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Cable Tray Wiring Systems Have Many Cost Advantages

Cost is usually a major consideration in the selection of a wiring system. This article provides information as to where cable tray wiring system cost savings will occur; however, it is not the intent of this article to state that the selection of a wiring system should be based only on cost.

Early in the life of a project, the costs and the features of the applicable wiring methods should be evaluated to provide decision information for the selection of the best possible wiring method or methods for the project. The evaluations should include items that relate to cost, dependability, future changes, maintenance, safety, and space savings. Usually the evaluation will determine if a cable tray wiring system or a conduit wiring system is to be selected as the project's major wiring system. Both large scale and small cable tray wiring systems have been in use for the last 45 years in North America and longer in other parts of the world. Forty-five years of operating experience has proven that cable tray wiring systems are superior to conduit system wiring systems for power, control signal and instrumentation circuits.

The following functions must be properly executed to obtain a quality wiring system installation:

1. Select the most desirable wiring method.
2. Properly design the wiring systems.
3. Specify quality materials.
4. Plan and execute the installation's sequence of activities and the techniques to be used.
5. Control of the quality of the installation.

Depending on the type of circuits and the wiring density, an installed cable tray wiring system may result in a total cost reduction (material + labor) of up to 60 percent compared to the cost of an equivalent conduit wiring system. There is also the potential for cost savings to occur in the design, material procurement, installation and maintenance areas when the wiring system is a cable tray wiring system.

Potential Design Cost Savings:

1. Very few projects are completely defined at the start of design. As a project progresses through the design phase, the operating logic and safety requirements are developed and refined. The changes and additions

required to meet the projects needs occur all through the design cycle and at times even into the initial construction phase. For projects that are not 100 percent defined before the start of design, **the cost of and time used to cope with changes during the engineering and drafting design phases will be substantially less for a cable tray wiring system** than for an equivalent conduit system.

It only takes a few minutes of design time to change the width of a cable tray to gain significant additional cable fill capacity. For an additional cost of less than 10 percent of the basic cable tray cost, 6 inches of additional cable tray width can be obtained. This extra 6 inches will accommodate large numbers of small diameter analog and/or digital signal cables. Where banks of conduits are involved, any change in wiring capacity requirements during the late stages of engineering and drafting design are very costly and time consuming. Significant conduit system additions or revisions are usually required to provide exit and/or entry points in the conduit runs for the circuit additions made late in the design phase.

Cable tray's unique feature that allows a cable to enter or exit a cable tray anywhere along the cable tray's route provides for the easy accommodation of cable additions. No raceway wiring system has this unique feature.

2. Using cable tray wiring systems **simplifies the overall wiring system design** process as fewer details are required for properly designed cable tray runs than for properly designed conduit banks. Conduit system design can be very complex due to the need for pull boxes, splice boxes and the involved conduit bank supports.
3. The fact that a cable tray system **isn't required to be mechanically continuous** eliminates the need for many complex installation details for conductor/cable entries into equipment and in dealing with cable tray run interferences.
4. The **installation space requirement is smaller for a cable tray** than an equivalent capacity conduit system. For cable tray systems, there is less apt to be space conflicts with other engineering disciplines on a project than for a conduit system. Coordination design time is saved by dedicated fixed dimensioned installation zones for the cable tray system. The cable tray installation zone's size will not grow as changes are made as it does for conduit banks in large projects.
5. Wire management systems for cable tray wiring systems **consume less design time** than is required for a conduit system. A spread sheet based wire management program may be used to control the cable tray fill. While such a system may also be used for controlling conduit fill, large numbers of

individual conduits will require fill monitoring while only a few cable tray runs require fill monitoring for an equivalent capacity wiring system.

Potential Material Procurement Costs Savings:

1. There are **fewer different components in a cable tray wiring system** than in a conduit wiring system. Fewer different components means savings due to fewer components to specify, order, receive, store and distribute.
2. Excluding conductors, **the cost of the cable trays, supports and miscellaneous items may provide a material savings of up to 80 percent** as compared to the cost of conduits, supports, junction boxes, pull boxes and miscellaneous materials. The NEC fill capacity for an 18-inch wide ladder or ventilated trough cable tray is 21 square inches. It takes seven - 3 inch conduits to match that fill capacity.
3. For feeders or branch circuits, where the installations involve parallel phase conductors, **there is a copper cost savings for cable tray wiring systems.** The derating factors don't apply to three conductor or single conductor cables in cable tray as they do for conduits. For the same circuit capacity of paralleled phase conductors, the cable tray installation uses fewer pounds of copper than the conduit installation. Where phase conductors are not paralleled, the cost of the 600 volt multiconductor cables used in cable trays is greater than the cost of the single conductor cables used in conduit. This cost difference depends on the insulation systems, jacket materials and cable construction.

Potential Installation Cost Savings:

1. The installation of a cable tray wiring system **requires fewer man-hours** than an equivalent conduit wiring system. **This is where the major cost savings are obtained for the cable tray wiring system.** Smaller sized electrician crews may be used to install a cable tray wiring system as compared to an equivalent conduit wiring system. This allows for manpower leveling, the peak and the average crew size would be almost the same number. The electrician experience level required for cable tray can be lower than that for a conduit wiring system as fewer electrician with conduit bending skills are required.
2. **Cable trays can be installed faster** than conduit banks. Since the work is completed in a shorter time period there is less work space conflict with the other construction disciplines. This is especially true if the installations are elevated and significant amounts of piping are being installed on a project.

3. **Many more individual components are required in a conduit system than in a cable tray system.** This results in the handling and the installing of large amounts of individual conduit items vs. small amounts of individual cable tray items. At elevated installation levels, many additional man-hours will be required to transport the components needed for the conduit system up to the installation level.
4. **Conduit systems contain materials and installation practices that are more complex and costly to install** than those used in cable tray systems. This is the reason that cable tray installation labor costs are significantly below conduit system installation labor costs. Conduit systems require pull or splice boxes where there is the equivalent of more than 360 degrees of bends in a run. Cable tray systems don't require pull or splice boxes. **Conduit systems normally require more supports** and the supports are more complex. When penetrating walls, conduits banks require larger holes and more repair work than is required for cable trays.

Concentric conduit bends for direction changes in conduit banks are very labor intensive and costly. However if they are not used, the installation will not be very attractive. The time required to make a concentric bend is increased by a factor of three to six over that of a single shot conduit bend. This labor intensive practice is eliminated when cable tray wiring system are used.

5. **Conductor pulling is more complicated and labor intensive for conduit wiring systems** than for cable tray wiring systems. For conduit systems, it is necessary to pull from equipment enclosure to equipment enclosure. The conduit system is required to be mechanically continuous from equipment enclosure to equipment enclosure. Tray cables being installed in cable trays don't have to be pulled through or into the equipment enclosures. Tray cable may be pulled from near the initial enclosure along cable tray route to near the termination enclosure, then the tray cable is inserted into the equipment enclosures for termination. Making the conduit system wire pulls through the enclosures increased the possibility of conductor insulation damage.

Potential Maintenance Cost Savings:

1. An article in the October 1991 EC&M magazine, "Cable Pulling for Conduit Wiring Systems," stated that 92 percent of the insulated conductors that fail do so due to the fact that they were damaged during installation. The failures of the insulated conductors may create unnecessary safety conditions and significant cost problems. **Why not select a wiring method where during the past 45 years its conductor failures due to installation damage have been almost non-existent?** Cable tray with quality cables is that wiring method.

Conductor insulation failures in cable tray wiring systems are rare. The reason for this is that the tray cables are rarely damaged during the installation. Many of the conduit conductors that fail do so due to the fact that they have been damaged when they were pulled into the conduits. Excessive forces imposed on the conductor's insulation system during the conductor installation process can be very destructive. For some critical combinations of conductors and sizes of conduit, **jamming of the conductors in the conduit can occur during the conductor installation.** This may result in conductor insulation damage. Critical jam ratio (J.R. = Conduit ID/Conductor OD) values range from 2.8 to 3.2. The 1996 NEC Chapter 9 Table 1. Fine Print Note is an alert for this serious problem.

2. **If circuit additions are made in the future, the fact that the cables can enter or exit the cable tray anywhere along its route allows for the cable additions at the lowest possible future cost.** This is a feature that is unique to cable tray. Future cable fill space capacity to accommodate cable additions to a cable tray can be provided at a very low cost.
3. The cable tray wiring systems **reduce the potential for moisture related equipment failures.** Tray cables don't provide the internal moisture paths that conduits do. This lowers future maintenance costs. Moisture is a major cause of electrical equipment and material failures. The day to night temperature cycling results in moisture laden air being drawn into the conduits and the moisture in the air condensing. **The condensed moisture accumulates in conduit systems.** The conduits pipe the accumulated moisture into the electrical equipment enclosures. Over time, this moisture may accelerate the corrosion of some of the equipment's metallic components and deteriorate the equipment's insulation systems to failure. Conduit seals are not effective in blocking the movement of moisture. Conduit systems have to be specifically designed to reduce moisture problems and this is rarely done.
4. A properly designed and installed wiring system will not be a fire ignition source. It is possible that the wiring system may be exposed to an external fire. For a localized fire, the damage to a cable tray wiring system will be less to a cable tray system than to the conduit system. This has been the case in some industrial facility fires. **The damage to PVC jacketed tray cables and the cable tray is most often limited to the area of flame contact area plus a few feet on either side of the flame contact area.** When such a fire envelopes a steel conduit bank, the steel conduit is a heat sink and the insulation of the conduit's conductors will be damaged for a considerable distance. Thermoplastic insulation may fuse to the steel conduit and the conduit will need to be replaced for many feet. This occurred in an Ohio chemical plant. The rigid conduit had to be replaced for 90 feet. Under such conditions, the repair cost for fire damage would normally be greater for a conduit wiring system than for a cable tray wiring system. In the Ohio

chemical plant fire, large banks of conduit and multiple runs of cable tray were involved. The cable tray wiring systems were repaired in two round-the-clock days, and the conduit wiring systems were repaired in six round-the-clock days. The conduit system repair required more than three times the man-hours that was used for the cable tray system.

In the July 1995 EC&M magazine, "Protecting Life Safety Circuits In High Rise Buildings" the section titled "Protecting signal and communication wiring" states the following: "Results of Steiner Tunnel testing performed by various cable manufacturers actually indicates that conduits tend to act as heat sinks, thereby decreasing the time required to damage insulation to cause conductor failures." This is a big negative for conduit systems.

Cable tray wiring systems have significant cost savings advantages over conduit wiring systems. They also have convenience, dependability and safety advantages over conduit wiring systems.

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