” network ports to a total of (20) private office locations.
- Provide (3) “black” network ports and (2) “red” network ports to a total of (221) modular work station locations.
- Provide (5) “black” network ports and (2) “red” network ports to a total of (9) large conference room locations.
- Provide (3) “black” network ports and (2) “red” network ports to a total of (7) small conference room / team room locations.
- Provide (3) “black” network ports to a total of (5) print/copy/fax locations.
- Provide (1) “black” network ports to a total of (18) wall phone / convenience locations.

System and Method Description:

Modular Zoned Cabling: Modular zoned cabling is a pre-engineered and manufactured cabling solution installed in a star topology. The zone cabling method utilizes consolidation points or zone boxes strategically located within the structure in a grid pattern spread across the building space. This quickly and efficiently distributes data and voice cable infrastructure. Zone distribution provides intrinsic value in the management and service of the communications cable infrastructure through the application of consolidation points. Moves, adds, and changes are more readily executed with an appreciable reduced cost. The modular aspect of this solution brings all of the repetitive and sensitive termination activities into a controlled, clean room factory environment. The benefits are the speed a cabling system can be installed, reduction or elimination of installation errors and material waste typically associated with legacy installations. This solution is fully 100% reusable and can be removed and reinstalled by competent personnel for the life of the building. Initial growth or surge capacity as defined by the UFC and is installed as a base option in this solution. The zoned cable solution is the preferred and defined cable solution for open office architecture per the Unified Facilities Criteria UFC-3-580-01 22JUN07.

Traditional Zoned Cabling: Like the previous, this cabling solution utilizes a grid or zoned distribution and management topology, applying consolidations points within each zone. The primary difference between these two methods is that this system is installed using legacy methods, terminating each cable in the field and installing raw, unbundled cable. The end result is similar with regards to the flexibility of the system, but adds considerable waste, time for initial installation, and usually entails the removal and full replacement of at least some of the cabling during the moves, adds, and change (operational maintenance) of the cable infrastructure. This solution does meet current UFC standards but is less efficient and more wasteful.

Legacy Cabling Methods: This installation method has been most common in construction of new voice and data cabling infrastructure to date. Commonly referred to as “home run” cabling, each individual cable is installed from a telecommunications closet to each faceplate or work area and terminated in the field. This system will not provide any surge capacity as it is fixed in place and offers no flexibility in the movement or repurposing of the cable system. This cabling method is incredibly wasteful during initial construction and continues with increased waste as each time a faceplate or outlet location needs to be moved, the existing cable is removed, thrown away, and a new cable installed to the new required location. It is possible that initial costs of construction may be less expensive, but these potential savings are erased within the first year of ownership though higher expenditures in labor and material to manage the cable infrastructure.

Cabling Topology Synopsis:

All cabling will be plenum rated, Category 6, 4-pair copper and 50um, laser optimized optical fiber. Installed via accessible ceiling pathway infrastructure, zone distributed cabling in a star topology will be installed from the required Telecommunications Rooms in each area. All cabling will be color coded, uniquely keyed per the specifications and terminated on common consecutive patch panels (by network) and available for use with any media required (voice, data, Ethernet video) without any modification to the cable infrastructure. Colored icons will be installed to identify the client assigned device to each user port on each end of all cable channels.

SCOPE DATA

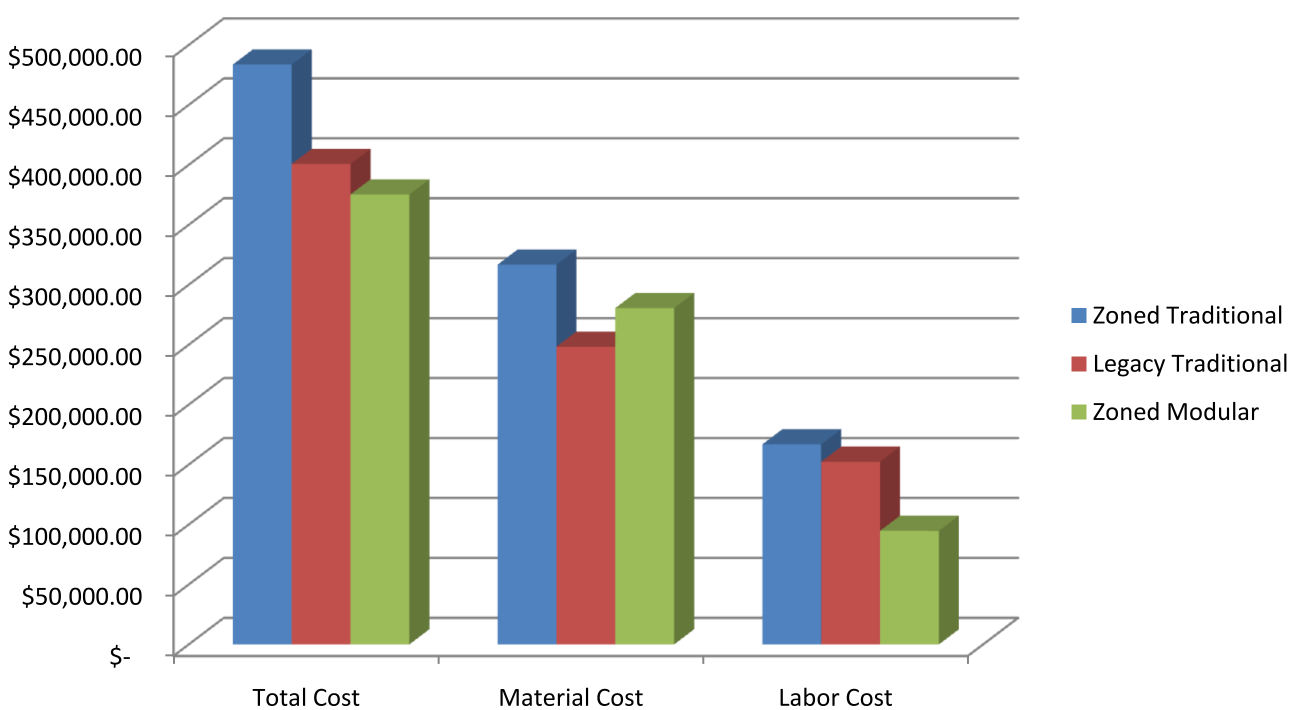
	Modular Zoned System	Traditionally Installed Zoned System	Legacy Cable Method
Copper Ports Installed	1488	1488	1170
Fiber Ports Installed	432	432	335
Immediate Surge Capacity UFC Requirement	25%	25%	0%
Installation Labor Hours	1263	2225	2032
Crew Size	5	5	5
Days on Site	25	45	41

PRICING SURVEY

	Modular Zoned System	Traditionally Installed Zoned System	Legacy Cable Method
Material Costs	$280,560	$316,800	$248,325
Labor Costs	$94,760	$166,892	$152,389
Total	$375,320	$483,692	$400,714

RS Means Electrical Cost Data - 2011

Initial Cost Comparison



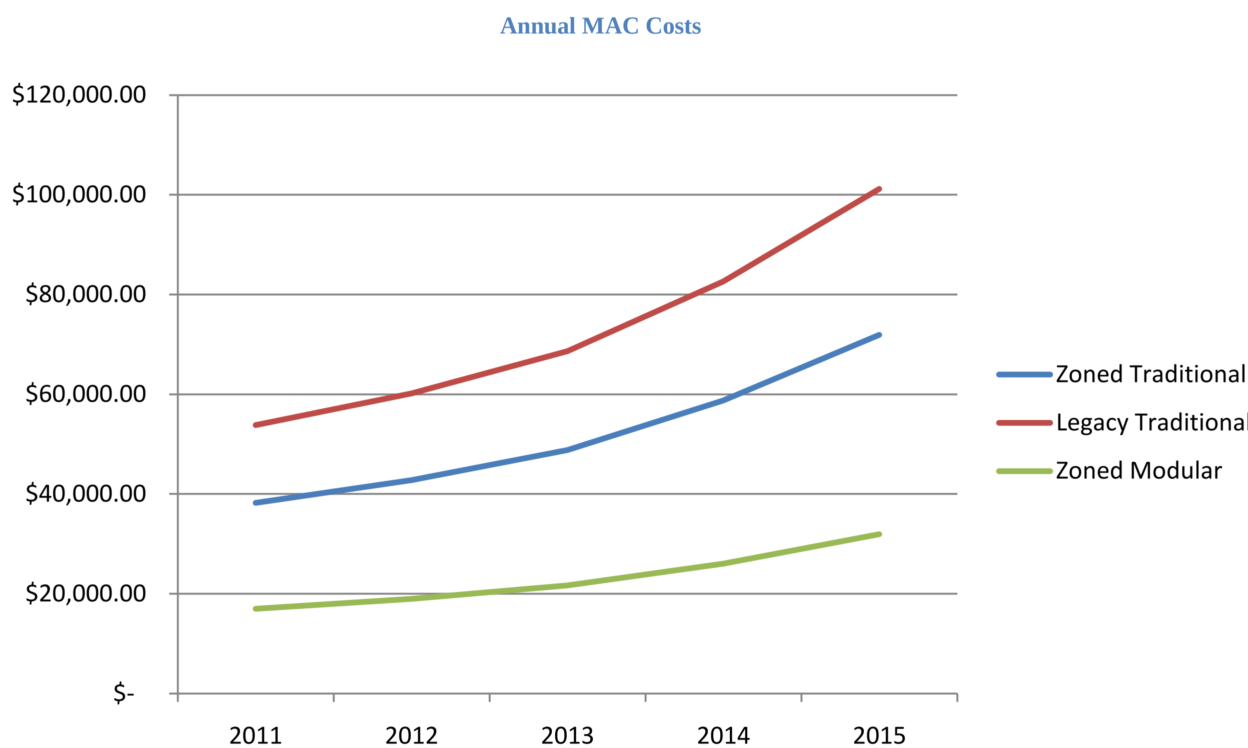
CHURN DATA (Moves, Adds, & Changes)

Annual Cost for MACs

Typical Annual Churn Rate **48%**

	2011	2012	2013	2014	2015
Zoned Traditional	$ 38,260.04	$ 42,782.37	$ 48,827.52	$ 58,754.16	$ 71,944.47
Legacy Traditional	$ 53,795.65	$ 60,154.30	$ 68,654.10	$ 82,611.48	$ 101,157.76
Zoned Modular	$ 16,976.40	$ 18,983.01	$ 21,665.31	$ 26,069.87	$ 31,922.55

IFMA Space and Project Management Benchmarks, Research Report #34



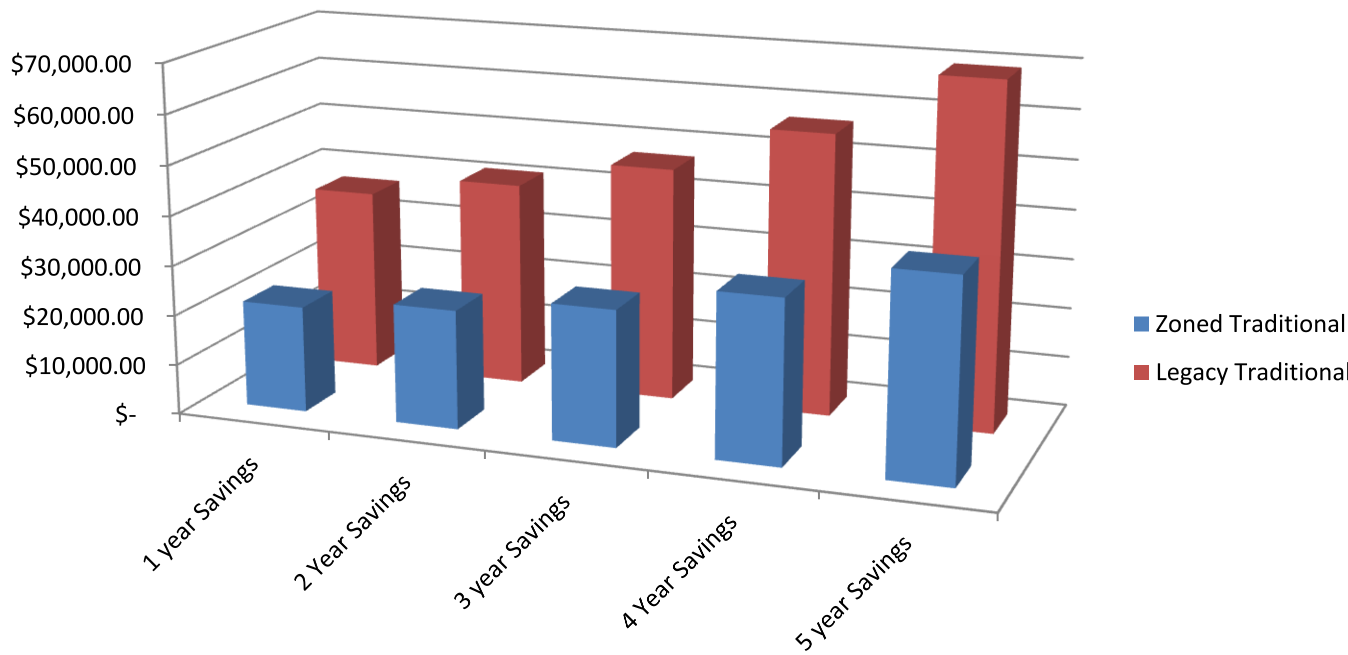
Annual MAC Cost Savings

Annual Cost Differential Compared to Modular Zoned Installation (Maintenance and MACS)

	Year 1 Savings	Year 2 Savings	Year 3 Savings	Year 4 Savings	Year 5 Savings
Zoned Traditional	$ 21,283.64	$ 21,283.64	$ 21,283.64	$ 21,283.64	$ 21,283.64
Legacy Traditional	$ 36,819.25	$ 36,819.25	$ 36,819.25	$ 36,819.25	$ 36,819.25

IFMA Space and Project Management Benchmarks, Research Report #34

Annual Cost Savings of Modular Zoned Over Legacy Methods

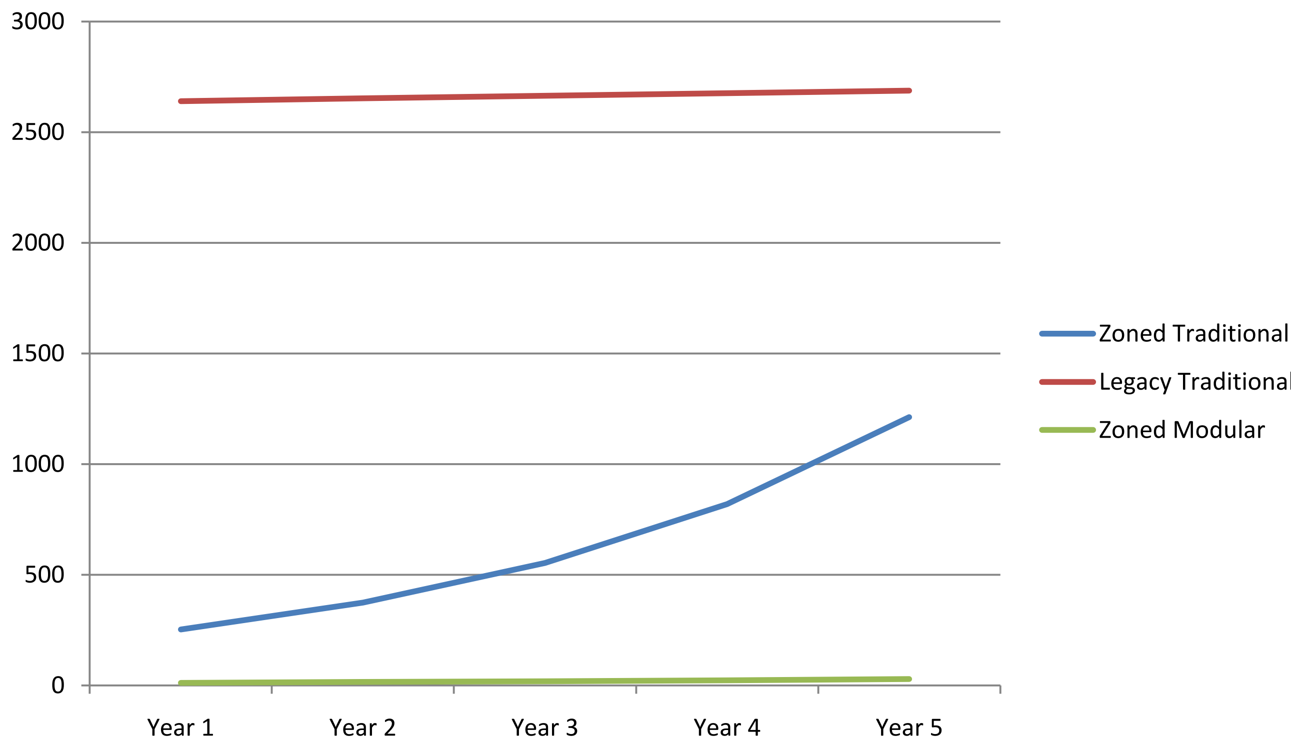


Annual Copper Waste in Pounds

	Initial	2011	2012	2013	2014	2015
Zoned Traditional	670	2640	2652	2664	2676	2688
Legacy Traditional*	527	281	416	616	912	1350
Zoned Modular	0	12	15	18	23	29

*Legacy Traditional cabling requires the removal of existing cable and installation of new cables for every MAC activity

Annual Copper Waste in Pounds



Findings and Recommendations

The data presented shows clearly the true costs of three common design and installation methods for structured cabling. Cable systems that employ legacy installation methods prove to be both cost ineffective and present severe environmental impact through high initial construction waste. Cost and waste generated during normal building operation further escalates over time.

Modular zoned cabling provides the greatest reduction in initial cost with continued savings realized over the lifespan of the building. The minimal environmental impact of a modular solution illustrate an ecologically conscience option is available for the communications infrastructure.

It is conceivable that there are additional reduced environmental impacts due to the reduced installation schedule and lower manpower requirements.

In the scenario presented in this survey, there is a 39% reduction of on-site days by using a modular cabling installation. Beyond construction schedule reduction, there are further reductions in power generation, construction site waste removal, and material staging requirements.

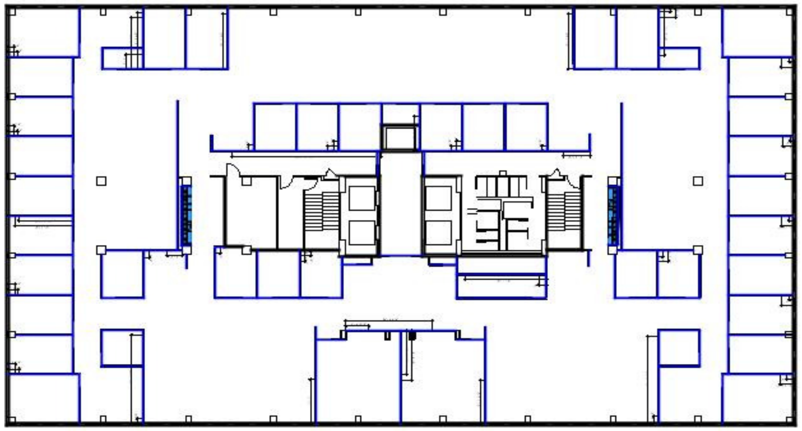
The fewer days required on site for initial installation equate to fewer carbon emissions generated by vehicles moving to the construction site.

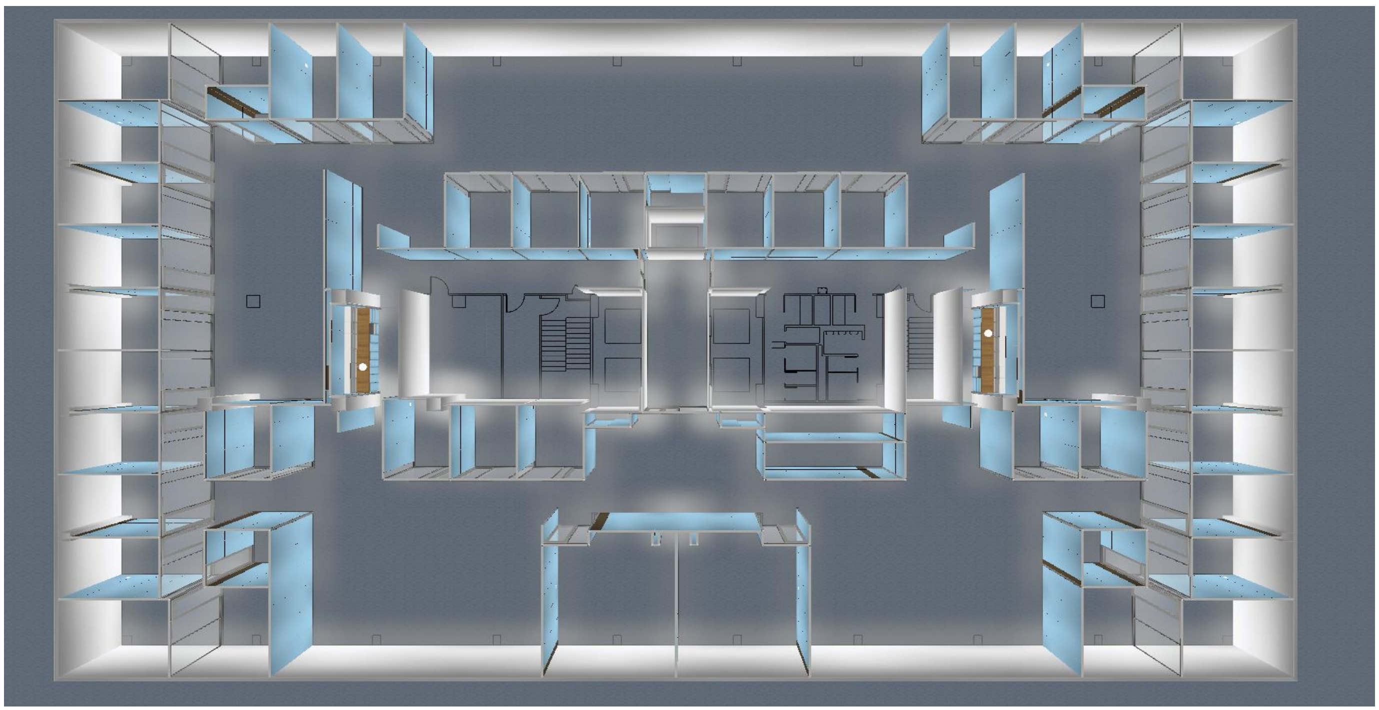
Modular cabling solutions lend themselves to consolidated freight plans. Fewer deliveries and transport vehicles to a construction site add to further reduced carbon emissions.

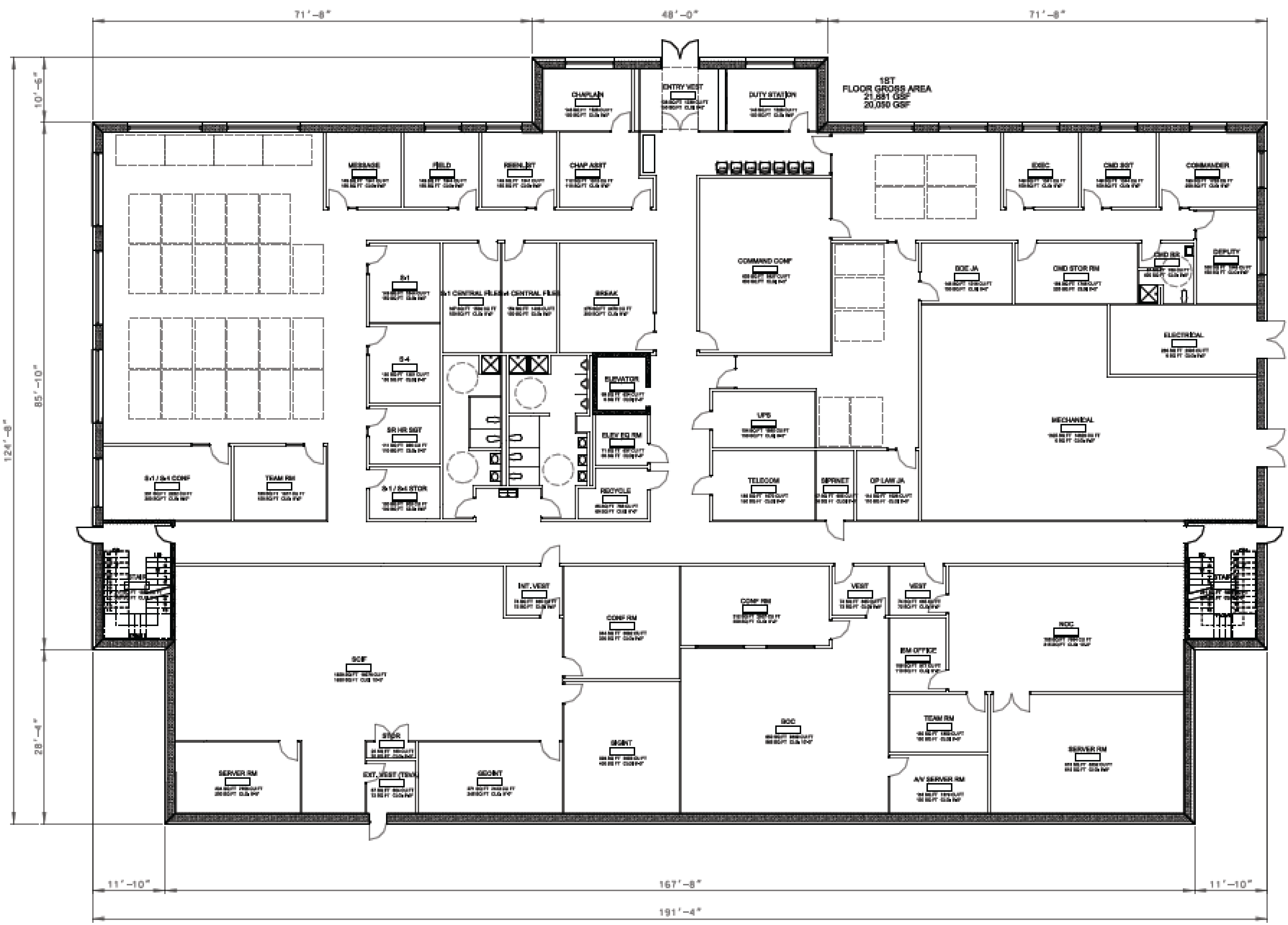
The rapid maintenance and reconfiguration of a modular zoned cabling solution provides fewer days temporary space would be required for personnel during renovations and tenant improvements.

KY - Ownsboro

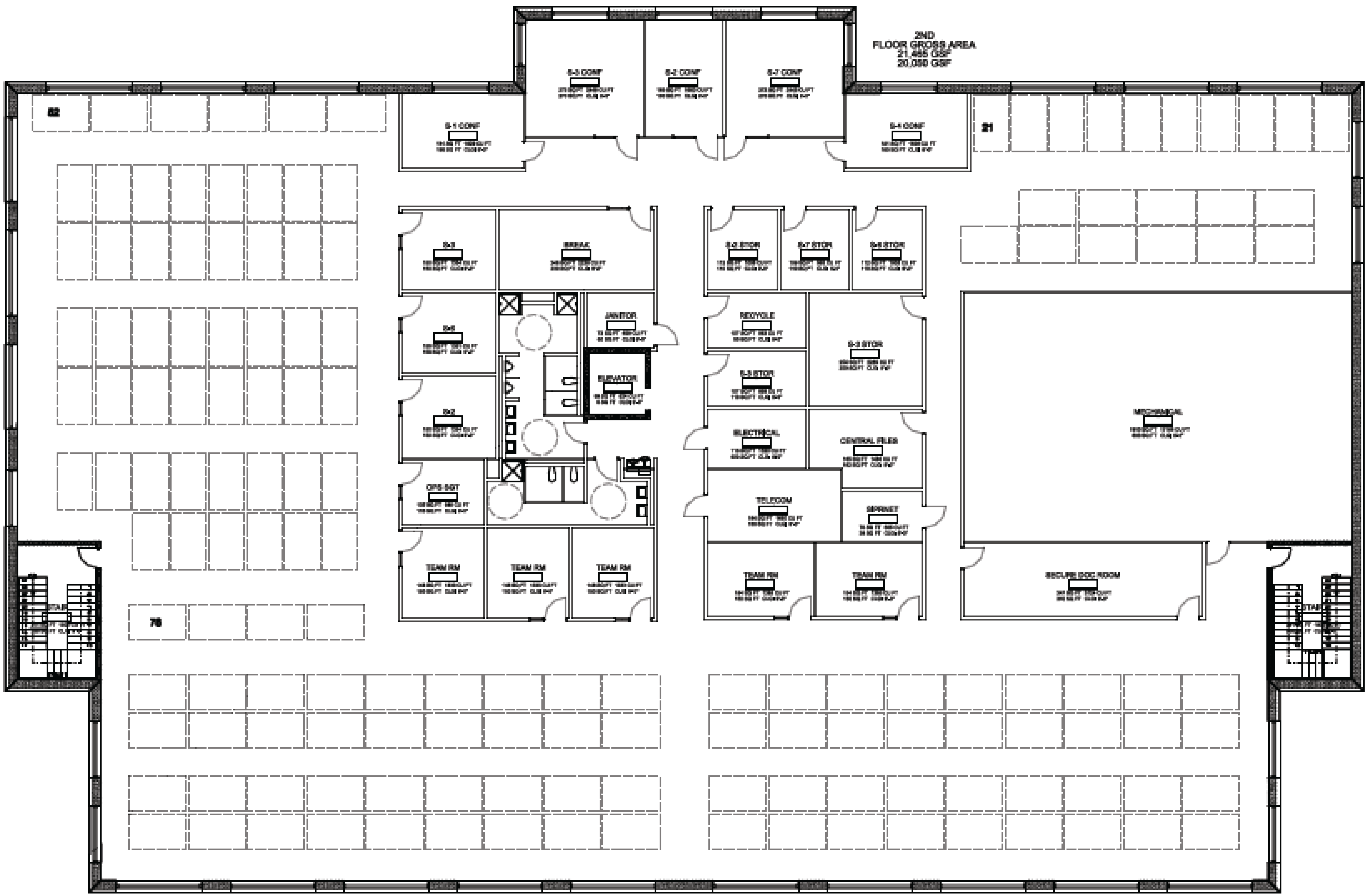
File Name : DIRTT ICEberg 18k-floor plan.ice -- Fri Nov 13 11:42:08 MST 2009



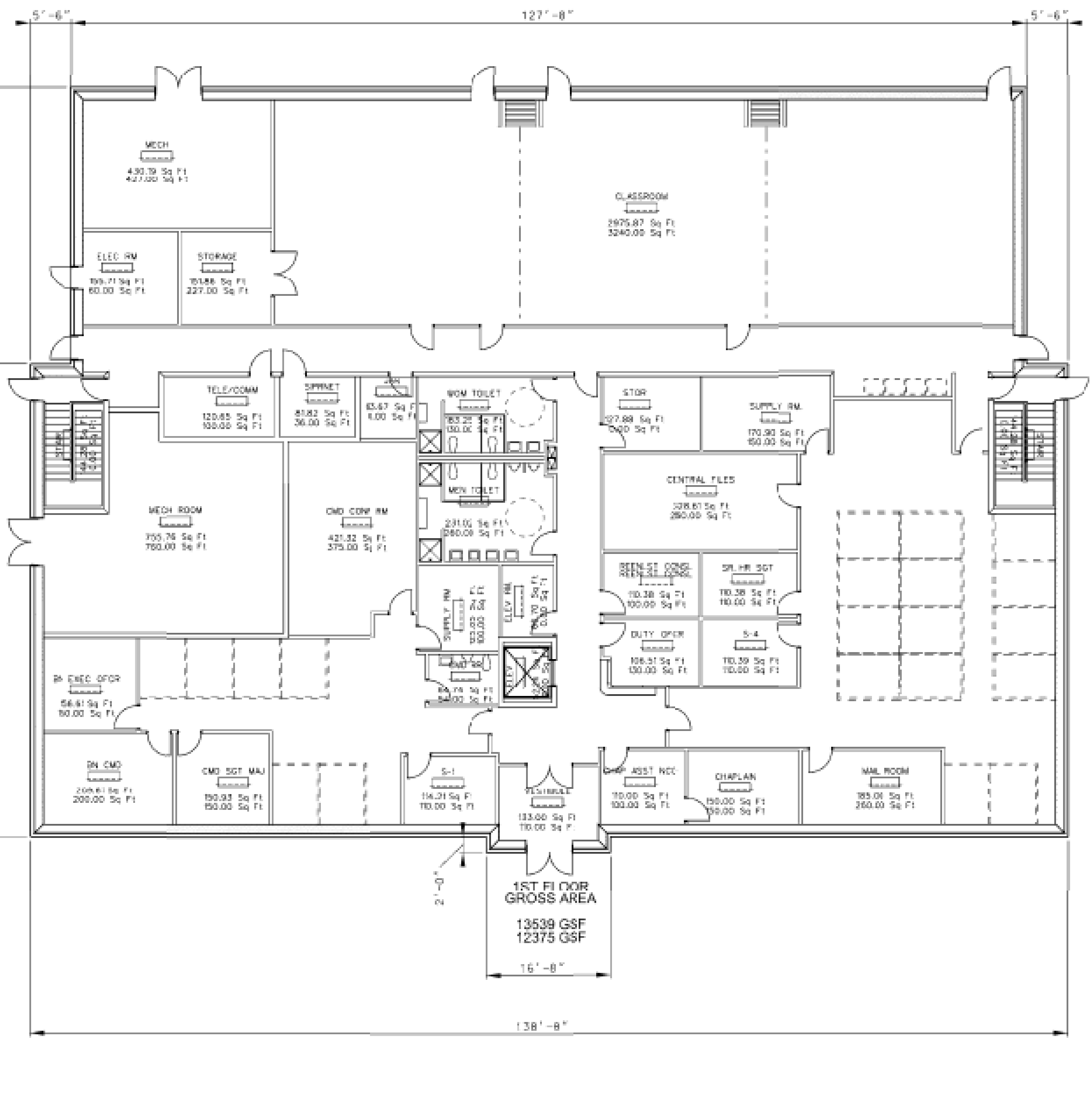




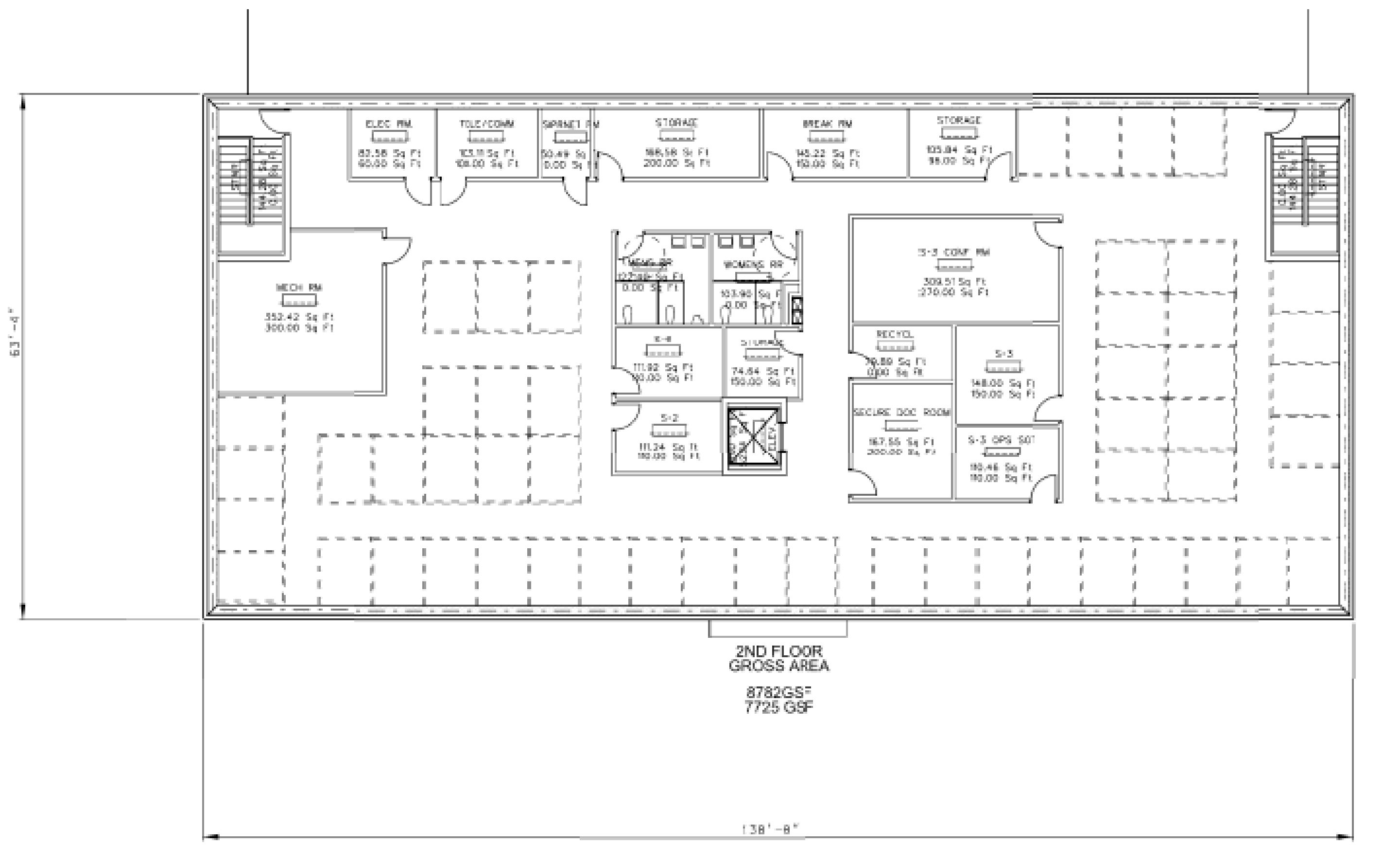
71'-8"
48'-0"
71'-8"
1ST
FLOOR GROSS AREA
21,681 GSF
20,050 GSF
CHAPLAIN
ENTRY VEST
DUTY STATION
MESSAGE
FIELD
CHAP ASST
EXEC
CMD SGT
COMMANDER
COMMAND CONF
BDE JA
CMD STOR RM
DEPUTY
S-1
S-1 CENTRAL FILES
CENTRAL FILES
BREAK
S-4
ELECTRICAL
ELEVATOR
MECHANICAL
UPS
SR HR SGT
ELEV EQ RM
S-1 / S-4 CONF
TEAM RM
S-1 / S-4 STOR
RECYCLE
TELECOM
SIPRNET
OP LAW JA
STAIR
INT. VEST
CONF RM
CONF RM
VEST
VEST
NOC
SCIF
EM OFFICE
SOC
TEAM RM
STOR
SIGINT
SERVER RM
SERVER RM
EXT. VEST (TEM)
GEOINT
A/V SERVER RM
10'-6"
85'-10"
124'-8"
28'-4"
11'-10"
167'-8"
11'-10"
191'-4"

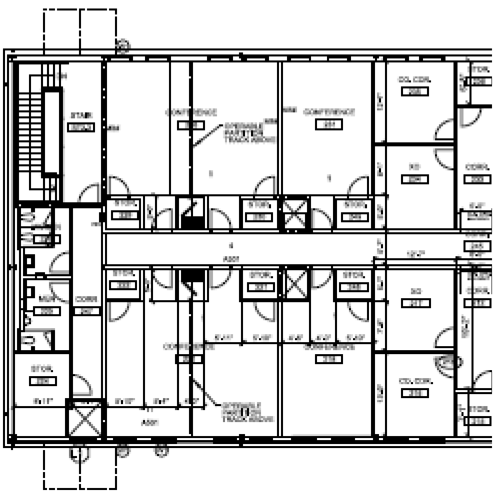


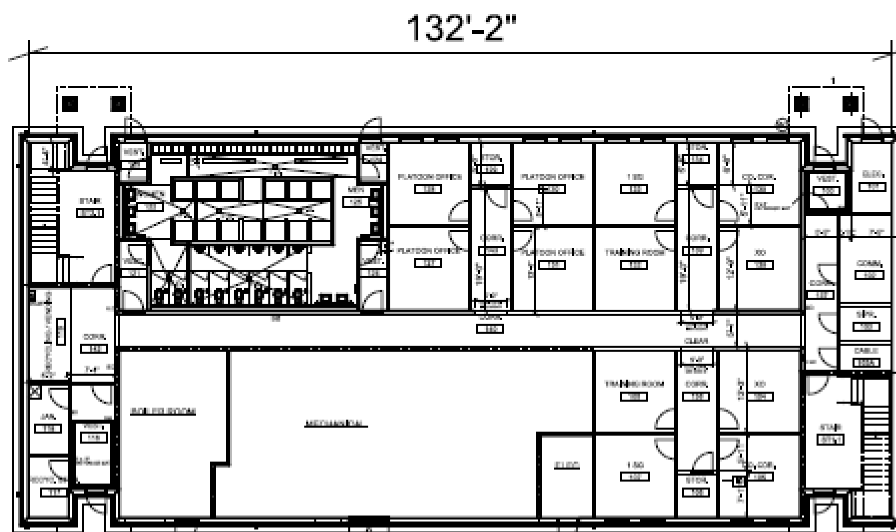
2ND
FLOOR GROSS AREA
21,465 GSF
20,050 GSF
52
21
76
BREAK
JANITOR
ELEVATOR
RECYCLE
MECHANICAL
ELECTRICAL
CENTRAL FILES
TELECOM
SIPRNET
OPS SGT
TEAM RM
TEAM RM
TEAM RM
TEAM RM
TEAM RM
SECURE DOC ROOM
STAIR
STAIR



127'-8"
5'-6"
5'-6"
37'-0"
63'-4"
MECH
430.79 Sq Ft
CLASSROOM
2975.87 Sq Ft
3240.00 Sq Ft
ELEC RM
60.00 Sq Ft
STORAGE
151.88 Sq Ft
227.00 Sq Ft
TELE/COMM
120.65 Sq Ft
100.00 Sq Ft
SIPRNET
81.82 Sq Ft
36.00 Sq Ft
WOM TOILET
MEN TOILET
231.00 Sq Ft
260.00 Sq Ft
STOR
127.88 Sq Ft
SUPPLY RM.
170.90 Sq Ft
150.00 Sq Ft
CENTRAL FILES
328.61 Sq Ft
280.00 Sq Ft
MECH ROOM
755.76 Sq Ft
760.00 Sq Ft
CMD CONF RM
421.32 Sq Ft
375.00 Sq Ft
SUPPLY RM
ELEV RM
SR HR SGT
110.38 Sq Ft
110.00 Sq Ft
110.38 Sq Ft
100.00 Sq Ft
DUTY OFCR
108.51 Sq Ft
130.00 Sq Ft
S-4
110.39 Sq Ft
110.00 Sq Ft
BN EXEC OFCR
60.00 Sq Ft
BN CMD
208.61 Sq Ft
200.00 Sq Ft
CMD SGT MAJ
150.93 Sq Ft
150.00 Sq Ft
S-1
114.21 Sq Ft
110.00 Sq Ft
VESTIBULE
133.00 Sq Ft
110.00 Sq Ft
110.00 Sq Ft
100.00 Sq Ft
CHAPLAIN
150.00 Sq Ft
MAIL ROOM
185.01 Sq Ft
260.00 Sq Ft
STAIR
2'-0"
1ST FLOOR
GROSS AREA
13539 GSF
12375 GSF
16'-8"
138'-8"


ELEC RM
82.58 Sq Ft
60.00 Sq Ft
TELE/COMM
103.11 Sq Ft
108.00 Sq Ft
SIPRNET RM
50.49 Sq Ft
0.00 Sq Ft
STORAGE
188.58 Sq Ft
200.00 Sq Ft
BREAK RM
145.22 Sq Ft
150.00 Sq Ft
STORAGE
105.84 Sq Ft
98.00 Sq Ft
MECH RM
352.42 Sq Ft
300.00 Sq Ft
WOMENS RR
103.90 Sq Ft
0.00 Sq Ft
S-4
111.92 Sq Ft
STORAGE
74.64 Sq Ft
150.00 Sq Ft
S-2
111.24 Sq Ft
110.00 Sq Ft
ELEV
S-3 CONF RM
309.51 Sq Ft
270.00 Sq Ft
RECYCL
S-3
148.00 Sq Ft
150.00 Sq Ft
SECURE DOC ROOM
167.55 Sq Ft
200.00 Sq Ft
S-3 OPS SOT
110.46 Sq Ft
110.00 Sq Ft
2ND FLOOR
GROSS AREA
8782GSF
7725 GSF
63'-4"
138'-8"





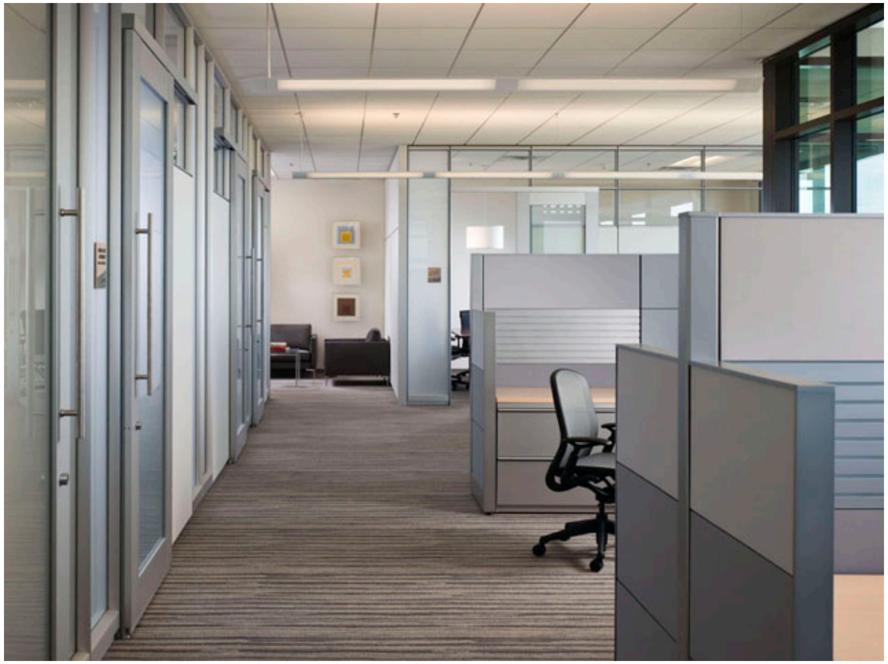
ADMINISTRATION BUILDING

FIRST FLOOR

SPAWAR

DIRTT



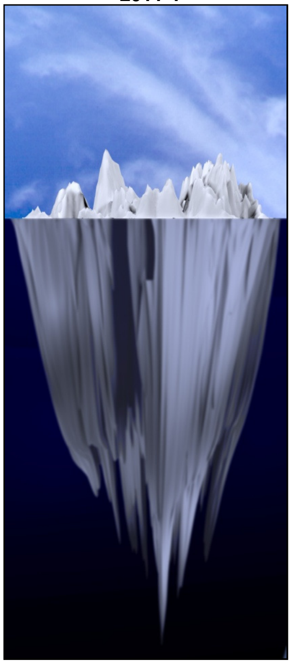



spider AGILE TECHNOLOGY ICEberg®

Welcome to Spider

State / Province / City **KY - Ownsboro**

2011-1



An ICEberg®. What you see is only a small portion of all there is to see.

COST SUMMARY		Cost/$		Cost/SF.	
		Spider	Typical	Spider	Typical
Details	Total Installed Cost	$84,318	$91,366	$4.68	$5.08

Cost Premium or (Savings)	($7,048)	-7.71%

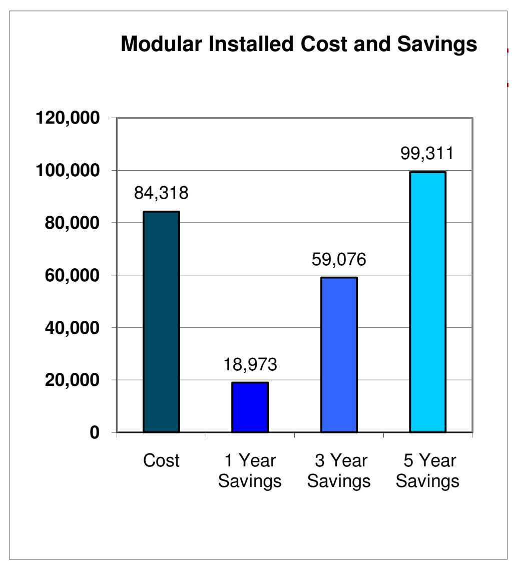
Churn, construction schedule, tax recovery, can all save you time and money during install and in the years to come.

Let's go deeper to see what ICEberg really looks like.

ICEberg demonstrates cash and time benefits of Sustainable Modular Electrical versus Typically Constructed Electrical.

Cost Premium or (Savings)	($7,048)	-7.71%

SAVINGS		Cash savings/Recovery		
		After 1st Year	After 3 Years	After 5 Years
Details	Churn	$ 17,616	$ 54,503	$ 94,139
Details	Tax Benefits	$ 1,357	$ 4,573	$ 5,173
Details	Schedule savings	8 days	8 days	8 days
Details		$ -	$ -	$ -
	Cumulative Cash Savings	$ 18,973	$ 59,076	$ 99,311
	Per Square Foot Savings	$1.05	$3.28	$5.52
	% of Total Project Saved	22.50%	70.06%	117.78%
		$0	$0	$0

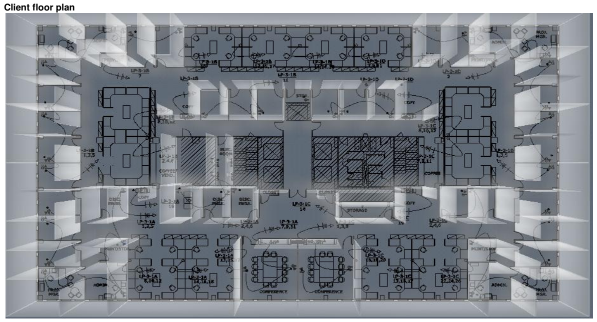


Installed Cost Back to: [Top]

		Installed cost		Cost per square foot			Settings
		Spider	Typical	Spider	Typical	% Difference	Ceiling/Wall ZB
Details	Under floor - high profile	$ -	$ -	$0.00	$0.00	-	Typical Solution: Pipe/Wire
Details	Under floor - low profile	$ -	$ -	$0.00	$0.00	-	Year: 2011
Details	Above ceiling	$ 27,487	$ 22,995	$1.53	$1.28	20%	Month: Jun-11
Details	In fixed walls	$ 7,042	$ 19,589	$0.39	$1.09	-64%	Contract: Less than 1M
Details	In moveable walls	$ -	$ -	$0.00	$0.00	-	Distribution: 100.00%
Details	Home runs to panel	$ 36,865	$ 36,865	$2.05	$2.05	0%	Typical home run: Pipe/Wire
				$0.00	$0.00	-	
				$0.00	$0.00	-	
	Shipping	$ 2,215	$ -	$0.00	$0.00	100%	% Total Cost: 3.10%
	Contingencies	$ -	$ -	$0.00	$0.00	-	Rate of Ctgcs: 0.00%
Details	Conditions & Fees	$ 10,709	$ 11,917	$0.00	$0.00	-10%	Rate of C&F: 15.00%
	Total	**$84,318**	**$91,366**	**$4.68** / SF.	**$5.08** / SF	**-7.71%**	
	Full solution cost / # of duplex	105	105	$803.03 EA	$870.15 EA		

Welcome to Spider KY - Ownsboro

Client floor plan

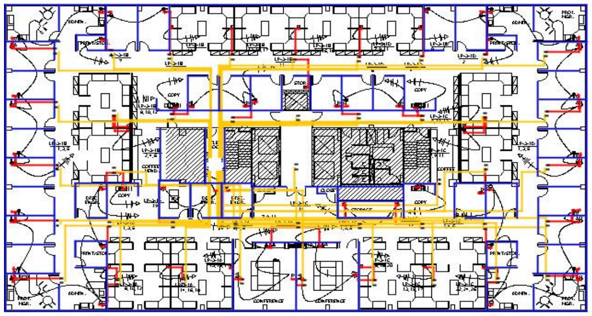


Zone Box Solution

Typical home run

Spider extender cables

File Name : 18K Floor Plan - Floor - RAFB - Zone Box.ice -- Fri Nov 13 13:05:17 PST 2009

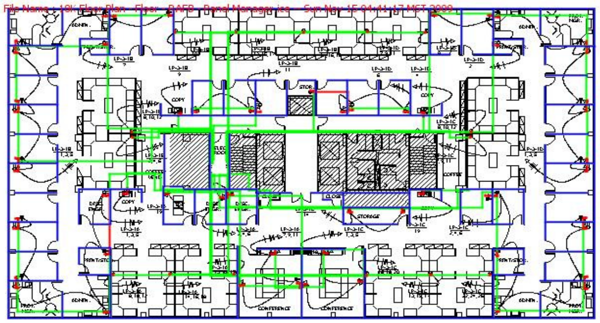


Panel Manager Solution

Spider express lines

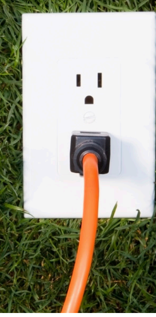
Spider extender cables

File Name : 18K Floor Plan - Floor - RAFB - Panel Manager.ice -- Sun Nov 15 04:41:17 MST 2009



Spider Agile Technology

MODULAR PLUG & PLAY POWER – WHAT ARE THE BENEFITS AND WHY SPIDER?



No matter how flexible you make the walls and furniture in your space, you are only as agile as your electrical infrastructure. If you have to bring in electrical trades to cut and reroute your wiring every time you make a move, add or change, then you will lose the freedom you worked so hard to create.

Modular plug & play power is a faster installation because the parts are engineered and manufactured in a factory – not in your space. Once installed, the system allows you to control your electrical needs without creating material waste or adding extra cost and time to the changes needed.

WHY SPIDER?

Communication

Spider uses ICE® software to design, specify, manufacture and install your modular power infrastructure. That means design teams and clients can see exactly where the power is being routed, how many outlets each end-user is getting and where their access is. They get all this in an interactive, real-time, 3D experience where any changes are automatically calculated in the specification and price for all to see without requiring any ability to read an electrical drawing.

Tested And True

All Spider components are UL and CSA tested and approved before shipping. The patented Spider boxes are also accessible for site inspectors to confirm compliance. Later, when changes are made, the components remain code compliant without any retesting required.

Efficiently Prepared

Until now plug & play modular zone box solutions asked all clients to over-engineer their space to adapt to change. Each box was ready to expand to react to business growth. This was not an easy thing for the facilities manager to sell to their stakeholders. 'Why buy more than we need now?' The Spider Panel Manager changes all that. It is scalable for total flexibility without the need for buying extra components to future-proof the space. Clients only buy what they need for their move-in and can quickly and cleanly reroute it to adapt to moves and changes. If the client does grow and add to the space, only then do they need to purchase and install more electrical components.

Thoughtful Design

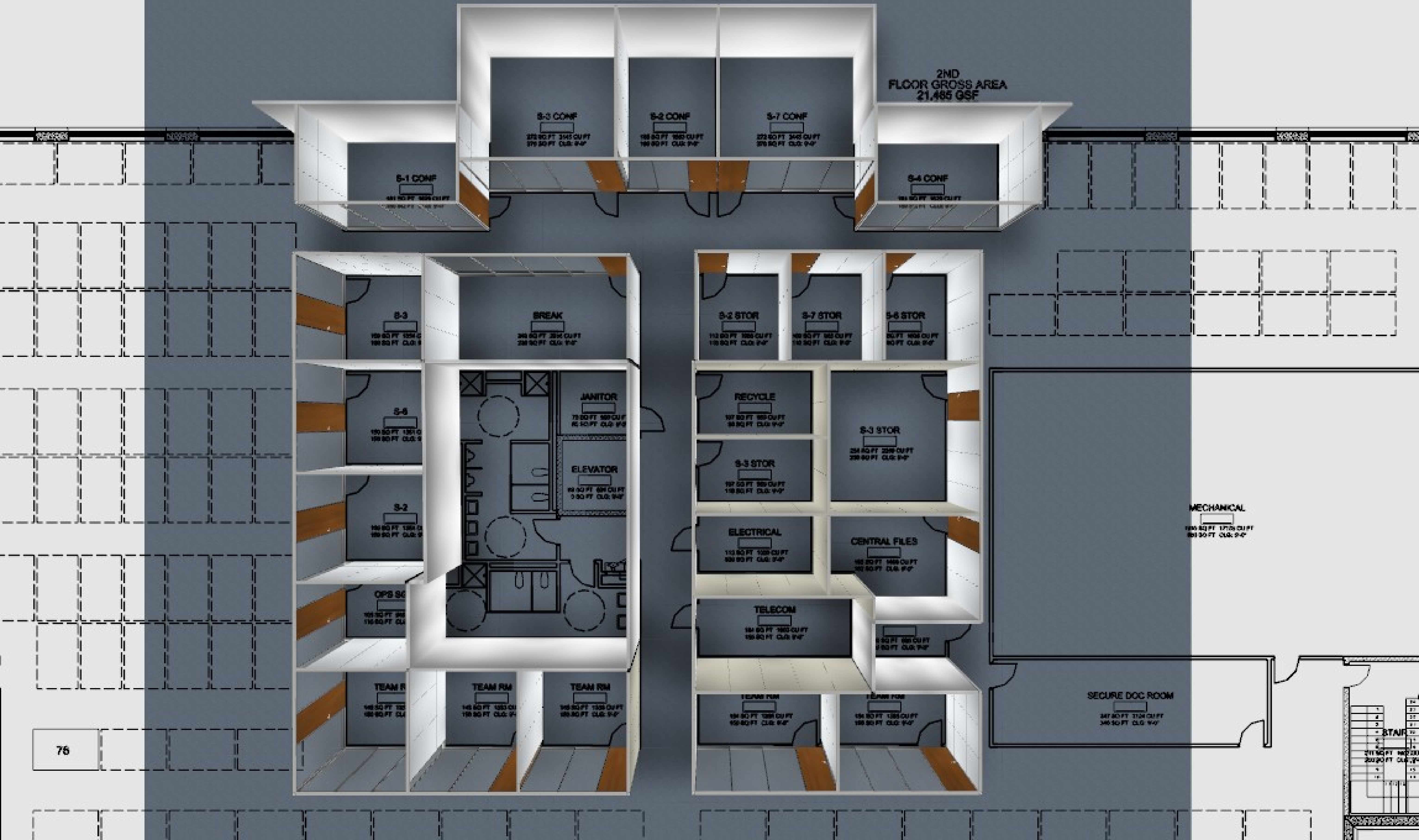
Spider's boxes can house data and security components, whether they are mounted in the floor or ceiling. The boxes' design can be ordered to match HVAC vent cut-outs in access floors. Lids for access floor boxes in multi-use rooms are easily opened and closed and safely integrate with the floor.

To learn more about Spider Agile Technology contact us at 250.765.2616 or sales@spidermfg.com

spider AGILE TECHNOLOGY
www.spideragiletechnolgy.com

SPAWAR

DIRTT

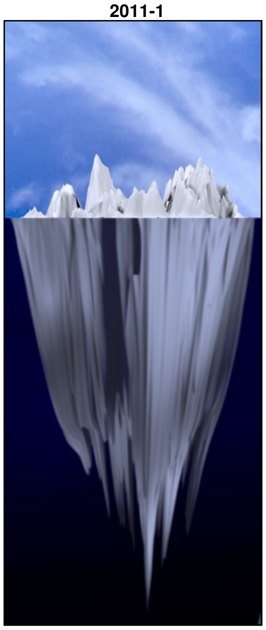


2ND
FLOOR GROSS AREA
21,485 GSF
S-3 CONF
S-2 CONF
S-7 CONF
S-1 CONF
S-4 CONF
S-3
BREAK
S-2 STOR
S-7 STOR
S-6 STOR
S-6
JANITOR
RECYCLE
S-3 STOR
ELEVATOR
S-3 STOR
S-2
ELECTRICAL
CENTRAL FILES
MECHANICAL
TELECOM
TEAM RM
TEAM RM
SECURE DOC ROOM
76

DIRTT ICEberg®

Select State/Province/City **KY - Ownsboro**

2011-1



An ICEberg®. What you see is only a small portion of all there is to see.

The same is true when building out your office interior.
An upfront cost comparison of options is only the tip of the ICEberg.

COSTS	Cost		Cost/SF.	
	DIRTT	Conventional	DIRTT	Conventional
Details Interior Space	$617,873	$683,342	$34.33	$37.96
Total Installed Cost	$617,873	$683,342	$34.33	$37.96

Cost Premium or (Savings)	($65,469)	-9.58%

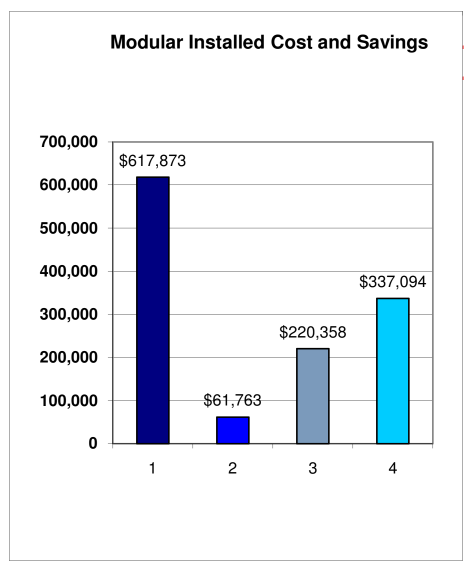
Reconfigurations, construction schedule, overhead, energy savings, tax recovery, can all save you time and money during install and in the years to come.

Let's go deeper to see what ICEberg really looks like.

ICEberg demonstrates possible cash benefits of Sustainable Modular Interiors versus Conventionally Constructed Interiors.

Cost Premium or (Savings)	($65,469)	-9.58%

SAVINGS	Cash savings/recovery by going movable			
	After 1 year	After 3 years	After 5 years	Settings
Details Churn	$ 10,742	$ 33,265	$ 57,513	24%
Details Reconfigurations	$ 24,441	$ 75,852	$ 131,460	5%
Details Tax Benefits	$ 26,580	$ 111,241	$ 148,121	40%
Details Construction Schedule	-	-	-	-
Details Contractor Overhead	$ -	$ -	$ -	10%
Cumulative Cash Savings	$61,763	$220,358	$337,094	
Per Square Foot Savings	$ 3.43	$ 12.24	$ 18.73	
% of Total Project Cost Recovered	10.00%	35.66%	54.56%	
Other Savings*	$231,782	$36,736	$956,468	



*There are many other benefits to a modular interior. We have seperated these items into their own section since their calculation requires some assumptions to be made. Check out this section for information on, Renovation Soft Costs, Cost of Wasted Space, What Happens When You Move, etc.

Interior Space Installed Cost — Back to: [Top]

		Installed Cost		Cost/Unit		%	Settings
		DIRTT	Conventional	DIRTT	Conventional	% Difference	Factor 106.09%
Details	Interior solid walls	$ 271,917	$ 110,635	$224.41 / LF.	$91.31 / LF	146%	Year 2011
Details	Interior glazing	$ 57,033	$ 150,378	$130.93 / LF.	$345.21 / LF	-62%	Month Jun-11
Details	Perimeter walls	$ -	$ -	$0.00 / LF.	$0.00 / LF	-	Contract $ Less than 1M
Details	Doors w trim/hardware	$ 62,669	$ 176,856	$1,253.37 / EA.	$3,537.12 / EA	-65%	Seismic No
Details	Refreshment centers	$ -	$ -	$0.00 / LF.	$0.00 / LF	-	GSA Yes
Details	Electrical in walls	$ 11,415	$ 16,564	$0.63 / SF.	$0.92 / SF	-31%	Level 3
Details	Raised access floor	$ -	$ -	$0.00 / SF.	$0.00 / SF	-	
Details	Floor covering	$ 75,315	$ 94,144	$37.66/ SYD.	$47.07 /SYD	-20%	Type Rolled
Details	Ceilings	$ 36,864	$ 36,864	$2.05 /SF.	$2.05 /SF	0%	
Details	Acoustics	$ 17,685	$ 17,685	$0.98 / SF.	$0.98 / SF	0%	Not Specified
	Freight	$ 28,320	$ -	$1.57 / SF.	$0.00 / SF	100%	% Total Cost 5.31%
	Contingencies	$ 3,365	$ 18,094	$0.00 / SF.	$0.00 / SF	-81%	Rate of Ctgcs 3.00%
Details	Conditions & Fees	$ 53,290	$ 62,122	$2.96 / SF.	$3.45 / SF	-14%	Rate of C&F 10.00%
	Total	$617,873	$683,342	$34.33 / SF.	$37.96 / SF	-9.58%	

KY - Ownsboro

"THE HUMAN RACE IS CHALLENGED MORE THAN EVER BEFORE TO DEMONSTRATE OUR MASTERY-- NOT OVER NATURE, BUT OURSELVES." Rachel Carson

Wasted Drywall During Construction

21,810 sq. ft. of drywall will be used for this conventional project.

Cornell University studies show that on average 1 pound of drywall ends up in a landfill site for each square foot of drywall installed. This waste comes from the initial installation of the product, not during a renovation, or a demolition.

Your choice of a conventional interior has added **21,810** lbs. of new drywall to the landfill in your area.

The design of an office space can create more waste than necessary with conventional building.

Waste from ceiling heights	0.00	9.00 ceiling height
Cut outs from doors	761.60	
Cut outs from clerestory/stacked	2,146.67	
	2,908.27	lbs. of scrap drywall from this floor plan design

Waste from changes		2,011	2,012	2,013	2,014	2,015
Rate	5%	3,817	7,634	11,450	15,267	19,084

What's wrong with throwing drywall into a landfill site?

1. Hydrogen sulfide gas may be produced when land filling gypsum, particularly in a wet climate.
2. Hydrogen sulfide gas is toxic at high concentrations (~1,000 parts per million) and has a foul rotten-egg odor.
3. Several communities in Canada do not accept drywall at landfills for this reason.
4. Incineration may produce toxic sulfur dioxide gas. Drywall is not permitted to be incinerated in California.

[http://www.ciwmb.ca.gov]

Drywall Scrap Generation by percentage: CA Integrated Waste Management Board 2005

New Construction	64%	Demolition	14%
Manufacturing	12%	Renovation	10%

Green solutions to conventional waste

1. Purchase substitutes that are reusable, such as modular partitions, for commercial buildings.

Source: CIWMB.CA 2005. Article on Wallboard (Drywall) Recycling

2. Purchase drywall with 25% recycled content for new construction. [www.gypsumrecycling.biz]
3. Use your scrap drywall in garden composting. Maximum gypsum for garden applications is 1% of the compost.

You are allowed 16.158 pounds per cubic yard. At 4" of compost in a garden, 16.158 lbs of gypsum will cover 9 sq. yards, or 81 square feet.

Your floor plan calculated scrap gypsum of **21,810** lbs. http://www.cleanitgreenit.net/frame.html

You will need a garden that is **109,335** sf. to use your scrap in garden composting.

Wasted Carpet During Installation

Back to: [Top]

**Average weight of rolled carpet is 5 lbs per sq. yard/ carpet tile is 10 lbs per sq. yard.*

Rolled goods	Modular open office installed in open room before walls (no raised floor)	Conventional office Installed in closed offices after construction
Cost	$75,315	$94,144
Scrap	1 - 2%	13 - 20 %
Cash	$1,130	$15,534
Yards	24.00	330.00
Pounds	240.00	1650.00

Carpet tiles	Modular open office installed in open room before walls over raised floor	Conventional office Installed in closed offices after construction
Cost	$57,821	$57,821
Scrap	1 - 2%	3 - 5%
Cash	$867	$2,313
Yards	30.00	80.00
Pounds	300.00	400.00

Wasted Carpet during Maintenance

	Cash	Yards	Pounds
Rolled goods replaced at a rate of 20% per year.			
Per Year	$ 18,829	400	2,000
5 Years	$ 94,144	2,000	10,000
Carpet tiles are replaced at a rate of 4% a year.			
Per Year	$ 2,313	80	800
5 Years	$ 11,564	400	4,000

[http://www.interfaceflooring.com/calculator]

Build, Demolish, Build, Demolish, and on and on...

Just how much debris is generated when this floor plan is gutted? Our tenant real estate space is an environmental crime waiting to happen. These spaces are constantly being built out, gutted, and built out again for the next tenant. The EPA has done studies on how much debris is generated when these commercial spaces are torn out. The EPA is claiming an average of 155 pounds of debris for each square foot of space.

Your floor plan is **18000.00** s.f.

How much garbage?	Lbs. of debris	Tons of debris
	2,790,000.0	1,246

[www.epa.gov]

Old Growth Forests Timber

[www.underwatertimber.com]

Consider purchasing your material from non-typical sources. High end, clear, finished wood can be purchased from companies that are now retrieving logs from the bottom of rivers that were used to float old growth forest trees to the mills during the 1800's. The high quality of this timber is unequal to anything that you can purchase today from second and third-growth forests. These recovered, old growth forest trees, are being considered for certification as a "Recycled" product. Source: Environmental Building News - April 2005

DIRTT's green solution

Use wood veneer on aluminum for all trim work.

[www.dirtt.net]

DIRTT Products Recycled Materials Content

Back to: [Top]

	By Weight	By Price	Recycled Price
Solid walls	78.00%	53.47%	$ 145,394
Glass walls	18.00%	3.53%	$ 2,013
Solid doors	50.00%	50.00%	$ -
Glass doors	18.00%	9.64%	$ 5,741
Total DIRTT recycled price			$ 153,149
DIRTT project price			$ 391,259
Interior by DIRTT recycled %			39.14%

[www.dirtt.net]

Paint, Varnish, Stain, and Other Finishing Fumes

Back to: [Top]

[http://www.epa.gov]

Volatile Organic Compounds (VOC's) are found in most construction and finishing products. A short list of these would include paints, stains, varnishes, solvents, adhesives, wood preservatives, waxes, polishes, sealants, dyes, etc. Almost all of these will end up in your conventionally built interior space.

Health effects of VOC's on your employees will vary by employee, proximity to VOC's, exposure time to VOC's, etc. These symptoms to exposure will also vary and include; eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system. Some organics can cause cancer in animals; some are suspected or known to cause cancer in humans.

The ability of organic chemicals to cause health effects varies greatly from those that are highly toxic, to those with no known health effect. As with other pollutants, the extent and nature of the health effect will depend on many factors including level of exposure and length of time exposed. Eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment are among the immediate symptoms that some people have experienced soon after exposure to some organics.

[http://www.babycenter.com/expert]

Studies are also being done to determine the long term effects of these chemicals on pregnant or nursing women.

VOC's in your space	SF.	Coats	Gal Required	VOC lbs/Gal	Lbs of VOC
Average latex paint/primer	21,810	3	139.22	3.17	441.58
Average oil paint/primer	21,810	3	139.22	4.38	610.08
Low VOC latex	21,810	3	139.22	2.10	292.47
Abusing low VOC latex	21,810	5	232.03	2.10	487.45
Low VOC oil	21,810	3	139.22	3.19	444.55
DIRTT chroma coat	21,810	1	46.41	2.09	96.99

[http://www.pfonline.com/articles/019703.html/]

Note: DIRTT chroma coat off gasses in our manufacturing process and not in your space!

DIRTT's green solution

[www.dirtt.net]

DIRTT uses water based finishing products and adhesives. This was done for the safety of our own precious employees first in the manufacturing process, and for yours during and after installation of our products, and in the years to come. There is minimal VOC off gassing with DIRTT finishing products.

Lead in Data Cabling

[http://www.epa.gov]

In 1999, 26% of all lead in the US was found in data cabling. An increase in lead use **from 16% in 1990**. Releases or transfers of lead from data cabling estimated at **8.6 million pounds in 1999**. Lead is used as a heat stabilizer in cable jacketing. Each time it is cut or nicked the cable releases lead contamination. There was an estimated **45 billion feet of data cabling in plenum space in 1999**, all containing lead. Lead has contaminated our air, our water, and our soil. Disposal of used cabling needs hazardous material handling in some jurisdictions.

Is your plenum cable removal considered Hazardous Material?	Non haz-mat	Hazardous
Plenum space for this project	18,000	18,000
Average SF. cost to remove cabling	$ 4	$ 30
Total cost	$ 72,000	$ 540,000

And from a further financial view point, never run another data cable for an employee move. Never have to update new cabling for hardware upgrades. Instead of having your employees meeting to work together, they can pick up their stuff and sit anywhere, together.

CDC - NIOSH Health paper on Lead http://www.cdc.gov/niosh/topics/lead

The CDC lists the top 3 jobs that run the most risk of lead exposure. Top of that list are Cable Splicers, followed by Construction workers and Manufacturers of bullets, batteries, ceramics, etc.

Noise Pollution

Back to: [Top]

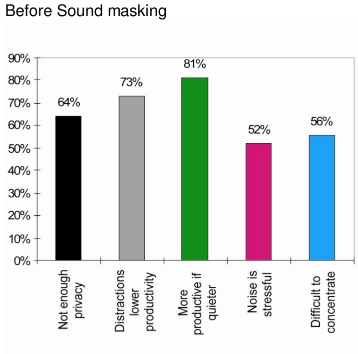
What does sustainable design sound like?

[http://www.acoustical-sound-masking.com/SoundSolutions-case-study.pdf]

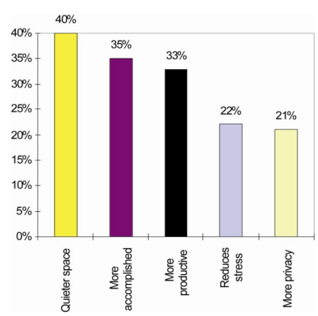
A study published by ASID revealed that 81% of business executives are unconcerned about office noise. This same study done with employees in open space revealed the top factors contributing to work place distractions are; noise 71%, air quality 20%, lighting 9%. Is it possible that this huge discrepancy relates to traditional construction practices that place executives in offices where sound was actually considered during design and construction?

The current ratio for open to closed space workers is 68:32. Almost 70% of a corporations single largest asset is not functioning at full capacity due to a factor that is easy to correct. Sound masking in an office environment, whether in conventional or modular construction, will improve employee productivity and satisfaction.

Before Sound masking



After Sound masking



Your cost to have 30% of your workers enjoy sound privacy with deck to deck construction	$ 53,054
Your cost to have 100% of your workers enjoy sound privacy with sound masking	$ 17,685

CO_2 Emissions on transportation

Back to: [Top]

Delivery location	KY - Ownsboro	**Manufactured location**	Calgary AB
Miles from Manufacturer	2,228		Details

CO_2	Crew	Trips	Commute	MPG	Fuel Used	CO_2
Conventional	16	599.84	26	17.60	886.13	17,190.91
Manufactured						
Common Carrier		4.80	2,228	12	891.20	19,784.64
Local Install	4	38.19	26	17.60	56.41	1,094.39
						20,879.03
	(Reduction) / Increase in pounds of CO_2 emissions					3,688.12

Average commute is 26 miles. http://abcnews.go.com/Technology/Traffic/story?id=485098&page=1

CO2 emissions in Diesel Fuel is 22.2 lbs per gallon.

CO2 emissions in Gasoline Fuel is 19.4 lbs per gallon. http://www.epa.gov/otaq/climate/420f05004.htm

Miles per gallon for Gasoline/Diesel fuels. http://www.georgetown.edu/facilities/fuelcellbus/overview3.html

Mileage for Carrier is driving miles. http://www.randmcnally.com/rmc/directions/dirGetMileage.jsp

Men for crews is calculated by RSMeans based on your floor plan.

Back to: [Top]

Electricity. Where does yours come from? How much CO_2 does it create in a year?

Our buildings are the single largest contributor to global warming.

Purchased electricity for your space comes from;

State Electrical Generation in Megawatthours			KY - Ownsboro	
Electricity generated by	**Total mWh**	**% of total**	**CO_2/kWh**	**CO_2/kWh ratio**
Coal	91,198,488	92.31%	2.095	1.934
Petroleum	3,340,898	3.38%	1.969	0.067
Natural Gas	1,176,046	1.19%	1.321	0.016
Nuclear	0	0.00%	0.000	0.000
Hydro or Other Renewable	3,051,091	3.09%	0.000	0.000
Other	25,491	0.03%	0.000	0.000
Total	98,792,014	100.00%		2.016

Your floor plan				
Floor plan sq.ft.	Your BTUs *	Your kWhs	Your CO_2 emissions from purchased electrical	
18,000.00	2,561,400	7,506,695	15,135,618	/pounds per annum

*Average annual BTU by commercial building per sq ft = 132.0 - 152.6, average142.3   1BTU = 2.9307 kWh

All State specific, CO2, and commercial building information is from the Energy Information Administration, Department of Energy.

http://www.eia.doe.gov

Back to: [Top]

CO_2 emissions. Big number. What does it mean?

Translating large numbers into a more human scale helps us all to understand it, make sense of it, and decide to change our behaviors to reduce it. Annual CO_2 emissions from your office space is equivalent to:

6,865	Metric tons of CO_2
1,257	Passenger vehicle emissions for a year
779,377	Gallons of gasoline consumed
910	Homes worth of electricity for 1 year
286,096	Propane cylinders used for home barbeques
2,367	Tons of recycled waste instead of landfilling it
0.0000	Portion of ALL coal fired power plants

Nature takes care of CO_2 emissions. How many trees would it take to sequester your office space's annual CO_2 emissions?

176,196	Seedlings grown for 10 years
1,561	Acres of mature pine forests

http://www.epa.gov/cleanenergy/energy-resources/calculator.html

Back to: [Top]

Power Smart

Occupancy sensors are a growing requirement in office space. Instead of relying on the last person out to turn off the lights you allow your technology to do it for you. Not only is this saving Corporations dollars it is also reducing greenhouse gas.

Type of room	Energy Savings %	Your space	Your annual lighting kWh*	Your annual cash wasted for electricity	CO_2 created for that wasted electricity
Private office	13 to 15%	5,760	408,364	$ 5,717.10	197,611
Open areas	20 to 28%	10,530	746,541	$ 17,916.98	361,257
Conference rooms	22 to 65%	540	38,284	$ 1,665.36	33,578
Corridors or rest rooms	30 to 90%	810	57,426	$ 3,445.57	69,472
Storage area or closets	45 to 80%	360	25,523	$ 1,595.17	32,163
* based on average of 17% of kWh for lighting		18,000	1,276,138	$ 30,340.18	694,082 lbs

http://www.anaheim.net/utilities/ea/PA_10.html

That took care of the overhead lighting. Now let's look at items per work station. What else can we turn off when it is not in use? According to the EPA 25% of all monitors and task lights are left on 24 hours a day, 365 days a year, and during a typical 9 hour work day that same monitor is also idle for an average of 5 hours.

[http://www.epa.gov]

Calculations for each employee — How many employees do you have? **120**

Item	Watts ea.	Idle time hrs	Kilowatt hrs	In a year	Cost each	Cost for all
Task light	50	19/5	0.43	155	$ 15.51	$ 1,861.20
Monitor	100	19/5	0.85	310	$ 31.03	$ 3,723.60
Personal item	50 - 100	5	0.38	137	$ 13.69	$ 1,642.80
			1.66	602	$ 60.23	$ 7,227.60
		CO_2 lbs.	3.35	1,213.80	All Employees	145,656 lbs

Smart power bars with personal occupancy sensors should be installed in each work station to further reduce our wasted energy usage in our office environments. Plug all monitors, lights, fans, heaters, radios, calculators, and anything else non essential into this power bar so when the employee walks away, they all switch off.

Harvesting daylight - Practical magic

Back to: [Top]

" Modeling must demonstrate 25 horizontal footcandles under clear sky conditions, at noon, on the equinox, at 30 in. above the floor..." LEED CI, credit 8.1

Most commercial spaces have enough daylight near windows to eliminate the need for electric lighting. Daylight harvest planning and systems can reduce your energy usage and allow you to take advantage of free light. Commerical energy peak demand hours are those same hours with the highest levels of daylight availability.

Space planning - Instead of having your private offices and conference/meeting rooms along the window walls and your open areas in the center why not switch those around? Next step to allow the natural light to penetrate as far as possible would be to add glass to those offices and conference/meeting rooms.

Systems to help you - There are 2 basic types of Daylight Harvesting systems on the market, both are sensored, and both will reduce your energy consumption. The most common, and expensive, is a lighting dimming control system that will read the amount of available light and dim the space lighting accordingly. The newest, and less expensive technology, is also sensored with a basic on/off control. Your choice of these options and deriving the most beneficial option for energy/financial savings may depend on where you live.

Location	KY - Ownsboro	Annual base building lighting kWh	1,276,138

Average weather condition				Annual	
Full sun	Cloud cover	Sensor type	Reduced kWh	Cash savings	CO_2 savings
36%	64%	Dimming	357,319	$ 35,732	720,455
		On/off	229,705	$ 22,970	463,150

Back to: [Top]

If you build it, they will come!

So does that mean if you do NOT build it they can work from home?

UNDER CONSTRUCTION!

With all of the recent advancements in technology more businesses have the opportunity to encourage their employees to work from home.

Back to: [Top]

Mold

"Our bathroom hasn't flooded and our roof hasn't leaked. They haven't even been built yet! Why should I be concerned about mold in my new construction project?"

Conventional construction is based on staging all of the sub trades who will be working on your space to ensure it is completed on time, on schedule, and hopefully, on budget. Part of the staging requires building materials to be delivered to your site. So? Building materials are stored, delivered, and staged **OUTSIDE. Exposure to the elements can start mold growing before your space is even built.**

Is this a serious issue for a client?

The Insurance Industry thinks so. A question you may want to ask your General Contractor before you sign that contract is, **"Do you have liability insurance coverage for Pollutants and Mold?".**

The media has made the public aware of the serious issues of mold on their health. This awareness has increased the number of law suits relating to mold and conventional construction. As a result of these law suits Commercial General Liability Insurance Coverage for the Construction Industry has separated and excluded Pollutants and Mold.

Here is an example of how serious this issue is in this industry and how quickly it is growing; as published in an article by Associated General Contractors (ACG) Society, Farmers Insurance had the following claims for mold:

[http://www.agc.org/index.ww]

1999	150 claims
2000	500 claims
2001	over 12,000 claims

DIRTT's Agile Architectural components, walls, doors, low profile raised floors, etc., are manufactured in a controlled facility. Finished product is wrapped and protected from the elements until it is installed in your space. These products are never exposed to the elements.

Before you take down a wall in your office space....

Back to: [Top]

Check to see when it was built. [www.ciwmb.ca.gov]

Interior drywall walls built in the 70's pose a serious health risk to your employees when you start knocking them down and have the dust spread throughout your space.

Drywall compound used to finish drywall walls built in the 70's contained asbestos. Demolishing that wall will release the asbestos into your space, your HVAC system, and the general environment. Test your walls for asbestos if you have no information on exactly when they were built.
Finishing paints on drywall walls built in the 70's may also contain lead-based paint. Have your paint tested for lead as well before you knock them down.

Klusmeier, Carmen D LRL

Subject: FW: Decision tables for EISA Value Study

----- Original Message -----
From: Nichols, Jeremiah R LRL
Sent: Thursday, October 27, 2011 12:05 PM
To: Robertson, Ben A LRL
Cc: Hoelzer, Cliff LRL
Subject: RE: Decision tables for EISA Value Study

Ben,

RC-56. I made a mistake on this one. This is being done as part of the original design (ASHRAE 90.1 and 189.1 requirement) for both the COF and HQs Bldgs (PN63641) as well as the TEMFs (PN64296).

RC-51. Rejected for both the COF and HQ Bldgs (PN63641). Included in original design for TEMFs (PN64296).

COF - Question first cost savings of $27,000 in that saving due to decrease fan motor is likely to be offset by increased air handler size. Although COF's issue with mechanical room space may not be as critical as HQ, issue with excessive latent and total capacity from lower face velocity still is of great concern.

HQs - The Mech Rm floor space size in the BGDE facility has been optimized based on AHU equipment sized on 500-550 fpm maximum face velocity. Acceptance of RC-51 would result in the use of dimensionally larger AHUs in which current floor space may not be available to accommodate. In addition, the oversized unit may present coil capacity problems. Lower face velocities potentially increase coil latent capacity, and since coils must be sized to meet the sensible load, excessive latent and thus excessive overall total capacity typically results. This is a concern. In addition, VE shows a 1st Cost Savings of $27,000, which is questionable and appears to be in error since larger AHUs will be required than that used in original design.

Thanks.

Jeremy Nichols, P.E.
Project Manager
Ft. Campbell Support Section
Louisville District
U.S. Army Corps of Engineers
Desk Phone: (502) 315-7445
BlackBerry: (502) 381-6424

-----Original Message-----
From: Robertson, Ben A LRL
Sent: Tuesday, October 25, 2011 9:42 AM
To: Nichols, Jeremiah R LRL
Subject: RE: Decision tables for EISA Value Study

Thank you sir.

Benjamin Robertson PE, AVS
Value Engineering Officer
U.S. Army Corps of Engineers, Louisville District
Attn: CELRL-ED-M-M, B. Robertson, Rm. 973 P.O. Box 59 Louisville, KY 40201-0059
O: 502.315.6336
C: 502.396.3651
F: 502.315.6373
Email: ben.a.robertson@usace.army.mil

You can't solve your problems with the same level of thinking that created the problems.

Albert Einstein

-----Original Message-----
From: Nichols, Jeremiah R LRL
Sent: Tuesday, October 25, 2011 9:34 AM
To: Robertson, Ben A LRL; Korene Robinson
Cc: Hoelzer, Cliff LRL
Subject: RE: Decision tables for EISA Value Study

Ben/Korene,

Roger that. I will discuss with SAS. I need to talk to them anyway about a couple of other project issues/questions.

Cliff - I'll take care of this.

Thanks.

Jeremy Nichols, P.E.
Project Manager
Ft. Campbell Support Section
Louisville District
U.S. Army Corps of Engineers
Desk Phone: (502) 315-7445
BlackBerry: (502) 381-6424

-----Original Message-----
From: Robertson, Ben A LRL
Sent: Monday, October 24, 2011 7:25 AM
To: Nichols, Jeremiah R LRL; Hoelzer, Cliff LRL
Cc: Korene Robinson
Subject: RE: Decision tables for EISA Value Study

Jeremy/Cliff,

Please see Korene's email below; sounds like we need a little clarification/confirmation that we understand the idea.

Benjamin Robertson PE, AVS
Value Engineering Officer
U.S. Army Corps of Engineers, Louisville District
Attn: CELRL-ED-M-M, B. Robertson, Rm. 973 P.O. Box 59 Louisville, KY 40201-0059
O: 502.315.6336
C: 502.396.3651

F: 502.315.6373
Email: ben.a.robertson@usace.army.mil

You can't solve your problems with the same level of thinking that created the problems.

Albert Einstein

-----Original Message-----
From: Korene Robinson [mailto:Korene@svs-inc.net]
Sent: Sunday, October 23, 2011 9:22 AM
To: Robertson, Ben A LRL
Subject: RE: Decision tables for EISA Value Study

Ben,
Why is RC-51 and RC-56 noted as reject on HQ, a code requirement on the COF's and already being done on the TEMF? This doesn't make sense because simply stated we are recommending installation of a bypass that would allow the system to operate on a simple economizer cycle rather than use the waste air to temper the incoming air. I will mark it as you have noted, but I think there is some confusion about what is being recommended.

Korene

-----Original Message-----
From: Robertson, Ben A LRL [mailto:Ben.A.Robertson@usace.army.mil]
Sent: Thursday, October 20, 2011 10:13 AM
To: Korene Robinson
Subject: RE: Decision tables for EISA Value Study

Here is the implementation results from the meeting I had yesterday with Jeremy and Cliff. I am waiting for justification responses from Jeremy on one or two things but this is the bulk of it. I really want to get this wrapped up and in my hands next week. If you have any questions or wish to discuss, please do not hesitate to contact me.

Thank you

Benjamin Robertson PE, AVS
Value Engineering Officer
U.S. Army Corps of Engineers, Louisville District
Attn: CELRL-ED-M-M, B. Robertson, Rm. 973 P.O. Box 59 Louisville, KY
40201-0059
O: 502.315.6336
C: 502.396.3651
F: 502.315.6373
Email: ben.a.robertson@usace.army.mil

You can't solve your problems with the same level of thinking that created the problems.

Albert Einstein

-----Original Message-----
From: Korene Robinson [mailto:Korene@svs-inc.net]
Sent: Wednesday, October 19, 2011 3:53 PM
To: Robertson, Ben A LRL
Subject: RE: Decision tables for EISA Value Study

Here is the write up - as it is now in the report.

-----Original Message-----
From: Robertson, Ben A LRL [mailto:Ben.A.Robertson@usace.army.mil]
Sent: Wednesday, October 19, 2011 2:43 PM
To: Korene Robinson
Subject: RE: Decision tables for EISA Value Study

Per our conversation, I only have the table at this point and not the idea so I didn't know. The title of the idea didn't define the idea.
We may want to consider changing the title.

thanks

Benjamin Robertson PE, AVS
Value Engineering Officer
U.S. Army Corps of Engineers, Louisville District
Attn: CELRL-ED-M-M, B. Robertson, Rm. 973 P.O. Box 59 Louisville, KY 40201-0059
O: 502.315.6336
C: 502.396.3651
F: 502.315.6373
Email: ben.a.robertson@usace.army.mil

You can't solve your problems with the same level of thinking that created the problems.

Albert Einstein

-----Original Message-----
From: Korene Robinson [mailto:Korene@svs-inc.net]
Sent: Wednesday, October 19, 2011 1:48 PM
To: Robertson, Ben A LRL
Subject: RE: Decision tables for EISA Value Study

Ben - it is in the report - CRC-4. Is that not what you are looking for? Only in the HQ report, though. Look at CRC-4 and see if that is what you believe is missing.

-----Original Message-----
From: Robertson, Ben A LRL [mailto:Ben.A.Robertson@usace.army.mil]
Sent: Wednesday, October 19, 2011 12:33 PM
To: Korene Robinson
Subject: RE: Decision tables for EISA Value Study

Thanks.

Ok, so why didn't the combining of the COF make it into the report? We discussed it after the workshop and decided it was a missed opportunity and it should have been developed so I developed it working with Rachael, Kent, and Cecil and provide you guys the final outcome. All that was needed was for you guys to review/validate the accuracy. Did you find something wrong with it? If so, please speak up otherwise I don't want to waste that effort.

I know it won't be accepted for this project however I am hoping it will get some folks attention at Army. This idea, as I submitted to you, has about $2.5M worth of savings not factoring in any premium we may pay for going vertical; the cost to go vertical is where I was hoping you guys could quickly add a cost factor.

Benjamin Robertson PE, AVS
Value Engineering Officer
U.S. Army Corps of Engineers, Louisville District
Attn: CELRL-ED-M-M, B. Robertson, Rm. 973 P.O. Box 59 Louisville, KY
40201-0059
O: 502.315.6336
C: 502.396.3651
F: 502.315.6373
Email: ben.a.robertson@usace.army.mil

You can't solve your problems with the same level of thinking that created the problems.

Albert Einstein

-----Original Message-----
From: Korene Robinson [mailto:Korene@svs-inc.net]
Sent: Wednesday, October 19, 2011 1:21 PM
To: Robertson, Ben A LRL
Subject: RE: Decision tables for EISA Value Study
Importance: High

Here is the TEMF table.

-----Original Message-----
From: Robertson, Ben A LRL [mailto:Ben.A.Robertson@usace.army.mil]
Sent: Wednesday, October 19, 2011 11:27 AM
To: Korene Robinson
Subject: RE: Decision tables for EISA Value Study

I realize you are out of town but can you get me the replacement TEMF sheets? I am meeting with Jeremy and Cliff in a few minutes.

thanks

Benjamin Robertson PE, AVS
Value Engineering Officer
U.S. Army Corps of Engineers, Louisville District
Attn: CELRL-ED-M-M, B. Robertson, Rm. 973 P.O. Box 59 Louisville, KY
40201-0059
O: 502.315.6336
C: 502.396.3651
F: 502.315.6373
Email: ben.a.robertson@usace.army.mil

You can't solve your problems with the same level of thinking that created the problems.

Albert Einstein

-----Original Message-----
From: Korene Robinson [mailto:Korene@svs-inc.net]

Sent: Wednesday, October 19, 2011 11:01 AM
To: Robertson, Ben A LRL
Subject: RE: Decision tables for EISA Value Study
Importance: High

Ben,
I never got anything additional from Jeff on this. We got something on the Barracks, but not on this. Here is the revised table for the HQ after my edits have been incorporated. I think you are correct, we sent you the table out of the Draft report, rather than the most current report. The most current version of the TEMF report has not yet been uploaded to the server for me to pull the current table. I'll get that to you as soon as I get someone to upload it. I am out of the office this week and don't have all the resources normally available to me.

I apologize for the confusion on this.

Korene

-----Original Message-----
From: Robertson, Ben A LRL [mailto:Ben.A.Robertson@usace.army.mil]
Sent: Wednesday, October 19, 2011 9:16 AM
To: Korene Robinson
Cc: John Robinson
Subject: RE: Decision tables for EISA Value Study
Importance: High

The decision tables you provided below are exactly the same as in the draft report......thought you guys were working on the report? These tables do not appear to have addressed my comments, Jeff's further development on his idea (RC-53) I am under the impression he provided, nor does it include the idea I developed to combine the COF (see attached).

Do I have the correct implementation sheets?

Benjamin Robertson PE, AVS
Value Engineering Officer
U.S. Army Corps of Engineers, Louisville District
Attn: CELRL-ED-M-M, B. Robertson, Rm. 973 P.O. Box 59 Louisville, KY 40201-0059
O: 502.315.6336
C: 502.396.3651
F: 502.315.6373
Email: ben.a.robertson@usace.army.mil

You can't solve your problems with the same level of thinking that created the problems.

Albert Einstein

-----Original Message-----
From: Korene Robinson [mailto:Korene@svs-inc.net]
Sent: Thursday, August 25, 2011 6:06 PM
To: Hoelzer, Cliff LRL; Nichols, Jeremiah R LRL; Robertson, Ben A LRL
Cc: John Robinson
Subject: Decision tables for EISA Value Study
Importance: High

Gentlemen:

Attached you will find a table to record your decisions, along with remarks/rationale, for the two projects that we did the EISA Value study on. We would like to include this information in the final report. WE believe that you have already made many of the decisions and this is merely a recording of them, at this point. However, if we need to discuss any of them, we are available next week to do a conference call.

Thank you.

Description: 2 - NewSVSlogo

Korene V Robinson, PE, LEED AP

President

Strategic Value Solutions, Inc.
19201 E. Valley View Pkwy, Suite H
Independence, MO 64055

816.795.0700 (w)
816.795.0725 (f)
Korene@SVS-inc.net

www.SVS-inc.net <http://www.svs-inc.net/>

Klusmeier, Carmen D LRL

Subject: FW: PN63641 - Supporting Docs for Rejecting HRC-7 & HRC-8
Attachments: RE: PN63641 (3BCT Complex) (UNCLASSIFIED); PN63641 (3BCT Complex) (UNCLASSIFIED)

Importance: High

----- Original Message -----
From: Nichols, Jeremiah R LRL
Sent: Thursday, October 27, 2011 06:19 AM
To: Robertson, Ben A LRL
Cc: Hoelzer, Cliff LRL
Subject: PN63641 - Supporting Docs for Rejecting HRC-7 & HRC-8

Ben,

Please see attached e-mails (one for CoS and one from Ft. Campbell DPW). These were the basis for rejecting both HRC-7 and HRC-8. Ultimately it came down to the Installation deciding that separate buildings were the best COA.

If you have any questions or need any additional information on these VE recommendations, please let me know.

Please do not contact the CoS or the Ft. Campbell DPW directly. All information and questions should be routed through me. Same goes for SVS communication - should be routed through you and then through me.

Thanks.

Jeremy Nichols, P.E.
Project Manager
Ft. Campbell Support Section
Louisville District
U.S. Army Corps of Engineers
Desk Phone: (502) 315-7445
BlackBerry: (502) 381-6424

Klusmeier, Carmen D LRL

From: Williams, Frederick L Mr CIV USA IMCOM [frederick.williams10@us.army.mil]
Sent: Monday, May 16, 2011 9:38 AM
To: Nichols, Jeremiah R LRL
Subject: PN63641 (3BCT Complex) (UNCLASSIFIED)

Jeremy,

I know you have been waiting for our answer. We have drilled into pros/cons for constructing separate BDE/BN buildings for 3BCT vs combining them.
We have determined that the most prudent COA is to construct separate buildings as originally planned with the following issues the basis for our decision:

- The real estate preserved from consolidation is less than expected due to the need to site parking in the stand alone battalion footprints.

- The upfront savings are immediately offset by additional design dollars.
- The loss of an entire set of battalion classrooms (3 total) resulting from consolidation, is a significant impact to the unit's training abilities.
- Combining the buildings eliminates any flexibility we might need to re-site/re-allocate to different units in light of dwindling MILCON funds and the push to re-allocate facilities.

If you have any questions, don't hesitate to call me.

VR
Fred

Klusmeier, Carmen D LRL

From: Toney, Steven V SAS
Sent: Tuesday, May 03, 2011 1:54 PM
To: Nichols, Jeremiah R LRL
Cc: 'Castleman, Sally P CIV USA IMCOM'; 'Williams, Frederick L Mr CIV USA IMCOM'; Lotz, Rick LRL; Brockbank, Thomas R SAS
Subject: RE: PN63641 (3BCT Complex) (UNCLASSIFIED)
Attachments: layout.pdf; CAMPBELL_BDE_BN--SF-_A-FPF1--.pdf; Document.pdf

Classification: UNCLASSIFIED
Caveats: NONE

Jeremy,

Please find attached three documents:

First is the site plan. It appears that the combined Headquarters building will fit on the site, however approximately 200 parking space will have to be located across the street. The total parking for the building is approximately 300. As you can see we oriented the building in the same direction as the stand alone Brigade.

Second you can see how we arranged the combined building. It turns out that the combined building will have about the same square footage as the total of the stand alone buildings. The stand alone total 87,772 SF. We estimate that the combined will total about 86,602 SF. Even though you are losing three classrooms this circulation space and restrooms, shown in the center one story space between the BDE and the BN, is required so the folks using the classroom will not have to enter the headquarters to use their restrooms. Additional space will be required in that area to act as a reception area to direct visitors to the correct location.

Third is the cost estimate prepared by our internal cost estimator. As you can see the first cost saving in building the combined is approximately $693,101. This savings would be offset by the lost effort to date of our design effort (approximately $600,000) and in addition to that you will lose the site design cost. This estimate was prepared using the latest PAX numbers and in FY-13 dollars. As far as the LCCA, it is difficult for us to imagine a significant savings for the consolidated HQ, but we have not attempted to model the building in that regard.

We are providing these documents for your review and are awaiting your direction to proceed.

Steven V. Toney RA
BDE/ BN COS Team Leader
Savannah District COE-EN-DC
912-652-5960

Classification: UNCLASSIFIED
Caveats: NONE

Klusmeier, Carmen D LRL

Subject: FW: Rejection of Combined COF

----- Original Message -----
From: Nichols, Jeremiah R LRL
Sent: Thursday, October 27, 2011 12:10 PM
To: Robertson, Ben A LRL
Cc: Hoelzer, Cliff LRL
Subject: Rejection of Combined COF

Ben,

Please use HQ USACE as the directing organization for the rejection.

Thanks.

Jeremy Nichols, P.E.
Project Manager
Ft. Campbell Support Section
Louisville District
U.S. Army Corps of Engineers
Desk Phone: (502) 315-7445
BlackBerry: (502) 381-6424

U.S. ARMY ENGINEER DIVISION, SOUTH ATLANTIC
CORPS OF ENGINEERS
3-May-11

PRE-CONCEPT ESTIMATE OF TOTAL PROJECT COST
FOR
3rd BCT COMPLEX, EISA Demonstration Project, Bn-Bde
FY - 2013 LINE ITEM - 63641
FORT CAMPBELL, KY

This estimate is based on conceptual information prepared by USACE Savannah District COS, dated May 2011, and cost information developed by USACE Savannah District Technical Support Section, Cost Engineering Team.

PROGRAMMED AMOUNT --

		QTY	UM	UC	Stand Alone	Combined	DELTA
CONTRACT COST - October 2013 Price Level							
0001	3rd BCT Brigade Headquarters Building	43,130	SF	$215.31	$ 9,286,336		
0002	3rd BCT Battalion Headquarters Building	22,321	SF	$237.04	$ 5,290,957		
0003	3rd BCT Brigade Headquarters Building	22,321	SF	$237.04	$ 5,290,957		
CONTRACT COST - October 2013 Price Level							
0001	Combined Brigade/2-Battalion Headquarters Building	86,952	SF	$220.53		$ 19,175,149	
TOTAL CURRENT CONTRACT COST (CCC)					**$ 19,868,250**	**$ 19,175,149**	**$ 693,101**
							96.51%

PREPARED BY:

FRANK B. GILL JR. CCC
Mechanical Engineer,
Technical Support Section

FOR OFFICIAL USE ONLY

FACILITY UNIT COST WORKSHEET

INSTALLATION: Fort Campbell, KY
PROJECT: 3rd BCT Complex
FY-2013 LI-63641
DATE: Oct-13

		2648	QTY	UM	2011 PAX UNIT COST	2011 PAX ADJUSTED COST
				ACF=	1.020	
	FACILITY UNIT COST CALCULATION					
	Combined Bn-Bde HQ Facility		86,952			203.81
14 182	Brigade Headquarters Building, Large (122-156 Staff)		40,100	SF	201.00	
	3rd Brigade HQ Bldg, Large		43,130	SF		
	Size Relationship	1.076				
	Size Adjustment Factor		SAF=	0.990		198.99
14 183	Battalion Headquarters Building, w/CR's (51-70 Staff)		18,100	SF	224.00	
	3rd BCT Battalion HQ Bldg, X-Large (2 Ea.)		43,822	SF		
	Size Relationship	2.421				
	Size Adjustment Factor		SAF=	0.931		208.54
	Location Adjustment Factor (LAF)		LAF=	1.020		207.89
	Cost Escalation Adjustment (CEA)		CEA=	1.000		207.89
	Tri Service MCP Index [Oct 2013]	2648				
	Bn-Bde Bldg Tri Service MCP Index [Oct 2013]	2648				
	Technological Updating Adjustment Factors		TUF=	1.061		220.53
	(Added Costs for High Efficiency Building)	1.040				
	(Added Costs for UFC's, SDD/LEED, EPACT05, Etc.)	1.020				
	Design Contingency Adjustment		DCA=	1.000		
	BASIC ADJUSTED UNIT COST				Min	220.53
	TOTAL ADJUSTED UNIT COST (CWE Summary)	**Oct-13**			***Likely***	***220.53***
	Other Cost Adjustments (Per TM-5-800-4)					
	Risk Adjustment Factor (Complex Technologies)		RAF=	0.000		
	Site Sensitivity Adjustment (Special Case)		SSA=	0.040		
	[Pick Conditions Applicable to Project]					
	Inadequate Labor Force	+	0.000			
	- Slightly Below Normal	+	0.040			
	- Substantially Below Normal		0.059			
	Congested Work Area		0.028			
	Inadequate Parking		0.021			
	Technical Specialty Competition Adjustment		TSCA=	0.040		
	(Special case(s) when large MILCON program over multiple FY's causes competition for specialty contractors)					
	Competition for Services of Specialty Craftsmen					
	[Pick Conditions Applicable to Project]	+	0.000			
	- S/C Availability Slightly Below Normal	+	0.040			
	- S/C Availability Substantially Below Normal		0.059			
	Total Other Cost Adjustment Factors			*1.080*		
	TOTAL POSSIBLE UNIT COST (CWE)	Oct-13			Max	238.17

FACILITY UNIT COST WORKSHEET

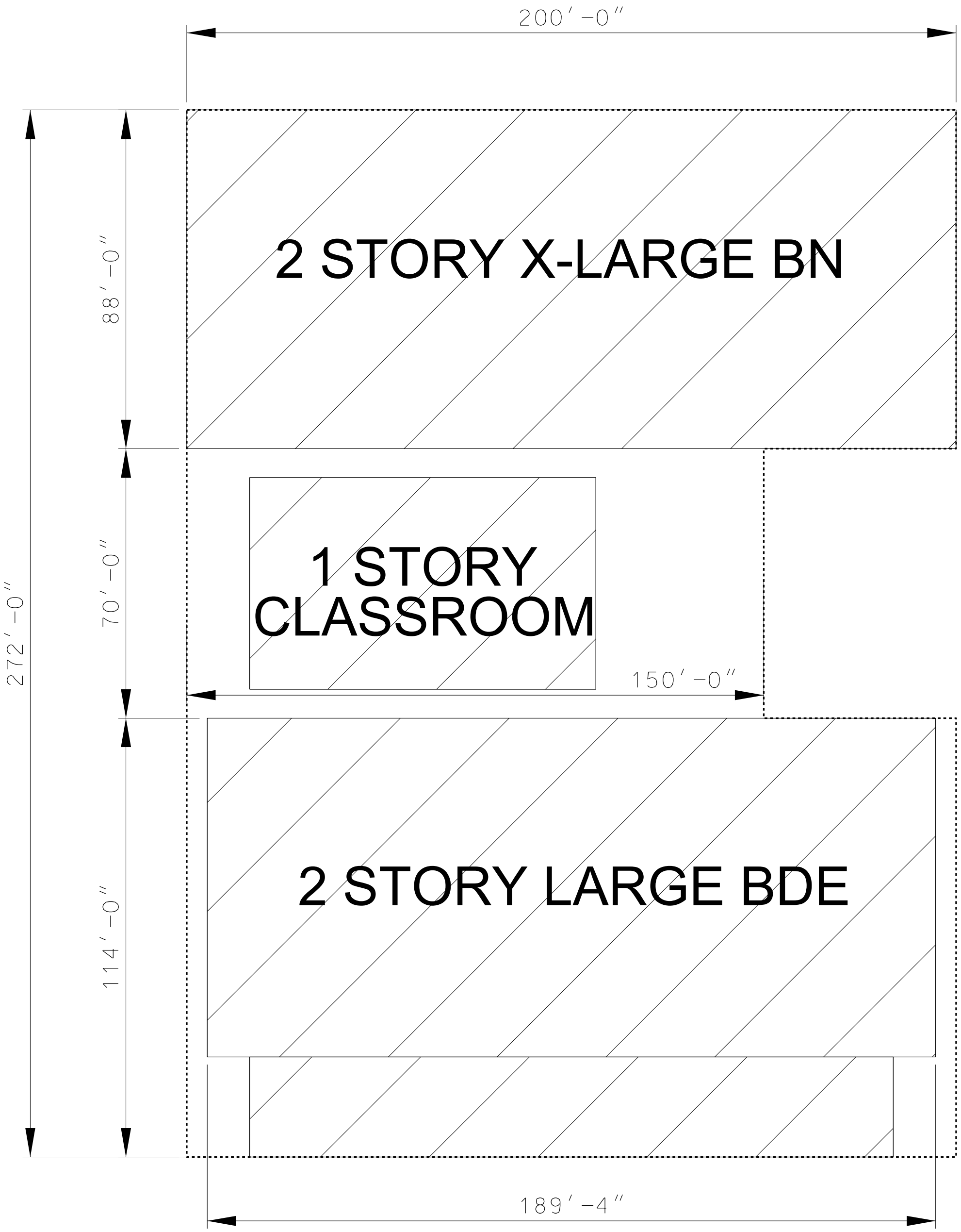
INSTALLATION: Fort Campbell, KY
PROJECT: 3rd BCT Complex
FY-2013 LI-63641
DATE: Oct-13

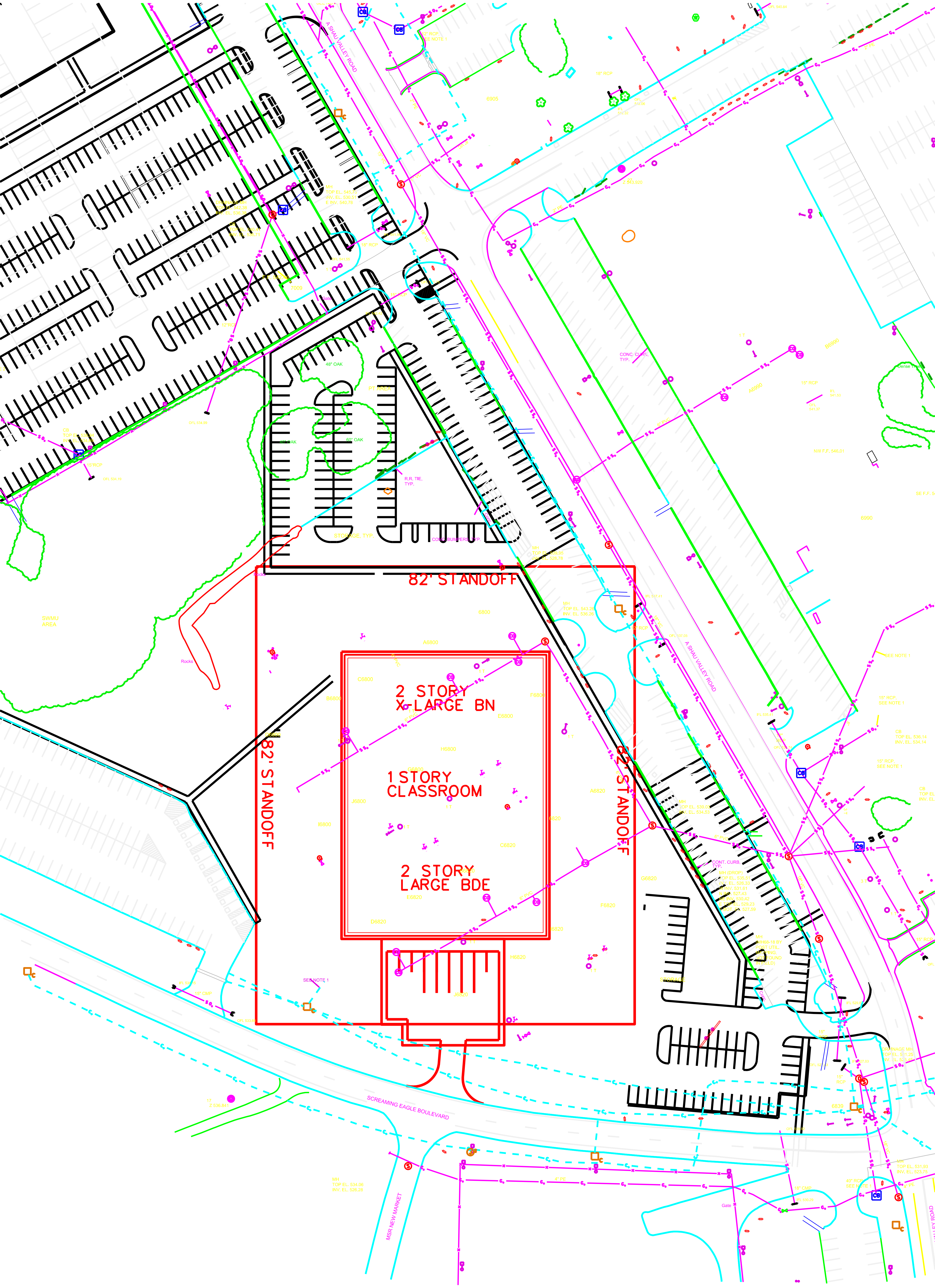
				ACF=	1.020	
	2648	QTY	UM		2011 PAX UNIT COST	2011 PAX ADJUSTED COST
FACILITY UNIT COST CALCULATION						
14 183 Battalion Headquarters Building w/Classrooms						
Battalion Headquarters Building, w/CR's (51-70 Staff)		18,100	SF		224.00	
3rd BCT Battalion HQ Bldg, X-Large		22,321	SF			
Size Relationship	1.233					
Size Adjustment Factor		SAF=	0.978			219.07
Location Adjustment Factor (LAF)		LAF=	1.020			223.45
Cost Escalation Adjustment (CEA)		CEA=	1.000			223.45
Tri Service MCP Index [Oct 2013]	2648					
Bn HQ Bldg Tri Service MCP Index [Oct 2013]	2648					
Technological Updating Adjustment Factors		TUF=	1.061			237.04
(Added Costs for High Efficiency Building)	1.040					
(Added Costs for UFC's, SDD/LEED, EPACT05, Etc.)	1.020					
Design Contingency Adjustment		DCA=	1.000			
BASIC ADJUSTED UNIT COST					Min	237.04
TOTAL ADJUSTED UNIT COST (CWE Summary)	**Oct-13**				***Likely***	***237.04***
Other Cost Adjustments (Per TM-5-800-4)						
Risk Adjustment Factor (Complex Technologies)		RAF=	0.000			
Site Sensitivity Adjustment (Special Case)		SSA=	0.040			
[Pick Conditions Applicable to Project]						
Inadequate Labor Force	+	0.000				
- Slightly Below Normal	+	0.040				
- Substantially Below Normal		0.059				
Congested Work Area		0.028				
Inadequate Parking		0.021				
Technical Specialty Competition Adjustment		TSCA=	0.040			
(Special case(s) when large MILCON program over multiple FY's causes competition for specialty contractors)						
Competition for Services of Specialty Craftsmen						
[Pick Conditions Applicable to Project]	+	0.000				
- S/C Availability Slightly Below Normal	+	0.040				
- S/C Availability Substantially Below Normal		0.059				
Total Other Cost Adjustment Factors			*1.080*			
TOTAL CURRENT UNIT COST (CWE)	Oct-13				Max	256.00

FACILITY UNIT COST WORKSHEET

INSTALLATION: Fort Campbell, KY
PROJECT: 3rd BCT Complex
FY-2013 LI-63641
DATE: Oct-13

				ACF=	1.020	
	2648	QTY	UM		2011 PAX UNIT COST	2011 PAX ADJUSTED COST
FACILITY UNIT COST CALCULATION						
14 182 Brigade Headquarters Building						
Brigade Headquarters Building, Large (122-156 Staff)		40,100	SF		201.00	
3rd Brigade HQ Bldg, Large		43,130	SF			
Size Relationship	1.076					
Size Adjustment Factor		SAF=	0.990			198.99
Location Adjustment Factor (LAF)		LAF=	1.020			202.97
Cost Escalation Adjustment (CEA)		CEA=	1.000			202.97
Tri Service MCP Index [Oct 2013]	2648					
Bn HQ Bldg Tri Service MCP Index [Oct 2013]	2648					
Technological Updating Adjustment Factors		TUF=	1.061			215.31
(Added Costs for High Efficiency Building)	1.040					
(Added Costs for UFC's, SDD/LEED, EPACT05, Etc.)	1.020					
Design Contingency Adjustment		DCA=	1.000			
BASIC ADJUSTED UNIT COST					Min	215.31
TOTAL ADJUSTED UNIT COST (CWE Summary)	**Oct-13**				***Likely***	***215.31***
Other Cost Adjustments (Per TM-5-800-4)						
Risk Adjustment Factor (Complex Technologies)		RAF=	0.000			
Site Sensitivity Adjustment (Special Case)		SSA=	0.040			
[Pick Conditions Applicable to Project]						
Inadequate Labor Force	+	0.000				
- Slightly Below Normal	+	0.040				
- Substantially Below Normal		0.059				
Congested Work Area		0.028				
Inadequate Parking		0.021				
Technical Specialty Competition Adjustment		TSCA=	0.040			
(Special case(s) when large MILCON program over multiple FY's causes competition for specialty contractors)						
Competition for Services of Specialty Craftsmen						
[Pick Conditions Applicable to Project]	+	0.000				
- S/C Availability Slightly Below Normal	+	0.040				
- S/C Availability Substantially Below Normal		0.059				
Total Other Cost Adjustment Factors			*1.080*			
TOTAL CURRENT UNIT COST (CWE)	Oct-13				Max	232.54


200'-0"
2 STORY X-LARGE BN
88'-0"
70'-0"
1 STORY CLASSROOM
150'-0"
272'-0"
114'-0"
2 STORY LARGE BDE
189'-4"


82' STANDOFF
82' STANDOFF
82' STANDOFF
2 STORY
X-LARGE BN
1 STORY
CLASSROOM
2 STORY
LARGE BDE
SCREAMING EAGLE BOULEVARD
A SHAU VALLEY ROAD
A SHAU VALLEY ROAD
MSR NEW MARKET