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33 71 39 HIGH VOLTAGE WIRING (ABOVE 600-VOLT)

The primary electrical distribution system throughout campus is an underground system in the tunnel network and is distributed at 12470 volts. Each new building shall provide the necessary switches and transformers for its connected load.

High voltage cable shall be ethylene-propylene-rubber, 133% insulation, shielded cable with a 40 year warranty, copper only, with full neutral required. Okonite manufacturer.

High voltage switchgear shall be box pad mounted, low profile, dead front type, S&C Manufacturer. High voltage switchgear shall be set on box pads per APS standards.

33 71 73 ELECTRICAL UTILITY SERVICES

Service Entrance Switchboards shall be provided with ammeter, voltmeter (both with phase switching positions and off positions). Provide kilowatt-hour meter with demand register. Multiplier shall be marked on meter. Label switchboards with CT ratios. KWH meters shall be adaptable to supply a pulse train output for future EMCS system.

33 73 00 UTILITY TRANSFORMERS

Service transformers shall be liquid cooled non-PCB type. Locate at exterior service side of building for accessibility. A concrete lip of 36" shall extend on the door side of the padmount transformers and padmount sectionalizing switches, 6 on other sides. Penta head bolt shall be used on transformer door. (Penta head socket to be turned over to NAU when job is complete.)

Transformers shall not be located in basements or other areas subject to contaminant by flood waters.

Provisions for extensions shall be specified for 12470 volt switch cabinets by adding incoming line primary loop feed configurations.

33 81 26 SITE COMMUNICATIONS UNDERGROUND DUCTS, MANHOLES, AND HAND HOLES

NAU communication pathway infrastructure consists of utility tunnel and conduit pathways connecting all campus buildings to three main switching nodes. All pathways and spaces to conform to TIA/EIA-758 standard. The Architect/Engineer shall specify the following site development requirements:

- Minimum of two 4 inch conduits for building entrance cable. Larger complexes may need more. One complete spare must be available after cable is installed. Pull string in place in spare conduit.
- Minimum of one 4 inch conduit populated with three 1 1/4" innerduct for Fiber optic cable Coaxial cable, etc.
- All conduits shall be buried at a minimum depth of 24"
- All conduits to be wrapped with tracer wire.
- Conduit construction to be minimum schedule 40 rigid non-metallic.
- All conduit runs designed with drainage slope and maximum of two 90° bends, all bends encased in concrete.
- The section length shall not exceed 600 ft between pulling points.

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- When a joint trench method is used the following vertical and horizontal separations between telecommunications facilities and other facilities shall be maintained.

| ADJACENT STRUCTURE | MINIMUM SEPARATION |
|--------------------------------|---|
| Power or other foreign conduit | 3 inches of concrete OR 4 inches of Masonry OR 12 inches of earth |
| Pipes (gas, oil, water, etc.) | 6 inches crossing OR 12 inches when parallel |

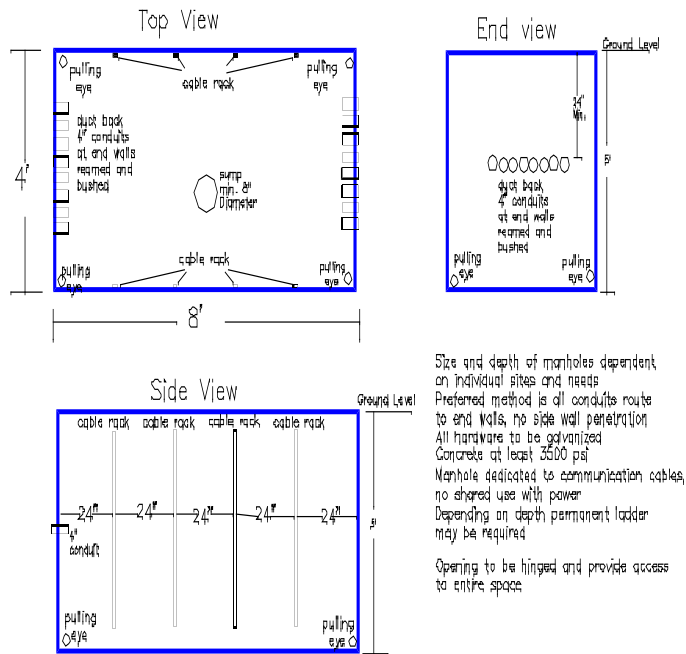
It is the universities preference that there are no manholes or handholes in the pathway design. However if access points are necessary minimum requirements are as follows:

- 4'x 8'x4' with cover providing full access to entire space
- All access points will be equipped with cable racking. Pulling eyes and sump
- Conduits should enter and exit from end walls of access point

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Typical Manhole



33 82 00 SITE COMMUNICATION DISTRIBUTION CABLING

The university campus communication system is based on a passive star architecture with three switching centers located in building 24, building 54 and building 64. All copper and optical fiber backbone cabling shall be routed to the appropriate switching center. All distribution design is the responsibility of NAU/ITS and the installation is the responsibility of the individual project. All University buildings shall be fed with twisted pair copper (number of pairs determined by NAU/ITS on a per project), minimum of 6 strands of Multi-mode optical fiber and minimum of 6 strands of single-mode optical fiber. Special applications may require more fiber strands.

33 82 01 SWITCHING CENTER TERMINATIONS

Building 24 terminate twisted pair on Cook brand C-377 protector units with gas modules. Building 54 terminate twisted pair on 3M brand 4188 protector units with gas modules and 25 pair Telco connectorized hand off Cables terminated on 66M1-50 blocks mounted on 183 type blue metal backboards. Building 64 terminate twisted pair on 3M brand 4188 protector units with gas modules and 25 pair Telco connectorized

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hand off cables terminated on 66M1-50 blocks mounted on 183 type blue metal backboard. All optical fiber shall be terminated with keyed ST type connectors.

33 82 13 SITE COPPER COMMUNICATIONS DISTRIBUTION CABLING

Copper cable shall be PE 39 type and meet the following requirements;

- Solid annealed, bare copper conductors
- Solid polyolefin insulation, color coded to telephone industry standards
- Cable core filled with waterproofing compound
- Aluminum shield with polyethylene jacket
- 24 AWG, pair count determined by NAU/ITS per project
- Cable shall meet the requirements of ANSI/CEA S-84-608

33 82 23 SITE OPTICAL FIBER COMMUNICATIONS DISTRIBUTION CABLING

Cable: Glass fiber, loose tube all dielectric gel filled osp cable rated for duct installation. Multi-mode 50 micron core, 125 micron cladding diameter with MIFL of 3.5db/km & 500 MHz-km @ 850nm, 1.5db/km & 500 MHz-km @ 1300nm. Single-mode 125-micron cladding diameter with MIFL of 0.4 db/km at 1300nm and 0.3 db/km at 1550nm. Proof tested to 100kpsi. Fiber Distribution Shelf: Modular design with jumper routing guides for vertical and horizontal runs and all associated shelves, panels, interconnection couplers and hardware necessary to terminate all fibers with room for 25% growth. Wall Mount Distribution Units: Metal construction, lockable, capable of splicing and termination in same housing, all hardware necessary to terminate fiber (including cable attachment, connector panels, interconnect couplers, fan-out kits, etc.) All connectors and interconnect couplers must be from same manufacturer.

Connectors: Keyed ST compatible with ceramic ferrule. Maximum attenuation of 0.4db and durability of 0.2db after 500 matings. All connectors and interconnect couplers from same manufacturer. Splice cases: Sealed, reenterable closure designed for fiber optic cable. All necessary trays, hardware, grommets, etc. to complete to manufacturer's instructions and specifications. All splices to be fusion, no mechanical splicing. All fibers (inter and intra building) tested for continuity and tagged at both ends with building number and ID number. All fibers tested for insertion loss, both directions, at 850nm and 1350nm on multi-mode, and at 1310nm and 1550nm on single-mode. All results documented. OTDR signature trace on all fibers with pertinent points documented (splice, endpoints, etc.) Only test results with University personnel present will be accepted.