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

Design Guidelines for Facilities Construction:

DESIGN GUIDELINE DG17-1 Outside / Inter-building Systems

GUIDELINE CONTENTS:

I. GENERAL

A. New Buildings

Most new buildings involve installation of outside communications cables to connect the new building to the existing communications system. Building renovations or other large projects should consider inclusion of updating the outside communications system. Some projects involve only outside communications components, in which case only some of the provisions her apply.

There must be an exterior communications cable pathway system connecting any building to the campus communications infrastructure. For new campus buildings, this is normally a new underground duct bank between an existing WMU manhole and the new Building Entrance Facility (BEF). In some situations, access between the existing cable plant and the new building may be less standard and require special design. Installation of additional manholes or re-routing of existing facilities may be required. For off-campus buildings, the exterior access depends on the specifics of the project and is often a function of local regulations and existing carrier facilities.

If possible, outside communications conduits should enter the building from multiple directions to increase the possible redundant paths for the primary University communications system.

All new campus buildings will have a single Building Entrance Facility (BEF) communications closet.

Large buildings will have an internal backbone riser structured cable system of copper and optical fiber cables serving all secondary or distribution communications closets (TCs) in the building from the main communications closet (BEF) installed in the interior cable pathway system. In many cases, there will also be a conventional CATV-style internal coax riser system to support video.

The specifics of what cables are used and where they will connect into the existing system will be defined based on the details of the building location and the outside cable pathways connecting to the campus infrastructure. OIT must be involved in the external cable pathway design of the project.

1. All new buildings will use single-mode as the primary fiber optic building feeds. Multimode fibers may also sometimes be required, depending on circumstances.
2. All building feeds should have a minimum of 12 single mode fibers. Larger counts may be specified if felt necessary due to the projected building use.
3. In a few special cases there may be a reason to include some sort of multimode fiber external access.

B. Off Main Campus Buildings

All new off-campus buildings will have some form of voice and data network connection to the main campus. There may also be a video connection to the main campus.

1. OIT must be consulted early in the design cycle to help define communications connections appropriate for the project.
2. Although various means may be used to bring external voice connectivity to the building (copper pairs, fiber and multiplexer, etc.) it is assumed that the final demarcation between external system and building system will be a set of copper pairs.

a. If the demarcation takes the form of RJ jacks rather than a punch field, the cross-connect system between the demarcation and equipment racks will need to be redefined or eliminated.

3. In many cases data communications connectivity will use the same copper connections as those used by voice communications.

If the building is to be served by a special purpose video system, specifications will need to be adjusted to reflect that as early in the design cycle as possible. OIT should participate in the design of the overall system to be sure there are no technical conflicts with OIT standards and capabilities.

For off-campus buildings and special cases, a special arrangement will need to be developed based on the individual circumstances. Specifications by the service provider may apply.

Specifications need to assure outside copper cable and coax are connected into existing systems and tested as necessary depending on the specifics of the design. Copper pairs must be tested between new entry and MDF serving the cable if applicable.

C. Existing Buildings

General buildings as used by WMU do not contain a main distribution frame. The "service entrance" as defined in some design guidelines is in the main telecommunications closet or building entry facility (BEF) and requires no separate treatment. BEF requirements are defined below.

II. EXTERIOR COMMUNICATIONS PATHWAYS

A. Design Guidelines

It is understood that the exterior portion of every project is different and must be designed to integrate the project requirements and the existing infrastructure that will support the project. WMU OIT should be consulted very early in the project design to help in determining the best means of access to existing facilities.

Whenever possible, the exterior communications pathway will enter directly into the main communications room (BEF) of a building through an outside wall. If this is not possible, the entry path will be as short and direct a path as possible.

1. It is normally necessary that the distance between entry and the BEF be less than 50 ft due to code requirements associated with copper cable protection and outside fiber cable fire rating.
2. Routing of communications ducts under the building footing or bottom floor and entry into the BEF through a bend to vertical is strongly discouraged. Direct entry through sidewall with extensions to BEF if required is strongly preferred.

Within the University campus, outside cables will always use protective ducts or other suitable enclosure. Access to off-campus buildings will use protected

underground ducts whenever possible. No permanent direct buried cable will be used. Aerial access will be used only when absolutely necessary.

1. Campus buildings will be served by a minimum of four 4" communication ducts. Additional ducts will be provided for large buildings and/or where a large communications cable demand may be expected.

2. Any communications vaults will be dedicated to communications use and will not share walls with electrical manholes.

3. In some cases, all or part of the pathway may be within a utility tunnel system or other special structure. Tunnels will be used only under the following conditions:

    a. A clean, clear path is available to allow a communications cable support system with clear access to allow for installation and servicing of large outside-style splice cases as specified below, and accommodation for large cable bend radii.
    b. Adequate provisions exist to assure the interior ambient environment will remain within telecommunications cable ratings at all times.
    c. There are adequate provisions to protect against steam, water, mechanical, or other forms of damage.
    d. Provisions are made to assure a safe work environment when personnel must be present for installation of maintenance work.

Outside ducts or other pathway for external backbone connections should already exist before beginning exterior communications cabling work. This is normally accomplished under division 16.

B. Products

1. Conduit system

Underground conduits will be polyvinyl chloride (PVC) of the single bore type. Conduits must meet the requirements of NEMA TC-6 and TC-8.

Innerduct will be 1 1/4-inch ID thick-wall, outside use.

2. Vaults

Unless otherwise specified or required, Type J from Advanced Concrete or Hartford. Size will depend on requirements. Minimum size will be 5' x 6' floor area by 7' high. Duct openings will be custom cut as required.

Vaults must be equipped with:

- Standard round access hole from ground level with lid marked Communications
- Sump
- Corrosion-resistant pulling irons
- At least two corrosion-resistant cable racks on all walls.

- Ladder

C. Execution

1. General

All outside cables up to ¾ inch in diameter will be enclosed in innerduct for protection over the length of the outside path. This is intended to include (but is not limited to) fiber optic cables and video coax cables.

Each individual exterior fiber cable will be enclosed in a separate innerduct for distances over 100 ft.

Where installation of a cable dictates installation of innerduct in a 4-inch outside duct, three innerducts will be installed in order to fully utilize the duct. (Additional innerducts may be used for other appropriate cables in this project as required.)

2. Buried Duct System

Ducts or conduits may be direct buried in sand or dirt except under locations of live loads (roads, etc.), which will be encased in concrete or otherwise appropriately strengthened to protect against damage from the loads involved. All ducts will have a non-degradable yellow or orange plastic warning ribbon buried approx. 1-2 ft above the duct bank.
Minimum depth to top of bank will be 36 in.

Before burial or encasing, ducts will be neatly arranged and secured together at intervals that will assure location integrity by spacers or braces designed for that purpose.

Duct system will have minimal bends only as required and will use sweeping bends of greater than 4-foot radius in all cases.

All individual ducts will have sections joined in a way that will assure physical integrity and full water tightness.

No run of conduit will exceed 500 ft. between vaults or vault and building entrance.

Duct entries to vaults, buildings, tunnels, etc., will be pre-cast or machine cut to an appropriate size and sealed in a manner to assure physical integrity and water-tightness from the outside prior to backfilling.

On completion, install and tie off pull strings with 200 lb. capacity in all ducts.

Upon completion, install removable watertight plugs in all conduit ends.

3. Vaults (Maintenance Holes / Manholes)

Vaults will be installed in a manner, which will prevent settling, or movement following installation.

Finished surface ground area in the vicinity of vaults will be graded to prevent drainage of water towards their openings.

Conduit banks should enter walls of vaults approximately halfway between floor and roof. Conduits entering or exiting vaults will be reinforced with poured concrete and steel bars drilled into the side of the vault or other means approved by owner to assure conduits and vaults cannot be displaced relative to each other due to ground shifting, etc. Ducts will end projecting approx. 4" from wall and will have smooth burr-free edges.

If not supplied as part of vault, all vaults will be finished with:

- Standard round access hole from ground level with lid marked Communications
- Sump
- Corrosion-resistant pulling irons
- Corrosion-resistant cable racks on all walls, grounded per code or best practice.
- Ladder, grounded per code and best practice.

4. Innerduct

Innerducts in larger ducts will be continuous with no junctions of any kind inside the duct.

Un-enclosed innerduct will be installed neatly in straight lines. At bends, maintain minimum cable bend radius and dress innerduct for minimal interference with other services.

Innerduct junctions will be accomplished neatly with no or minimal exposure of fiber cable(s). Junction / pull boxes will be used as appropriate. Junctions will be watertight if possible.

Pull boxes will be installed in un-enclosed innerduct as appropriate and in any event for every 180 degrees of bend of copper cable and 360 degrees of bend for fiber cable.

5. Communications pathways in Tunnels or Service Spaces (Crawl-spaces, etc.)

Cable capacity over the entire route will equal or exceed that of other portions of cable paths that depend on or join with the path in question.

Pathway will be continuous and maintain as uniform an elevation as possible. Any required elevation transitions will be gradual and provide support over the entire length.

Pathway will be in safe areas that will not subject communications cable to extreme environment or significant hazards from any source.

Any bends required will have a minimum of a 4-foot radius.

If installation of large cable(s) is expected (for large projects), pulling hardware of appropriate capacity will be installed at appropriate locations (consult BICSI and other recommendations).

There will be adequate access space available for personnel to install and maintain large cables and large outside-quality splice cases as required.

Communications path may be a combination of ladder rack and rigid conduit.

- Ladder rack will be continuous and open to ready access over the entire route.
- Conduit will have pull box or access for every 180 degrees of bend.
- Any pull boxes will be NEMA and UL approved and adequately sized for size of conduit and expected cable. If use of large cables may be expected, pulling holds of adequate strength will be positioned appropriately to assist in cable pulls.
- All conduit openings will be burr-free and have collets installed.

III. SERVICE ENTRANCES (BEF)

A. General

Most projects will involve installation of new outside single mode fiber cable(s). Most buildings will be served by an external copper multi-pair cable that requires over-voltage protection at the point of entry. Off-campus buildings will normally have external support from the local exchange carrier (LEC). The external twisted pair copper entry demarcation is cross-connected to the BEF/communications room equipment racks through a 110-block to RJ panel system, which is defined separately.

This section covers only building entrance and protection requirements. Cabling and terminations and other requirements associated with the backbone systems are covered separately.

Most specifications included here apply primarily for campus buildings, which will be fed from the existing campus copper cable infrastructure.

B. Products

Protection for outside cables should be Circa brand, type 1880ECA1 series building entrance terminal with pairs protected using C3BIS-BAL units.

C. Execution

Any coax cables entering the building must have the outer shield grounded at entry. Fiber cables are to be all dielectric and need no grounding.

Protection Blocks:

- Protection terminal(s) can be mounted on wall backboard about 4 ft high and at a location convenient to cable entry and access to ladder tray connecting to BEF racks.
- Install individual 100-pair protection terminal cabinets neatly in a vertical columns or rows.
- Protection terminals will be clearly and permanently labeled with pair assignments as defined by owner.
- Grounding modules will not be installed on unused pairs since switch end is grounded.

IV. OUTSIDE CABLING SYSTEM

A. General

The outside cable system for projects may include fiber optic, twisted-pair copper, and coaxial cables in various forms used for external backbone connections. Individual cables should connect to the existing campus systems at points defined by OIT.

Every building should have at least one backbone link for each type of required cable. Whenever possible, multiple fiber connections into the existing system should be installed in order to provide redundancy for the primary University communications system.

The exterior / outside backbone fiber optic trunk feed to campus buildings should be a minimum of 12 single mode fibers. As a guideline, this should support up to 500 full-time equivalent occupants and student access stations. An additional 6 single-mode fibers should be added for every additional *250* full-time equivalent occupants (or portion thereof) or planned student access stations, up to a maximum of 24 fibers. If the new building is to be used as a distribution point, the size of the trunk will need to be further increased. This will be function of long-term OIT backbone planning.

All backbone fibers (outside and riser) are terminated with ST connectors except for the top 6 of each single mode cable, which are terminated with FC/APC to allow support for broadband analog (video) signals.

B. Products

Exterior / outside fiber cable will be Corning brand FREEDM or Altos type cable with specified fiber counts. Cable will be non-armored, all dielectric construction.

Outside Copper telephone cable will be filled core, made to REA PE-89 specifications and will have 0.008” coated aluminum shield. Cable will be made in USA. Acceptable manufacturers: Superior Essex, Lucent/AT&T, or General Cable.

Splice cases will be Preformed brand Armadillo series stainless steel of appropriate size for the number of splices enclosed. No encapsulants will be used.

Case-enclosed splice hardware will be 25-pair modules: 3M Splicing Modules or equivalent approved by owner.

Rear cable support brackets will Middle Atlantic Products **LBP-1R4** 4" offset round rod or equivalent approved by owner.

Innerduct will be thick-wall, intended for outdoor use.

C. Execution

If cable passes through vaults or manholes, it will be routed around the outer wall by the shortest route.

- Cable will be supported by and secured to appropriate rack arms.
- Cable routing will not interfere with personnel access or access to duct or other openings.

Cables passing through manholes or other accessible spaces will be labeled appropriately at each entry point and once at least every 20 ft of exposed length.

Copper splice cases and associated cables will be neatly mounted and retained on appropriate rack arms.

- All components will be located so as to not interfere with personnel access or access to ducts or other openings in the vault.
- Vault splice cases will be assembled and closed in a manner that assures they will be watertight since vaults may flood or hold standing water. No encapsulants will be used.
- Splicing will be done in accordance with good BICSI practice using 25-pair splicing modules. Spliced pairs will be worked so untwisting is minimized. Modules will be properly retained within splice case before closure. Spliced pairs will be dressed neatly using routing with acceptable bend radius. No pairs will be kinked.

Fiber cables will be continuous, without splices or junctions, between defined termination points.

Outside cables ¾” or less in diameter will be installed in innerduct within 4” entry ducts.

Preparation, splicing, and termination of external cables will be done by qualified technicians experienced with this work.

Fiber cables will be installed in full accordance with Corning, and applicable TIA and BICSI specifications and good practices.

- All fiber system work will be carried out by Corning certified installers.
- Fiber cables will be enclosed in innerduct over the entire path, except for excess coils. In exposed areas, innerduct should be orange.
- Fiber cables will be terminated in rack-mounted fiber termination cabinets of appropriate size for fiber counts.

1. All inter-building and intra-building backbone cables will be terminated with connectors rated for the type of fiber terminated.
2. All but the top 6 fibers in each cable will be terminated with ST-style connectors.
3. The top 6 (highest numbered) fibers in each cable will be terminated with FC/APC connectors. Direct-connectorization or spliced-pigtail terminations are acceptable.
4. Hardware selected, fiber dressing, etc., will be appropriate to the termination type.

All cables will be dressed and retained neatly between space entry and termination cabinet.

Excess will be neatly coiled and retained at an out-of-the-way location that will not interfere with access to equipment or working of other cables in the space.

Cabinets and panels where cables are terminated will be clearly labeled with destination/source and fiber or pair number.

V. ENTRY COPPER CROSS CONNECT SYSTEM

There will be a copper cross-connect system to allow interconnection between the exterior access and the RJ-jack based interior riser system described below.

The cross-connect system will be arranged to allow up to 100% of external pairs to be used for single-pair connections and for approximately 25% to be used for 2-pair connections.

B. Products

110 blocks will be Panduit Pan-Punch Category 5e series, with legs for backboard mounting (parts P110KB or P100BW with P110CB).

Panduit panels and modular jacks as required for all WMU UTP connections.

Category 5e jacks are acceptable for outside cable terminations.

C. Execution

Entry cross-connect system will be terminated on one RJ panel or set of panels, as required. Panels will not be shared with riser of horizontal connections.

Install Category 5e 25-pair power sum cables totaling the count defined below between 110 blocks mounted on wall backboard near entry cable protection equipment and appropriate quantity of RJ jacks and in rack-mounted panels in the BEF equipment rack.

- Total pair count for cross-connect cables will be 125% of the pair count of the entry cable (rounded to 25-pair increments).
- For the first 75% of the entry count of the cross-connect pairs, each pair will be terminated to a rack-mounted gray RJ jack as pair 1.

- For the remaining count (equaling approximately 50% of the entry count), two pairs will be terminated to a rack-mounted black RJ jack as pairs 1 and 2.
- One pair may remain unused in each jacket.
- See typical drawing illustrating these specifications.
- Cross Connect Panels will be labeled prominently and similar to horizontal panels with a T followed by a sequence number in pair sequence: T1, T2, etc. See 17170 for additional labeling requirements.
- Jacks will be permanently labeled with pair numbers that will match permanent labeling on 110-block end of cross-connect cables.

END OF SECTION