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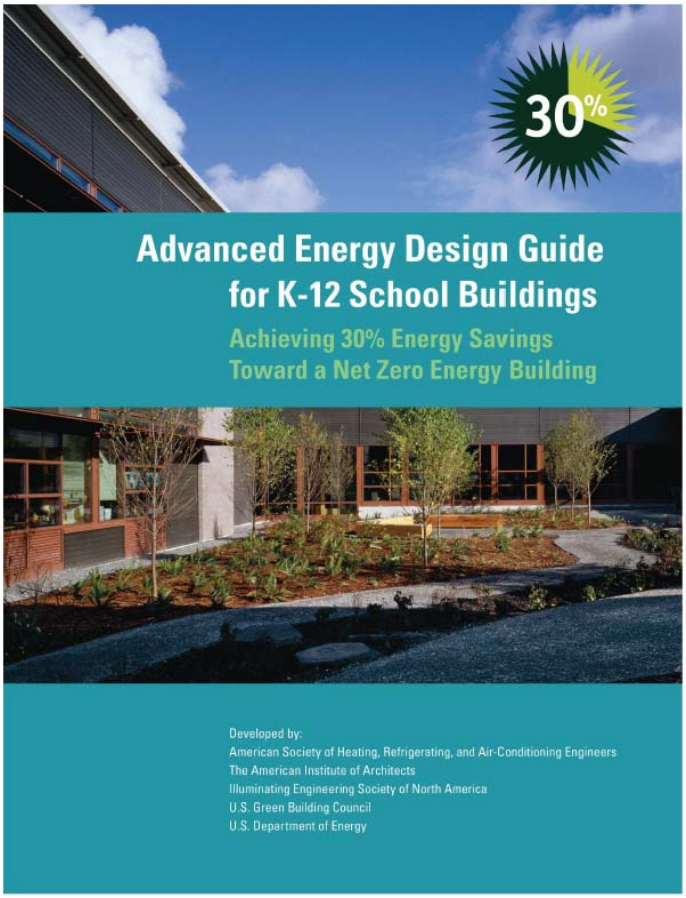
Excerpts from ASHRAE's Advanced Energy Design Guide for K-12 School Buildings



Technology Case Study: Twenhofel Middle School Independence, KY

Twenhofel Middle School in Kentucky installed both energy-efficient transformers (CSL-3) and typical specified transformers (CSL-1). Each of the three grade wings of the school had distribution transformers, the 6th grade wing had the energy-efficient transformer, and the other two wings had typical transformers. The following were the results:

1. The electric use in the 6th grade wing was continuous lower than the other wings
2. Testing of the transformers revealed that the loading for these transformers during the day were very low—between 2 and 3%.
3. The efficiency of the transformers at this loading was 79.5% for the typical transformer and 91.5% for the energy-efficient transformer. This meant an improvement in efficiency of more than 15% in addition to the no load loss improvement between 500–700 W/h.

The following illustrates the potential energy savings when specifying and installing energy efficient transformers, at current use of distribution transformers in schools and average electrical energy cost across the nation.

- Typical 73,000 ft² elementary school—$9000/year and more than $400,000 over a 50-year building life
- Typical middle school—$13,000/year and more than $600,000 over a 50-year building life
- Typical high school—$20,000/year or more than $1 million over a 50-year building life

Note: The 50-year life figures do not include any rate increase during the period.

Powersmiths E-Saver-C3 transformers power the 6th grade wing of Twenhofel Middle School.

ADDITIONAL SAVINGS

AS1 Electrical Distribution System (Climate Zones: all)

Energy-efficient distribution transformers should be provided in all construction/repair projects: new construction, renovation, or replacement. Minimum transformer specifications as of January 1, 2007, are classified by DOE as TP-1 and are the lowest efficiency

available. Energy-efficient transformers that are 30% more efficient than the minimumTP-1 are classified by DOE as CSL-3.

The size of an educational building is a contributing factor in the determination of the electrical voltage service brought into the building. Electrical service from the utility in smaller schools is usually 120/208 three-phase voltage and in larger schools 277/480 three-phase voltage. When the 277/480 volt service is provided, 120/208 volt dry step down transformers are placed in key locations in the building to provide the power to the electrical outlets throughout. Electrical distribution systems in today's schools contribute to the energy inefficiency. The following good practices will help improve the energy efficiency of the electrical distribution system.

Electrical Service Voltage. School facilities smaller than 40,000 ft2 should design the incoming electrical service from the utility for 120/208 V. Schools facilities larger than 40,000 ft2 should have the incoming electrical service designed from the utility at 277/480 V. This design will require the placement of internal step down dry transformers 277/480 V to 120/208 V to provide the needed power for the plug load.

Energy-Efficient Transformers. DOE recognizes that current step-down transformers contribute to energy waste throughout the country. The CSL-3 standard has been established to improve the energy efficiency of distribution transformers. This standard recognizes the low loading, especially in schools, and the no-load losses with current transformer design. The standard CSL-3 design eliminates any impact for normal harmonics created by the loads in the school. Concentrating all larger computer loads on one transformer can be handled by a variation in the CSL-3 design and still keep the required efficiencies and no-load losses. The standard includes specifics on the no-load losses for specific sized transformers and specific percent efficiencies at given loadings. For example, a CSL-3 75 KVA 277/480 to 120/208 volt transformer maximum no load loss is 170 W/h versus the current industry average of more than 850 W/h. This same transformer will meet or exceed 98.4% efficiency at one-sixth loading. The efficiency of the standard transformers currently specified at one-sixth loading is 80% to 85%. This is an unregulated load at this time.

Specification of Energy-Efficient Transformers. Energy-efficient transformers should be specified using DOE's CSL-3 Standard as the basis. Specifications must include maximum no-load losses for specified transformers sizes and percent efficiency at 16.7% loading. A statement should be included in the specifications that requires the bid submission to include test data for the transformers being provided.

Electrical distribution equipment is usually provided by one supplier. This means the cost of the transformer is "buried" in the electrical distribution equipment price. The following statement should be included in the bid specifications: "The bid price for the dry distribution transformers specified (277/480 to 120/208 V) must be identified (priced) separately within the electrical bid and cannot be included in the bid pricing for other electrical distribution equipment that falls under Section 16 of the Standard AIA Specification Structure. If specified transformers are not separately identified in the bid pricing then the entire bid will be disqualified."