CATV CONSTRUCTION - EUROPEAN STYLE

Michael J. Jones
Comm/Scope, Inc.

Abstract

The following paper is an overview of the unique construction practices employed within the United Kingdom in order to build underground CATV and telephony systems. This paper discusses civil construction, cable installation and the different types of cables available in Europe.

The CATV market in the United Kingdom has been trying to emerge since the early 1980's. After many staggered starts it now seems to be "all systems go."

The total population of the United Kingdom is approximately 58.4 million people which equates to just over 21 million television homes.

Recently the Cable Authority in conjunction with the Department of Trade and Industry finished the franchising operation. They have issued, in total to date, 136 franchises covering 14 million television homes or a potential 14 million cable subscribers.

Build rates vary from 3 to 5 years depending on the franchise, but however long it takes, in order to cable the United Kingdom it will require digging up and re-instating approximately 140,000 kilometers or 86,970 miles of pavement and roads. Because of the UK housing, a large population in a relatively small land mass, for every mile of trench laid this opens up access to 160 to 220 homes per mile as potential CATV telephony subscribers.

With system being the operative word, let's look at what constitutes a United Kingdom CATV/Telephony System with particular regard to civil construction, cable installation and cable types available.

The most popular system architecture being used at present is the tree and bush configuration. This is a hybrid version of the tree and branch networks employed in the United States. The major difference between the tree and branch and the tree and bush configurations is the placement of the subscriber taps. In tree and branch we design the placement of the subscriber taps every 100 to 150 feet down the feeder cable depending on density and expect average drop lengths of 100 to 150 feet. In a tree and bush configuration, the node or multi-port taps are designed to feed up to 64 subscribers from a central point using an average drop length of 260 feet. It is not uncommon to reach upwards to 1000 feet per drop per subscriber depending on system design.

As mentioned earlier, the amount of civil construction is vast. The next section will explain in more detail typical methods of underground CATV/ telephony system construction.

Most pavements or sidewalks are finished in concrete slabs, solid concrete or tarmac. The main excavation is normally 18 inches wide and 18 to 24 inches deep. Disc cutters and small digging machines are used but the majority of the work is done by hand utilizing pneumatic drills, picks and shovels. Great care must be taken to minimize damage to existing underground services. Although survey maps exist, their accuracy is suspect. Damage to power, gas, water or telecoms can be costly and time consuming.

Once the trench has been opened, the next stage is the installation of the PVC or polyethylene duct. Sizes of the duct vary but the most common in use is the 90mm or 4" duct. The number of actual ducts placed in the trench can be anywhere from a single up to 6 ducts depending on system design and subscriber density. It could be many years before the local councils or authorities permit this type of massive construction project again. Many operators, (realizing this and also the future value of a conduit to basically two thirds of the households in the United Kingdom) are designing extra duct space into their networks, with an eye towards the future of either using the extra duct themselves or possibly leasing it as new technologies arise.

Once the duct is installed, in order to be able to enter and exit the duct system for construction and maintenance, a series of pits or underground chambers are used. Most installations employ two types of pit, main and intermediate. The main or larger pits are usually used in front of the equipment cabinets and at the corners of street crossings depending on the size and number of cables being pulled. The intermediate or smaller pits are normally spaced between the main pits at intervals of 75 to 100 feet to access the duct for subscriber installations, hard cable installation and plant maintenance.

There are three major reasons pits or chambers are used:

(1) The pavements are much narrower and do not easily allow the massive excavation required to install 45^0 or 90^0 rigid ducting.

(2) Because of the subscriber density constant access is required.

(3) Pits are used to facilitate 90^0 bends and road crossings.

Size and materials used for chambers or pits also varies. Some are plastic with metal flush-fit lids, others are pre-formed in concrete and some where necessary are hand built in brick. It really depends on cost restraints and individual engineering preference.

Once the duct work and pits are installed, temporary or permanent reinstatement follows quickly. Very rarely do you see long spans of open trench. The policy seems to be backfill and re-instate as you go.

Having completed their civil construction, these crews move on to make way for the hard cable pulling gangs. These gangs normally consist of four or five men.

Stationing themselves at a main pit, the cable pulling gang will assemble a drum or drums of cable on a stand behind the pit. They then open up all the intermediate pits between the pull points. Certain precautions need to be taken before the actual cable pulling begins. Such as the use of entry and exit rollers where the cable is fed into the pit or out of the pit. This prevents the coax from being deformed or the jacket rupturing on the lip of the pit. Another precaution which is utilized is the use of bell mouths into all exposed duct ends where the cable is to be pulled. This reduces the chances of damaging the hard as well as drop cable jackets on the sharp jagged edges of the duct ends exposed in the main and intermediate pits. Most trunk and distribution cable is pulled in by hand using draw ropes. Very few companies use power winches. Some of the shorter runs are installed using a Cobra.

The Cobra is a semi-rigid, limited reach, push/pull tube coiled on a circular frame which is fed into the duct. On the end of the Cobra is a swivel eyelet. The cable is attached to this and then drawn back through the duct.

Duct carrying capacity is critical as is good duct management. If the management is poor, full duct fill is not achieved. Thus causing wasted construction expense. As an example, the typical capacity of a 90mm duct is figured at 20 to 24 RG6/Sidecar cables. Thus one duct has the ability to contain the drop and telephony cables to wire 20 to 24 subscribers.

In many cases during a build, it is necessary to take the cable through a 90 degree bend. This is achieved by entering and exiting the pull pits and utilizing a sequence called "fleeting." During fleeting, the cable is pulled out of the pit and laid down the pavement in a large loop or figure of eight. The lead end of the cable is then fed back pit into the correct duct to accomplish a 90 degree bend. The advantage of fleeting over the conventional methods of using angled ducting is the ability to pull long lengths of cable in stages, pull pit to pull pit. This also reduces the maximum tension exerted on the cables. If fleeting is done correctly, the amount of 90 degree bends is virtually unlimited, no matter what size cable is being pulled. Obviously, great care must be taken during this process. The cable is extremely vulnerable to mechanical damage when laid out in this way. To lessen the possibility of damage, good construction practices must be adhered to as well as the previously mentioned use of entry and exit rollers, pit pads and bell mouths. Fleeting can be and is used to pull all types of cables into the CATV and telephony network.

All the system electronics are housed above ground in street cabinets. Cabinets housing the main trunk amplifiers also, in most cases, house the telephony equipment. Access for cabling is achieved through the base of these cabinets.

Similarly, distribution cables terminate into the street cabinets. This is normally the multi-port tap or node point, the bush in the tree and bush configuration. Depending on the requirements, it is possible to feed up to 64 subscribers from these points. Drop cable will vary in length from this point but a good average seems to be 80 meters or approximately 260 feet.

The drop installation crews gain access to the duct system via a subscriber point. These are normally set into the pavement next to the garden wall during initial construction and capped to prevent ingress of rubbish which could block or foul the system. The subscriber points, normally a 35mm or 1 1/2" duct, are connected to the main ducting by a directional coupling or "Swept T." The "Swept T" concept was developed exclusively for the UK market. As the Cobra is pushed down the duct from the subscriber point the "Swept T," being off-set, directs the Cobra towards the node.

The drum stand or "A" frame holding the drop cable or sidecar telephony cable is positioned over the pit nearest to the node cabinet. The cable is then connected to the swivel eyelet on the Cobra and drawn back through to the subscriber point in the pavement. If 90 degree bends are required, the same fleeting procedure is adopted as used with the larger trunk and distribution cables.

Most houses in the UK, be they private or council housing, have a small front garden which is normally enclosed. Permission must be obtained to dig a trench to bury the drop cables to the front wall of the house. Some operators use a small PVC conduit for the drop cables but the majority direct bury.

Once at the house a small plastic box is used to terminate both CATV and telephony drops. The wall is then drilled and the cable is taken to the isolator box inside the house.

Back at the node, the RG6/ Sidecar cable is separated. The drop is connectorized and joined to the multi-port tap for CATV service. The telephony pairs are prepared and connected for immediate use into the telephone exchange or are weather sealed for future use.

Even though the preference in the UK is towards North American style cables due to quality, availability and pricing; the actual range of cable types available for use is quite extensive.

European cable designs vary between manufacturers and also countries. Two main aspects remain common however.

(1) All primarily use some form of copper for both the inner and outer conductors.

(2) Semi-air spacing is the most commonly used dielectric construction.

Center conductors are usually made of solid copper. Copper coated aluminum or copper covered steel are rare.

Dielectric construction is varied but the primary styles are:

(1) Bamboo or fused disc
(2) Thread in tube
(3) Five cell or cartwheel
(4) Solid polyethylene
(5) Expanded foam

Bamboo or fused disc and thread in tube are typically Dutch or German design.

Five cell or cartwheel constructed dielectrics are typically British designed.

Solid polyethylene and expanded foam dielectrics are derived from old British military specifications and are manufactured by all countries.

Outer conductors or outer screens also differ. Once again the main conductor metal is solid copper but it now comes in the form of a tape which is longitudinally applied over the dielectric. No welding process is used. The copper tape is just over-lapped. Some manufacturers use a braid at this point as well. If the cable is to be used in an underground environment, an aluminum tape will also be applied to act as a water barrier. The whole assembly is then sheathed or jacketed in PVC or polyethylene. At no point is a flooding compound used. Bonding between components using high powered adhesives is also not common among European manufacturers. The over braid not only acts as an extra screen but also secures the copper tape in place.

North American cable manufacturers tend to rely on tried and tested cable constructions such as Parameter Three and the relatively new Quantum Reach products.

Both typically have a copper covered aluminum center conductor bonded to an expanded foam polyethylene dielectric, which is bonded to an outer conductor of solid aluminum. The aluminum outer conductor can be applied in one of two ways:

(1) Extruded aluminum tube

(2) An aluminum tape which is formed around the dielectric and then R.F. welded.

These methods are both acceptable from an engineering standpoint but the welded tape process enables the manufacturer to produce a more flexible product. This enables the cable to be installed in an underground system much easier. Saving both time and capital expense.

The cables are then coated with either polyisobutylene or tar flooding compound and over-sheathed in PVC or polyethylene.

European drop cables are constructed in exactly the same way as trunk and distribution but obviously scaled down.

One new addition to the drop cables being used in the United Kingdom has evolved through the necessity to provide both CATV and telephony services. We call it the "Sidecar."

It consists of a full specification RG, either 59, 6, 7 or 11 forming one leg and two twisted telephone pairs in either 24 or 26 AWG forming the other. The cable is then fully flooded with polyisobutylene and sheathed in polyethylene. Simple to install, it eliminates installation crews having to go back to pull another cable when further services are sold. This again saves both time and cuts capital expense.

I hope this transcript has given an insight into the United Kingdom and European CATV and telephone systems now being built to those in our industry not at present involved overseas.