M E F C
Middle East Fiber Cable Manufacturing Co
كابلات الألياف البصرية
شركة الشرق الاوسط لصناعة كابلات الالياف البصرية

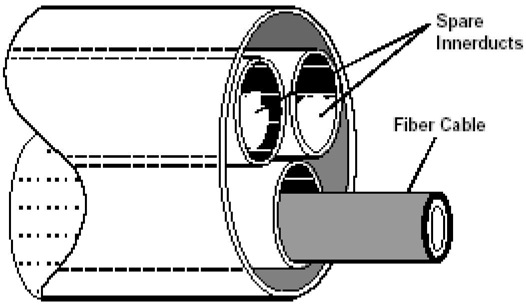
DUCT CABLE INSTALLATION

Installation of optical cables requires careful planning as it shall cover the cabling, infrastructure, cable routes, potential hazards and installation environment. Also it includes bill of materials, technical requirements for the cable, connectors and closures.

Pay attention to the following specifications of the cable manufacturer. Damage caused by over loading may not be immediately apparent but can lead to failure later in the service life time.

- Minimum Bending Radius
  - Under load
  - Under no load
- Maximum tensile rating

When the ducts are in poor condition, have excessive curvature or ducts have already cables in the maximum pull distance will be reduced accordingly. Because the condition of underground ducts intended for fiber cables are required to be in good condition, make sure that the ducts are as clean as possible. It is always recommended to have a sub duct provision either in a single or multiple form to provide segregation of cables and extra protection to the cables.



Calculation of pulling tension

While fiber optic cables are usually stronger than copper cables, it is still important not to exceed maximum pulling tension during installation. Calculate the maximum pulling tension using the formulae given below and compare the value with manufacturer's recommendation. If the values are close, then consider providing a greater margin of safety with an alternate cable design, shortening the route, changing the route or direction of cabling, providing intermediate winches or by taking special precautions at a particular locations.

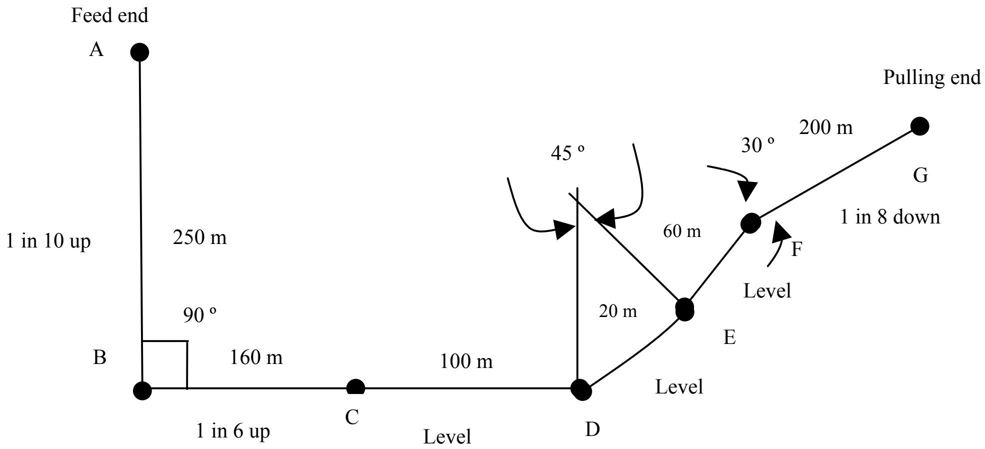
Second Industrial Area, P.O.BOX –585, Riyadh –11383, Kingdome of Saudi Arabia
Tel : 00966-1-2650777, Fax: 00966-1-2650203, Website: mefcf.com, e-mail: general@mefc.com

Maximum cabling tension:

The following main contributory functions need to be considered when calculating cable tensions:

The mass per unit length of cable
The coefficient of friction between cable sheath and surfaces with which it will come in contact
Deviations and inclinations.

Using the routes and common tension formulae in Figure A.1 as an example:



Equation 1 (for straight sections) $T = Ti + \mu lwg$
Equation 2 (for inclined sections) $T = Ti + lwg(\mu \cos\theta + \sin\theta)$
Equation 3 (for deviated sections and bends) $T = Ti\, e^{\mu\theta}$

Where
T is the tension at end of section (N)
Ti is the tension at beginning of section (N)
μ is the coefficient of the friction (between cable and duct or guide)
l is the length of section (m)
w is the cable specific mass (kg/m)
θ is the inclination (radians, + up, - down) or deviation (radians, horizontal plane)
g is the acceleration due to gravity (9.81 m/s^2)

fig. A.1 cable tension calculations

Total tension

Total tension can be calculated on a cumulative basis working through each section, from one end of the route to the other, as indicated ion table A.1, (for this example,
μ=0.55 and w =0.92kg/m)

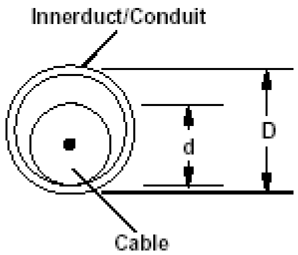
Section	Length M	Tension at beginning of section Ti	Inclinatio n rad	Deviatio n rad	Equation	Tension at end of section (cumulative) T
A	-	0	-	-	-	0
A-B	250	0	0.100	-	2	1460
B	-	1460	-	1.571	3	3464
B-C	160	3464	0.165	-	2	4484
C	-	4484	-	-	-	4484
C-D	100	4484	-	-	1	4980
D	-	4980	-	-	-	4980
D-E	20	4980	-	0.785	3	4669
E	-	1669	-	-	-	4669
E-F	60	1669	-	-	1	4967
F	-	7967	-	0.524	3	10628
F-G	200	10628	-0.124	-	2	11390

NOTE: Where more than one cable per duct is installed, tension can be greatly raised and it is necessary to take account of this by applying a factor before the deviation calculation. Factors vary with the number of cables, sheath/cable materials, cable/duct sizes, cable flexibility .. etc. Values cab be in the order of 1.5 to 2 for two cables, 2 to 4 for three cables and 4 to 9 for four cables.

CABLE PULLING GUIDELINES IN DUCT / CONDUIT.

1. Use less than a 50% fill ratio by cross sectional area. Calculate the duct utilization ratio as below.

Duct utilization and fill ratio = $(d^2/ D^2) < 50\%$

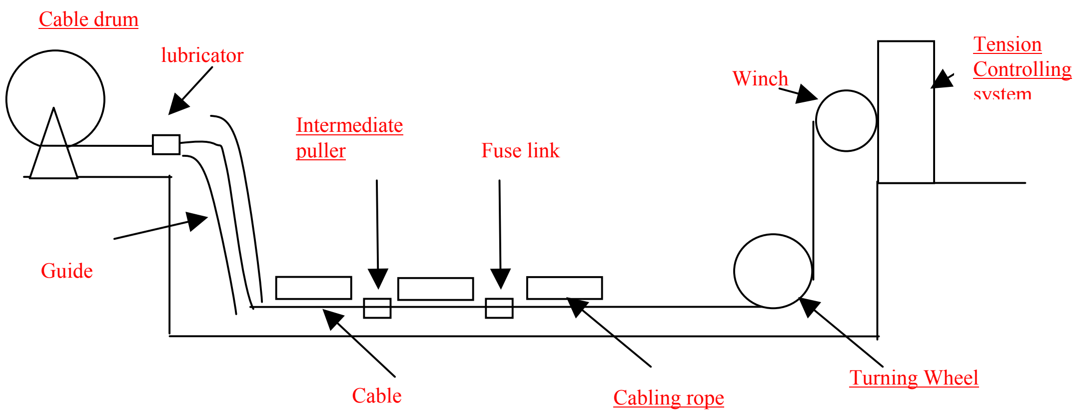


2. Design a duct layout, when possible, such a way the bends are concentrated near the end from which the cable is pulled. This will result in lower tensions.
3. Establish the direction of the pull based on safe pulling tension calculations.
4. Select correct size pulling eyes or pulling grips.
5. Place cable reels in such a way that the tension at the pay of end is minimized.
6. Choose pulling equipments that provides uniform speed control.
7. Choose a pulling rope with sufficient tensile strength.
8. Prior to pulling, ensure that the duct / conduit is clean free of obstacles, dirt, water… etc.
9. For long pulls, pre-lubricate the duct / conduit and pull the rope.
10. Test the cable before installation.
11. Install a dynamometer for tension monitoring.

M E F C
Middle East Fiber Cable Manufacturing Co
كابلات الألياف البصرية
شركة الشرق الاوسط لصناعة كابلات الالياف البصرية

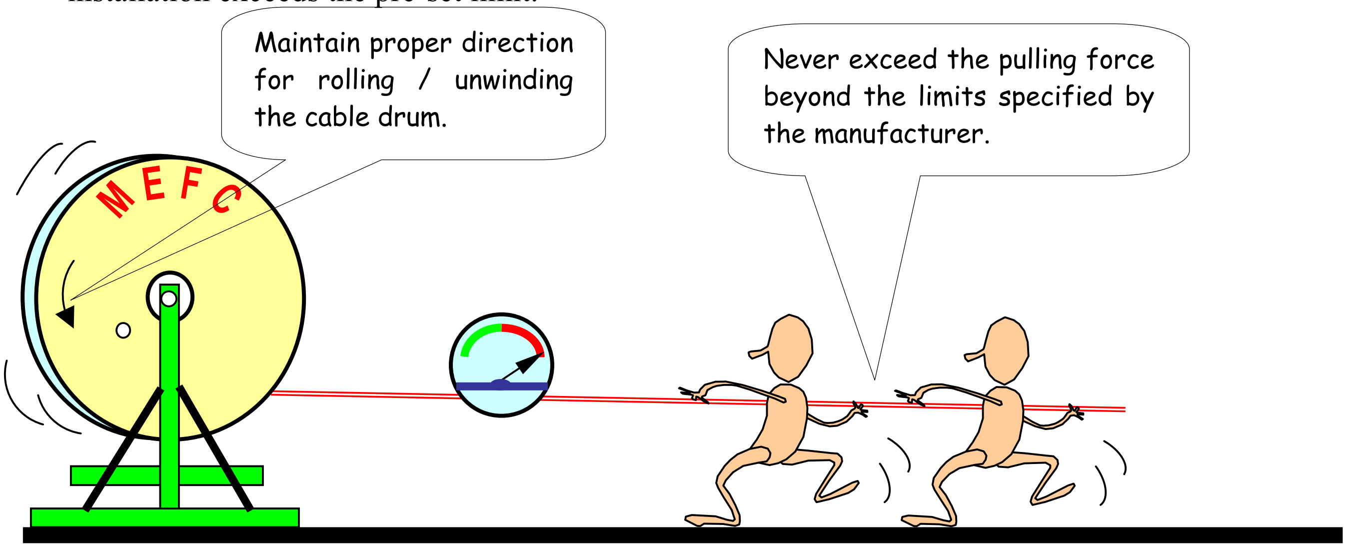
CABLE PULLING PROCEDURE

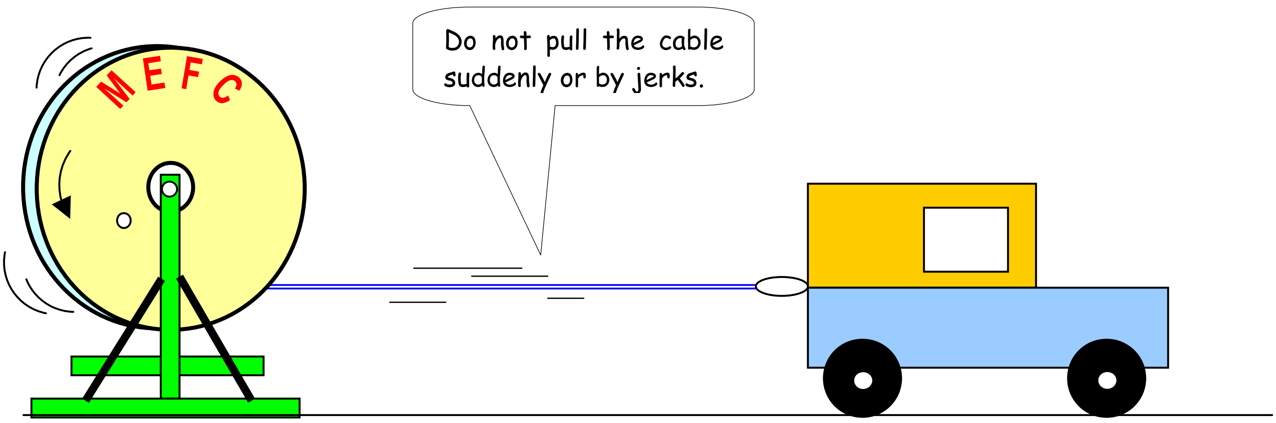
A typical installation is shown in the figure mentioned below



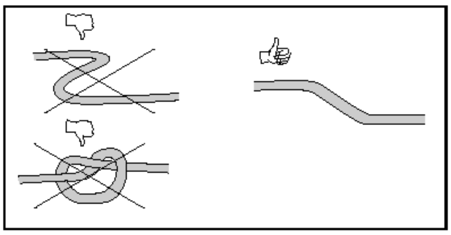
1. Apply lubricant liberally during installation. Lubricants must be compatible with the cable jacket and duct material. Lubrication will have beneficial effects in reducing the installation force needed.

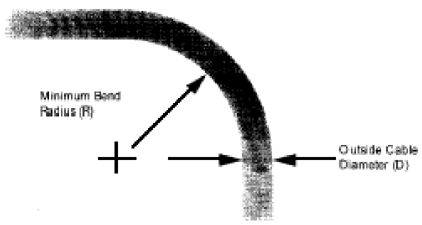
2. Accelerate slowly and smoothly to a constant pulling speed. The recommended maximum speed is 75m/min. cable winches should be capable of providing varying rope speeds. The winch shall be provided with a tripping devise that automatically stops the winch if the installation exceeds the pre-set limit.





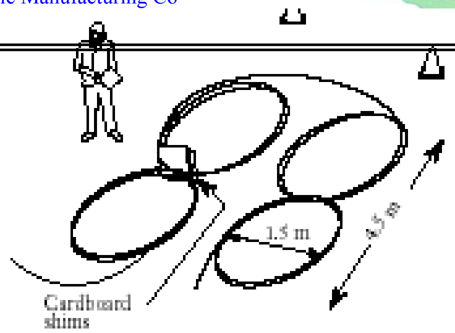
3. If the capstan type intermediate puller is used, the diameter of the capstan should be greater than the minimum bending dia of cable. Do not pass pulling eyes and cable grip around capstans or pulleys.





4. Avoid stopping past way through the pull. The friction is greatly increased when restarting a pull.

5. When a longer length installation is required and if it is not possible to pull in a single run because of load limitations, then divide the load along the cable length at an intermediate point. Pull and place the cable in figure “8” pattern at a intermediate point with required length and continue pulling this length.



6. Leave additional length of cable at the point of joint adequate for testing and jointing.