

*New Buildings Energy Performance  
Improvement through Incorporation of  
New Proven Technologies into Standard Designs*

*Standard Design for TEMF*

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# Issues

- **Current Army Standard Designs don't specify potential energy saving and sustainable design opportunities, available energy saving technologies, and technologies resulting in better indoor air quality and thermal comfort;**
- **Building envelope, its elements and energy/ventilation systems are not optimized for heating/cooling loads reduction;**
- **Standard Designs require significant engineering efforts and budget for its application to each specific site and its optimization for efficient energy performance in the given climate...inconsistently applied by variety of A/E firms and there is no USACE process to police A/Es**



# objectives

- **Provide an opportunity for improved building energy performance, indoor air quality and thermal environment by incorporating different building, process and energy systems related measures into the Standard Designs;**
- **Insure Standard Design SPiRiT rating at, at least, Silver level (with a potential for a Golden level when applied to a specific design);**
- **Insure, that proposed measures have a three to five years or less pay-back period.**



# Methodology

- **Develop methodology for building energy and security optimization;**
- **Select modeling and simulation tools and technologies screening procedure;**
- **Select representative Standard Design (e.g., Tactical Equipment Facilities) for the pilot analysis;**
- **Analyze current Standard Designs and evaluate opportunities for improved building energy performance and security, indoor air quality and occupants thermal environment;**



# Methodology (Continued)

- Produce a list of building, process and system related measures for further consideration;
- Select and get consensus on representative climatic conditions, and energy costs;
- Using simulation tools, e.g., Energy Plus, DOE-2, FEDS, LCCA, etc., screen the proposed technologies and measures for the appropriate performance and a pay-back period in representative climatic conditions;
- Incorporate changes into Standard Design.



# Examples of Representative Climates/Locations/Energy Rates

| Location       | Climate                          | Cost of Energy        |                        |
|----------------|----------------------------------|-----------------------|------------------------|
|                |                                  | Electricity<br>\$/kWh | Natural<br>Gas,\$/MBtu |
| Ft. Wainwright | Arctic winter/mild summer        | .1048                 | 2.88                   |
| Ft. Drum       | Cold winter/mild summer          | .0681                 | 5.75                   |
| Ft. Carson     | Cold winter/hot-dry summer       | .0441                 | 4.04                   |
| Ft. Lewis      | Maritime                         | .0357                 | 6.98                   |
| Ft. Campbell   | Moderate winter/Hot-humid summer | .0492                 | 5.12                   |
| Ft. Bliss      | Mild winters/Hot –dry summer     | .0800                 | 4.18                   |
| Ft. Bragg      | Mild Winter/Hot-humid summer     | .0455                 | 4.54                   |



**The methodology can be applied to any or all Standard Designs.**

**USACE suggested the Standard Design for Tactical Equipment Maintenance Facilities can be used to test the concept.**



# Scope of Work for TEMF Standard Design

## Phase 1 (8 weeks)

- Analyze current 1996 Standard design and evaluate opportunities for improved building energy performance, indoor air quality and workers thermal environment;
- Produce a list of building, process and system related measures for further consideration;
- Using simulation tools, screen the proposed technologies and measures for the appropriate performance and a pay-back period in several representative climatic conditions;
- Incorporate changes into standard design for the Technical Panel consideration;

## Phase 2

- Select the site for a pilot testing and work with an A&E firm to adopt the proposed pilot “standard design” to specific site and climatic conditions;
- Provide technical assistance to the contractor when needed;
- Evaluate pilot building performance and report the results to the Technical Panel for its consideration on changes to be made in the final standard design.



# Examples of Potential Measures Allowing for TEMF Building Performance Improvement

- Vehicle exhaust rails in the motor repair bays
- Welding fume exhausts in the welding bay mounted on the suspension beam with a flexible extraction arm
- Exhaust systems are sized for a partial load with a VFD, motorized dampers and pressure sensors allowing to match extraction rate with the process requirements
- VAV air supply system to production bays with a CO2 monitoring
- Heated floors with a zonal control
- Insulated folding or rapid-rolling doors
- Cold air curtains with a lobby (mild climates)
- Double air curtains (cold- + warm-air curtains) for cold climates
- Double-pane glazing with reflecting coating
- Combined exhaust from the administrative area with cooling/heating energy recovery to be used for supply air treatment

Standard Design can also include measures allowing for the building CBR protection and energy systems reliability



# Potential for a SPiRiT Rating Increase Built-in the Standard Design

| Sustainable Design Initiatives                                 | SPiRiT Rating              |                                |
|----------------------------------------------------------------|----------------------------|--------------------------------|
|                                                                | 1996<br>Standard<br>Design | Proposed<br>Standard<br>Design |
| 1. Optimized Energy Performance                                | ?                          | 20                             |
| 2. IAQ monitoring                                              |                            | 1                              |
| 3. Increase Ventilation Effectiveness                          |                            | 1                              |
| 4. Indoor Chemical and Pollutant<br>Source Control             |                            | 1                              |
| 5. Controllability of Systems                                  |                            | 1                              |
| 6. Thermal Comfort                                             |                            | 2                              |
| 7. Holistic Delivery of Facility                               |                            | 2                              |
| 8. <i>Soldier and Workforce Productivity and<br/>Retention</i> |                            | 3                              |
| Total                                                          |                            | 31                             |



**Examples of energy saving technologies for TEMF, which may or may not be applicable for different sites (climatic, seismic conditions, etc.)**



# ***Examples 1. Building Air Pollution with Diesel Exhausts***



# Solution: straight rail connected to vehicle exhausts



## Example 2. Excessive heating/cooling loads due to un-insulated doors doors with no protection against cold/warm air drafts



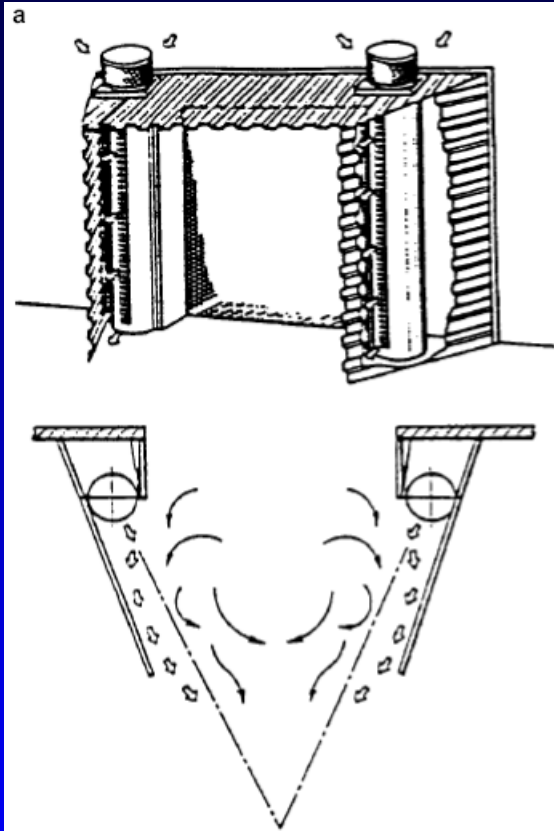
## **Solution: Insulated doors e.g., rapid-roll doors and rapid-fold doors with foam infill for extra insulation**



**Pros.: Reduces heating/cooling loads on HVAC systems, better thermal environment in the building perimeter.**



# **Solution: unheated air curtains with a lobby to prevent cold air drafts into the building**



**Solution: air-lock prevents cold air drafts into the building and allow to heat the vehicle prior to bringing it to the shop**



The building is protected from then outdoor air by two sequentially installed gates with an enclosed space (“air lock”). There is only one gate open at a time to let a vehicle in or out the building. After the vehicle enters the “air lock” the first gate closes and the second one opens.



# Example 3. Solution: Air Distribution Strategies



Air Supply into motor repair bays through round nozzles into the isles between vehicles.

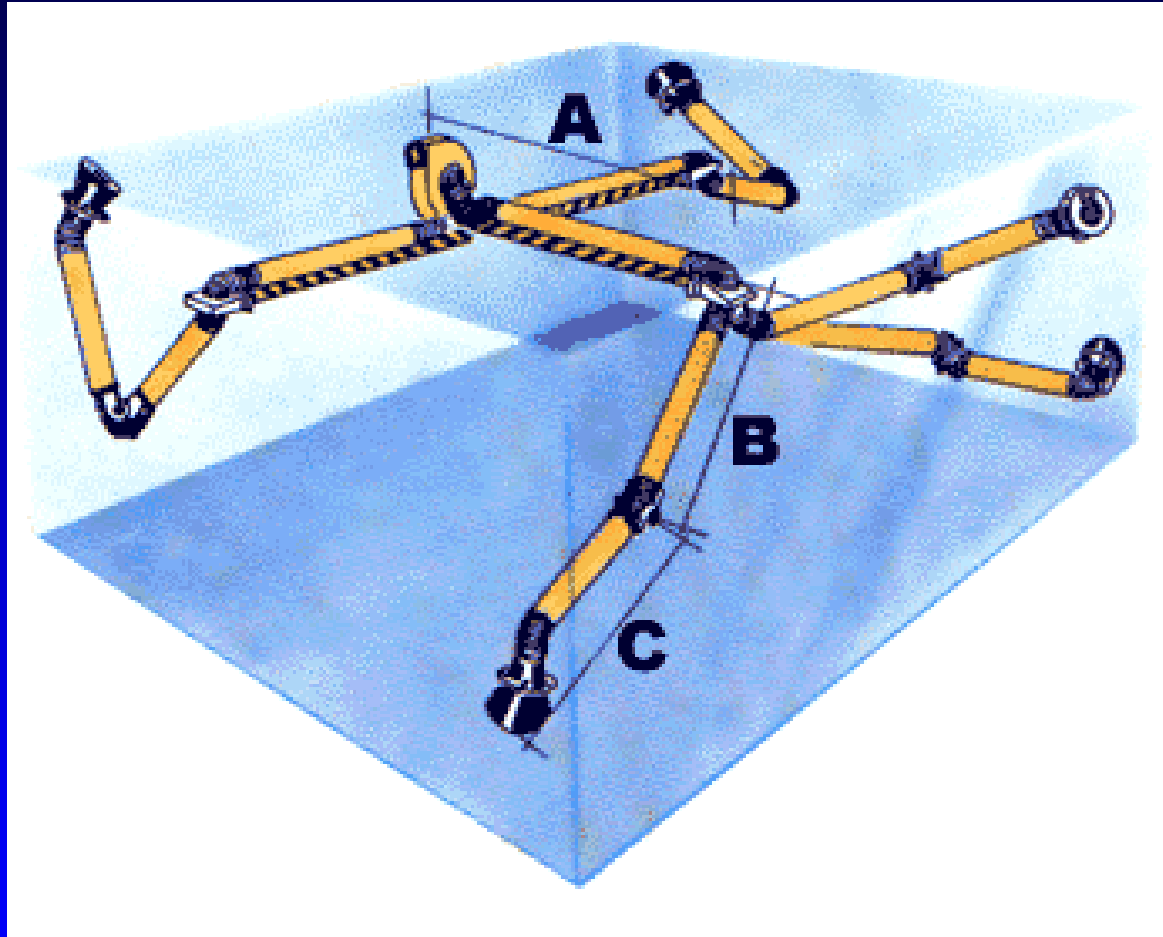
Pros. : minimizes poor ventilated areas, high induction, VAV capability, no temperature gradient, low first cost.

Air supply into welding area through perforated diffusers.

Pros.: high ventilation efficiency, creates temperature and contaminant gradient



## Example 4. Solution: welding fumes extraction for large welded pieces



## Example 5. Conventional heating systems



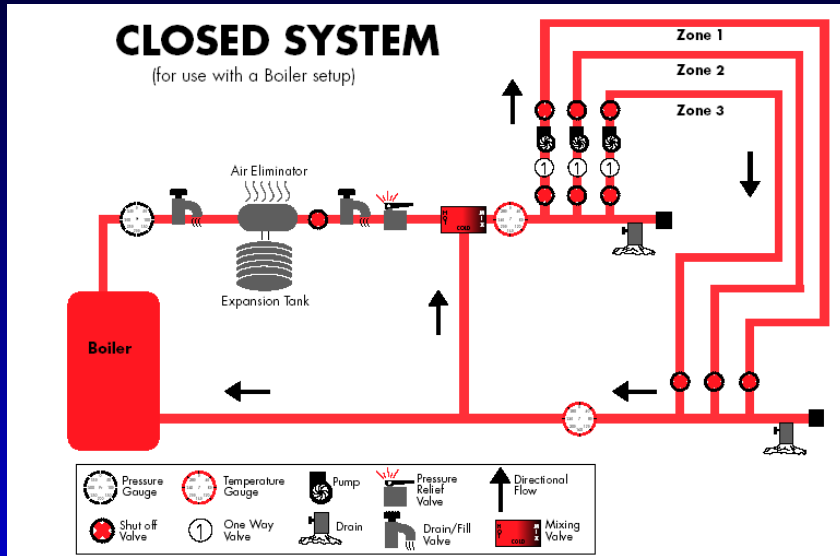
**Cons. Doesn't heat floor  
under the vehicle.  
Low efficiency due to  
the loss of heat  
convective component**



**Cons. Requires time to heat the space  
after doors have been open  
Cold floors make soldiers work under  
vehicles uncomfortable.  
Low efficient due to temperature  
stratification along the height**



# Solution: radiant floor heating system



- 30-40% more efficient compared to forced warm air system
- Provides thermal comfort for soldiers working under vehicles
- Better thermal conditions with doors open and immediately after doors closing
- Equipment cost ~ \$0.75/ft<sup>2</sup>
- Zonal control of heat supplied to each bay



# Questions, Comments??

## Contact Information

<http://www.cecerc.army.mil>

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