Western Michigan University – Office of Information Technology & Campus Planning, Design & Construction

Design Guidelines for Facilities Construction:

DESIGN GUIDELINE DG17-3 Building Communications Pathways & Outlets Boxes:

GUIDELINE CONTENTS:

I. General 1
II. General Design Considerations 2
A. Riser Cable pathways 2
B. Horizontal Cable Pathways 2
III. Specific Requirements 5
A. Products 5
1. Overhead Cable Tray 5
2. Surface-mount Cable Raceway 5
3. In-floor Trench Duct 5
4. Under-floor Cable Paths 5
5. User Outlets 6
6. Other communications cable path or outlet hardware. 6
7. Prohibited Fittings 6
8. Inside Innerduct 6
B. Execution 6
1. General 6
2. Backbone Riser Cable Path / Access Between Closets 7
3. Horizontal Cable Paths 7
4. Communications User Outlet Boxes 9
5. Innerduct 10
6. Incidental Cable Supports 11
7. Fire-Stopping 11

I. GENERAL

Modern communications cabling should be installed over defined pathways rather than routed by arbitrary routes and supported by random building fixtures.

The riser cable pathway connects the BEF to other communications distribution rooms (CDRs) distributed throughout the building. Where communications rooms have been stacked, much of the riser pathway may simply be pass-throughs in the ceilings and floors of the CDRs. Where it is not, the cable pathway between BEF and subordinate closets should consist of ladder tray or multiple 4” ducts with a minimal number of bends of large radius.

The horizontal cable pathway system between the CDR and the user work area outlet (WAO) consists of a combination of a comparatively large-capacity trunk system of cable tray and individual conduit feeds or other support paths. Special use spaces such as computer labs may have special cable pathway facilities.

- The communications backbone system requires protected cable pathways between the main communications closet and all subordinate / distribution closets. In some cases backbone cable paths are required between individual communications closets, depending on the specific building structure and communications architecture.
- The horizontal cable distribution system similarly requires a continuous accessible, protected, safe cable path between the source distribution CDR and the end user outlet box.

II. GENERAL DESIGN CONSIDERATIONS

The entire cable pathway system as whole must be constructed in such a way that will permit the cabling contractor to install all cables in accordance with applicable bend requirements, pulling tensions, etc., for Category 6 copper UTP, video cables and fiber optic cables.

The entire cable pathway must maintain clearance from possible sources of electrical interference or damage in accordance with current EIA/TIA, BICSI, and other standards and recommendations.

All communications cable paths should be dedicated solely to use by communications and other low voltage cabling.

A. Riser Cable pathways

Cable pathways between closets should be as short, direct, and as free of impediments (bends or pull boxes) as possible. In stacked CDRs, the inter-CDR cable path may use intermediate CDRs as part of the path as long as sufficient cable-passage capacity is provided.

It is desirable that there be paths available between CDRs without the requirement of always passing through the BEF as the root of a strict tree structure. These may be required for alternate emergency cable paths or to support unforeseen system architectures. With stacked CDRs this is easily accomplished by simply having pass-throughs available between all adjacent levels. For multiple CDRs on the same floor, this is sometimes easily accomplished by simply assuring that the trunk cable tray system for the floor is continuous between CDRs. Where CDR columns occur in separate, loosely connected wings (like Haenicke Hall), an acceptable option is to provide a 4-inch duct through any available connecting path (like a bridge) on at least one level to interconnect CDRs directly or connect the ends of the horizontal trunk cable tray system for each wing.

B. Horizontal Cable Pathways

The entire horizontal cable path must be designed and specified in a way that allows ready compliance with Category 6 and fiber optic cabling requirements throughout the entire path. Specifications requiring special attention include distance limitations, prevention of electrical interference, minimum bend radius, and pulling force limits.

- To function with current systems, no single horizontal copper UTP cable length may exceed 295 ft.

Horizontal trunk paths should be designed / specified to provide a complete cable path from CDR to each user outlet that allows ready insertion and removal of cables and innerducts as required.

Horizontal cable pathways should provide adequate cable support between the serving CDR and the end user outlet box.
OIT prefers a system of trunk cable trays from the local CDR above false ceilings with side-leg conduits or supports feeding each user outlet box. The architectural design of buildings may not allow such a basic system for all user outlets, but the need for an accessible, continuous limited-length cable path for every user outlet remains.

- All cable pathways should be designed and routed to allow service access with minimal disruption to building occupants.

- Whenever possible, trunk cable path systems should follow hallways or other accessible routes.

- OIT prefers a complete conduit between the trunk cable tray and each outlet. The specifications below call for a full conduit for exposed runs. Above false ceilings, a suitable system of cable hangers is allowed. When full length conduits are not used, OIT recommends that the division 16 specifications carry the responsibility of providing a cable support system / pathway of hangers, etc., (to Category 6 specifications) from the outlet to the trunk cable tray. This will avoid having the cable installation contractor responsible for doing the physical work of installing hangers on the physical system already in place. Additionally, it will prevent the cable contractor simply stringing the cables by a random path through whatever overhead components are between the conduit outlet and the trunk cable tray, as has been done in the past. Finally, if full conduits are not required from outlet to trunk cable tray, it must be assured that the division 16 contractor installs a passage of adequate capacity for all required cables (plus growth) through any walls extending to the overhead between the conduit openings and the trunk cable tray in order that a complete usable pathway exists for all outlets. Where such passages are constructed, it becomes an issue to see that ones, which are not actually used, are fire-stopped when required.

Special function cable path facilities, such as those for high-density computer labs, need special design attention; especially as new and unique furniture arrangements are increasingly popular in modern buildings. Cable paths for them should be direct and readily accessible for maintenance purposes. Some specifications are provided below, but it is recommended that OIT be involved in discussions of special cable paths for such facilities from the beginning of the design.

Use of in-floor cable distribution is discouraged. In-floor distribution systems should be limited to areas where it is required for specific reasons whenever possible. Where such systems must be used:

- In-floor trench duct should be routed along permanent walkways and through open, accessible spaces. Routing under walls, cubicles, or any other permanent or semi-permanent items should be held to an absolute minimum since this makes cable maintenance inefficient and disruptive to occupants.

- The entire in-floor system must be carefully designed to assure all served outlets can be reached from the supporting CDR with a total cable length of less than 295 ft., including any lengths, which must be routed through modular systems.

- In-floor communications outlets are strongly discouraged due to high probability of damage and difficulty of use.

Where outlets occur within systems such as surface-mounted wireway or in-floor systems, they should be selected and designed so a space equivalent to a full-depth, dual-gang box will be available for communications cabling and jack installation. Similarly, the entire system must be designed with adequate cable space to act as the path for the number of cables required for the outlets planned, plus possible growth.

Note also that any single user UTP cable that is damaged at any point due to inadequate protection in the cable path requires complete replacement from CDR to outlet. There is no way to repair modern communications cables and still meet Category 6 standards. All provisions possible should be made to assure the cable path will not damage cables.

Whenever possible, user outlets should be served by a CDR on the same level. In unusual cases, some user outlets may need to be routed to a CDR on some other level in order to stay within the maximum allowable distance of 295 feet.

Under-floor or in-floor troughs or other systems will not be used in paths between communications closets without agreement of owner.

CDRs at the base of each stack and isolated CDRs will be connected to the BEF by multiple 4" conduits following a direct path with minimal bends.

- There will be a minimum of two 4” conduits or 8” dedicated cable tray width between BEF and each CDR or base CDR in a stack. Additional conduits or space will be used for large buildings or where large cable capacity will be required.

- Inside conduits and cable trays will access the BEF overhead whenever possible. If they must access through the floor, they will be in a floor area not obstructing work or traffic, preferably near a wall and within easy reach of other conduits or cable trays feeding other CDRs.

- Where CDRs cannot be directly stacked, connections between floors will consist of 4-inch conduits with minimum possible length and bends or 10” of dedicated cable tray width equipped with bend-radius control fittings.

III. SPECIFIC REQUIREMENTS

A. Products

1. Overhead Cable Tray

The central trunk horizontal cable support system will be open-top cable tray with full-length top access for cable installation. The system will allow ready access for cables to enter from side or bottom as required and will accommodate access from and grounding of individual outlet conduits as required.

High quality open "wire-basket", "spine & rib" or ladder rack style cable tray systems are acceptable.

2. Surface-mount Cable Raceway

Whenever possible, Panduit: styles with integrated means designed to accommodate faceplates for Mini-Com series connector modules. (Mini-Com connector modules are mandated for University uniformity throughout communications systems.)

Where Panduit systems do not meet requirements, with approval of owner, other reputable manufacturers who are experienced in this type of product for at least three years and that have openings which will easily accommodate Panduit Mini-Com faceplates. Products used will have been in production for at least one year.

3. In-floor Trench Duct

In-floor systems will be chosen with ability to support EIA/TIA Category 6, Panduit Mini-Com products, and other modern wiring standards as a major factor.

Specific products used for in-floor cable paths must be approved by owner before use.

4. Under-floor Cable Paths

Use of cable path hardware under or within raised floors for individual rooms or other areas is acceptable and encouraged.

Whenever possible, standard products listed elsewhere, such as basket tray, will be used for under-floor cable path systems.

Specific cable path products used for under-floor systems must be approved by owner before use.

5. User Outlets

The default user outlet will be a full-depth standard approved double-gang box with a single-gang mud-plate fed with 1” EMT.

6. Other communications cable path or outlet hardware.

Any other required communications cable path or outlet fixtures required such as floor boxes, power poles, etc., will be selected with the following factors as major selection criteria:

- Compatibility with EIA/TIA Category 6 cabling requirements.
- Ability to easily install Panduit Mini-Com modules.
- Owner must approve all such special hardware.

7. Prohibited Fittings

No LB fittings of any size will used at any point in communications conduit or cable paths.

No PVC conduit or PVC sleeves are to be used for communications paths within the confines of a building, except for underground runs where allowed by code.

8. Inside Innerduct

Inside innerduct will be good quality flexible duct with fire rating appropriate to location in accordance with codes.

- All innerduct will be 1-inch ID or greater.
- Thickwall innerduct will be used within 4” conduits with runs of more than 25 ft. and in locations where cable passes through exposed areas without other support or areas where there is obvious danger of mechanical damage.
- Thinwall innerduct is acceptable except where thickwall is required above.
- Acceptable manufacturers: Panduit, Carlon, Pyramid, or equal approved by owner.

B. Execution

1. General

All cable paths of all types will be installed with the probability of fiber optic cabling being installed in it. Consideration will be given to maintaining minimum allowable bend radius and minimizing pulling tensions.

Complete system will be installed, including especially grounding, in accordance with current NEC and other applicable codes satisfactory to authority having jurisdiction.

- Entire cable path system will be bonded and grounded according to codes and good practices.

Most of the installation of interior cable pathways consisting of conduits, cable tray, etc., is usually completed by the electrical contractor. Installation of innerducts for fiber cable and small pieces needed to finish off a pathway are often completed by the communications contractor. Ducts between communications closets and a cable tray system and other facilities for horizontal connections must exist before this can proceed. The communications contractor may be involved in completing fire-stopping of openings after cable installation. Attention needs to be given to assure these two contractors can coordinate efforts effectively

2. Backbone Riser Cable Path / Access Between Closets

A minimum of two 4" pass-throughs will be provided between stacked CDRs. Additional pass-throughs will be used in large buildings or where large cable capacity will be required. Where possible all pass-throughs will be in a single line against a wall in an out-of-the way area of the CDRs.

If conduit bends are present in a run, there will be pull boxes sized appropriately for the duct system for every accumulated 180 degrees of bend.

All 4" conduits will have no bends of less than 4-foot radius.

Install and tie off pull string with 200 lb. capacity in all conduits on completion.

3. Horizontal Cable Paths

a. General

Install the entire horizontal cable path in a way that allows ready compliance with current EIA/TIA 568 Category 6 and fiber optic cabling specifications throughout the entire path. Specifications requiring special attention include distance limitations, prevention of electrical interference, bend radius, and pulling tension.

Assure that a complete path is available for all cables serving all individual outlets.

Assure cable path systems have clear, easy entry to communications closets with access openings and other aspects designed for easy adherence to fire codes.

Cable paths will be easily accessible and spaced from other systems so that cables can be easily inserted or removed at all points.

All cable path parts will have smooth edges, fittings, etc., which will not be likely to cause cable damage.

b. Overhead cable support systems
Cable trays, hangers, and other cable supports will be supported independently of other structures except supports intended for multiple simultaneous uses.

- Arrange hangers and supports to provide a clean path with minimal interference to installation of cables.

A minimum clearance of 6” will be provided between the top edge of the cable tray and all other objects to allow for insertion of cables and innerducts.

Cable tray will be continuous along its path with ramps or slanting laterals to accommodate changes in elevation or linear travel. There will be no disconnected segments to accommodate routing anomalies.

All such connecting segments will be designed and fitted to assure compliance with Category 6 and fiber optic cable bend radius limitations.

c. In-floor cable systems

Cable paths between in-floor distribution systems and other equipment must fully protect cables and assure adherence to minimum bend radius for Category 6 or fiber optic cables.

Paths between in-floor cable paths and other equipment must be adequately sized for the required number of cables and be arranged to allow insertion and/or removal of cables as required.

d. Under-floor cable systems

Under-floor cable paths, if used must present a clear continuous path throughout the intended length of use.

Cable path hardware may not interfere with other required support facilities for the space. Adequate clearance must be maintained above and below the path to allow for the installation and/or removal of facilities for other under-floor systems sharing the space.

Cable path will maintain adequate spacing from other facilities that may cause electrical interference or possibly damage communications cables by heat or other means.

e. Individual Outlet Cable Pathways

Unless otherwise specified, each communications outlet box will have a dedicated 1-inch conduit or equivalent pathway space between the outlet box and the trunk cable tray or CDR adequate to install four Category 6 4-pair cables.

In exposed locations, overhead conduit from outlets will be used for the entire path and will terminate at or within 1 ft. of trunk cable tray.
Above false ceilings, the conduit from wall boxes may be stubbed above the ceiling and a system of cable hangers installed and spaced to assure Category 6 specifications may be used.

- Hangers will be arranged to assure a neat path between conduit outlet and trunk cable tray.
- Where this system is used, there must be adequate pass-throughs or other passage in all barriers between the outlet stub opening and the trunk cable tray. Such passages should have total area exceeding the sum of all conduit stubs served plus 25% growth.
- Optionally, a complete conduit path may be provided to the cable tray.

For outlet box conduits:

- Openings from stubs will be towards access to trunk cable tray.
- Full-length conduits will be arranged to provide the shortest, most direct cable path to the trunk cable tray.
- Minimum bend radius for 1-inch conduit will be 10.5".
- Install insulated bushing in ends of all conduits.
- An accessible 4" minimum pull box will be installed for every accumulated 270 degrees of bend.
- All conduit runs will be left with a nylon 200-lb. capacity pull string installed and tied off at ends.

4. Communications User Outlet Boxes

a. All Outlets

Unless otherwise specified, all user outlets will be a full-depth double-gang box with single-gang duplex receptacle type faceplate (mud-plate).

All outlet housings will have at least the space of and retainer threads for a single-gang duplex opening.

b. Wall Outlets

Wall user outlet boxes will be secured to wall joists or other building structure before installation of wallboard.

c. Wireless Access Point System Outlets

Standard wireless system outlet boxes will be mounted in or on the wall at a height approximately 12” above a suspended / false ceiling.
At locations where wall mounting is not available, wireless outlets will be mounted to an accessible multi-use support structure if available or provided with a dedicated mount at a height between 1’ and 2’ above the ceiling.

d. Floor Outlets

Floor outlets will be minimized.

Where floor outlets are required, they will be of a type and installed in such a way to provide maximum protection for jacks from dirt, water, or mechanical damage.

5. Innerduct

a. All fiber cables used for inside distribution, either riser or horizontal, will be install in innerducts.

b. Install innerduct pathways to protect the full length of interior fiber cables.

- In cable trays, innerduct will be installed neatly in straight lines along an edge or an adjacent duct installed at an edge. Innerduct will be retained neatly to cable tray as required at intervals of 4’ or less. At bends, maintain minimum cable bend radius and dress innerduct for minimal interference with other cabling.

- In 4” conduits, innerducts may share space with other innerducts to a reasonable degree or to limits of code conduit fill specifications.

- Multiple inside fiber optic cables may be installed within one innerduct when appropriate. Size innerduct to allow adequate space for cables.

- If cable that requires innerduct is routed where cable tray is not available, innerduct will be suspended by bracketing to walls or using only appropriate support structures similar to conduit system.

    - Thickwall innerduct will be used in these situations.

    - Supports will be every 8 feet or less.

- Innerduct junctions will be accomplished neatly with no or minimal exposure of enclosed cable(s). Where junction occurs in exposed areas (i.e. not in cable tray, etc.) junction will be made using appropriately sized junction / pull box.

- Split innerduct may be used to protect fiber cable for short runs within CDRs.

- Coils of excess fiber cable do not require innerduct protection.

c. Replace all pull strings used so duct has available pull string with 200 lb. capability on completion of cable installation.

6. Incidental Cable Supports

If cable pathway for required cables is inadequate or does not exist:

- Cables will be routed neatly through the space and will be supported only by fixtures or brackets intended for cable support.

- Fixtures, brackets, etc. will be installed to support cables as needed to assure cables meet all requirements of Category 6 installations for support, bends, spacing, etc.

- Fixtures, brackets, etc. will be attached only to walls, hardware intended for multipurpose support, or dedicated supports. Cable may not lie on ceiling; use ceiling hangers, other cabling, etc. for suspension.

7. Fire-Stopping

At completion of work, after installation of all cables, assure that all riser conduits, innerducts, cable tray openings, and other openings are fire-stopped in a re-enterable manner in accordance with codes.

END OF SECTION