

BEYOND

SMART CITIES

LIGHTING SYSTEMS - CEM REFRESHER

ONLINE TRAINING COURSE

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ENERGY SPECIALIST CURRICULUM

Lighting Simulation Specialist

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BENEFITS OF GROUP RELAMPING

FOR ENERGY PROFESSIONALS

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WHAT SHOULD YOU LEARN

Benefits of group of relamping

Group of relamping example

Lighting Simulation Specialist

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BENEFITS OF GROUP RELAMPING



- Lower labor cost
- More light
- Fewer un-replaced burnouts
- Less lamp stocking
- Fewer work interruptions



CALCULATING GROUP RELAMPING INTERVAL

Given:

- ✓ 1000 each 3-lamp fixtures
- ✓ Annual fixture operation = 4000 hrs
- ✓ Average rated lamp life = 25,000 hrs
- ✓ Group replace lamps at 70% of rated life

Calculate group relamping interval:

$$\begin{aligned} \text{GRI} &= 25,000 \times 0.7 / 4000 \\ &= 17,500 / 4000 \\ &= 4.375 \text{ years} \quad = 52.5 \text{ months} \end{aligned}$$



GROUP RELAMPING EXAMPLE

	Spot Relamping (on burn-out)	Group Relamping (@ 70% of rated life)
Relamp cycle	20,000 hours	14,000 hours
Average relamps	525 relamps/yr	750 relamps/yr
Average material cost	\$1,391 /year	\$1,988 /year
Average labor cost	\$3,150 /year	\$1,125 /year
Average disposal cost	\$263 /year	\$375 /year
AVG. MAINT. BUDGET	\$4,804 /year	\$3,488 /year

Assumptions:

Material	\$2.65 /lamp	\$2.65 /lamp
Labor (relamp & clean)	\$6.00 /lamp	\$1.50 /lamp
Disposal (recycle)	\$0.50 /lamp	\$0.50 /lamp
Operation	3,500 hours/yr	3,500 hours/yr
Fixtures	1,000 lensed troffers	1,000 lensed troffers
Lamps/fixture	3 F32T8	3 F32T8



LIGHTING MAINTENANCE ACTION CHECKLIST

- ☒ Group relamp to reduce lumen depreciation and maintenance costs
- ☒ Clean fixtures at the time of relamping, more often in dirty locations
- ☒ Write a lighting maintenance policy Design your lighting projects to incorporate effective maintenance
- ☒ Get help when needed from lighting management companies, consultants, distributors, manufacturers, etc.



ASSUMPTIONS FOR EXAMPLES

- ☒ Average energy cost: \$0.07/kWh
- ☒ Four lamps in a fixture
- ☒ Annual fixture operation: 3500 hrs
- ☒ Lamp life: 28,860 hrs
- ☒ Labor to replace lamps: \$6/lamp
- ☒ System life: 15 years
- ☒ No inflation or time value of money



EXAMPLE 1 - ANNUAL OPERATING COST

Given: Case A

Fixture Power: 144 W

Lamp Cost: \$1.50 each

Case B

Fixture Power: 101 W

Lamp Cost: \$3.00 each

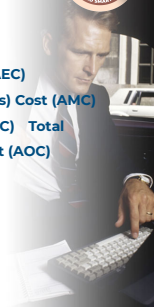
Find:

Annual Energy Cost (AEC)

Annual Material (lamps) Cost (AMC)

Annual Labor Cost (ALC) Total

Annual Operating Cost (AOC)



EXAMPLE 1A

Solution:

$$\text{AEC(A)} = 0.144 \text{ kW} \times 3500 \text{ hrs/yr} \times \$0.07/\text{kWh} = \$35.28/\text{yr}$$

$$\begin{aligned} \text{AMC(A)} &= 4 \text{ lamps} \times \frac{3500 \text{ hrs/yr}}{28860 \text{ hrs/lamp}} \times \$1.50/\text{lamp} = 0.485 \\ &\text{lamps/yr} \times \$1.50/\text{lamp} = \$0.73/\text{yr} \end{aligned}$$

$$\text{ALC(A)} = 0.485 \text{ lamps/yr} \times \$6/\text{lamp} = \$2.91/\text{yr}$$

$$\text{AOC(A)} = \text{AEC(A)} + \text{AMC(A)} + \text{ALC(A)} = \$35.28 + \$0.73 + \$2.91 = \$38.92/\text{yr}$$



EXAMPLE 1B

Solution: $\text{AEC(B)} = 0.101 \text{ kW} \times 3500 \text{ hrs/yr} \times \$0.07/\text{kWh}$
 $= \$24.74/\text{yr}$

$$\begin{aligned} \text{AMC(B)} &= 4 \text{ lamps} \times \frac{3500 \text{ hrs/yr}}{28860 \text{ hrs/lamp}} \times \$3.00/\text{lamp} \\ &= 0.485 \text{ lamps/yr} \times \$3.00/\text{lamp} = \$1.46/\text{yr} \end{aligned}$$

$$\text{ALC(B)} = 0.485 \text{ lamps/yr} \times \$6/\text{lamp} = \$2.91/\text{yr}$$

$$\begin{aligned} \text{AOC(B)} &= \text{AEC(A)} + \text{AMC(A)} + \text{ALC(A)} \\ &= \$24.74 + \$1.46 + \$2.91 \\ &= \$29.11/\text{yr} \end{aligned}$$



EXAMPLE 1B

Solution: $\text{AEC(B)} = 0.101 \text{ kW} \times 3500 \text{ hrs/yr} \times \$0.07/\text{kWh}$
 $= \$24.74/\text{yr}$

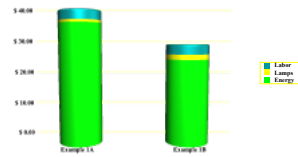
$$\begin{aligned} \text{AMC(B)} &= 4 \text{ lamps} \times \frac{3500 \text{ hrs/yr}}{28860 \text{ hrs/lamp}} \times \$3.00/\text{lamp} \\ &= 0.485 \text{ lamps/yr} \times \$3.00/\text{lamp} = \$1.46/\text{yr} \end{aligned}$$

$$\text{ALC(B)} = 0.485 \text{ lamps/yr} \times \$6/\text{lamp} = \$2.91/\text{yr}$$

$$\begin{aligned} \text{AOC(B)} &= \text{AEC(A)} + \text{AMC(A)} + \text{ALC(A)} \\ &= \$24.74 + \$1.46 + \$2.91 \\ &= \$29.11/\text{yr} \end{aligned}$$



EXAMPLE 1



EXAMPLE 2 – LIFE CYCLE COST

Given: Initial Cost(A): \$50
Initial Cost(B): \$100
Discount Rate: 5%

Find: Life Cycle Cost (LCC)



EXAMPLE 2 – LIFE CYCLE COST

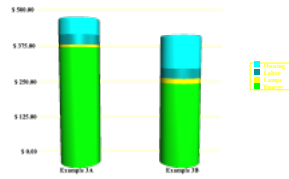
Solution: $LCC = IC + [P/A, 5\%, 15] (AEC + AMC + ALC)$

$$\begin{aligned} LCC(A) &= \$50 + 10.380 (\$35.28 + \$0.73 + \$2.91) \\ &= \$50 + \$366.21 + \$7.58 + \$30.21 \\ &= \$454.00 \end{aligned}$$

$$\begin{aligned} LCC(B) &= \$100 + 10.380 (\$24.74 + \$1.46 + \$2.91) \\ &= \$100 + \$256.80 + \$15.16 + \$30.21 \\ &= \$402.17 \end{aligned}$$



EXAMPLE 2





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