

PULLING CABLES IN TO CONDUIT

T_0 = TENSION AT THE COMMENCEMENT OF A SECTION (N)

T = TENSION AT THE END OF A SECTION (N)

m = MASS OF CABLE PER UNIT LENGTH (kg m^{-1})

w = EQUIVALENT CABLE FORCE PER UNIT LENGTH = $9.81 m$ (N m^{-1})

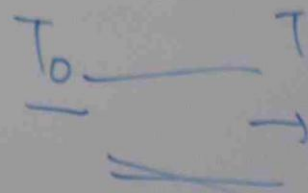
μ = COEFFICIENT OF FRICTION IN A GIVEN SECTION

L = LENGTH OF STRAIGHT LEVEL SECTION (m) (OR)
LENGTH OF INCLINED SECTION (m)

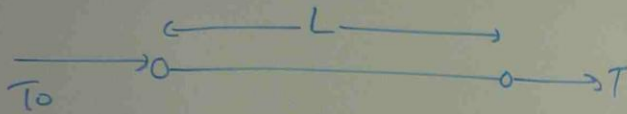
R = RADIUS OF HORIZONTAL BEND (m)

θ = ANGLE OF SUBTENDED ARC IN BEND (RADIAN)

F = SIDE WALL FORCE (N m^{-1})

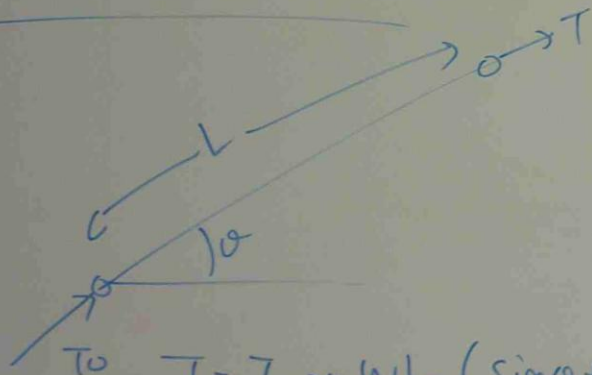


STRAIGHT SECTION



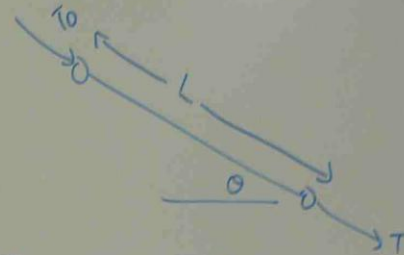
$$T = T_0 + \mu WL$$

UPWARD INCLINED



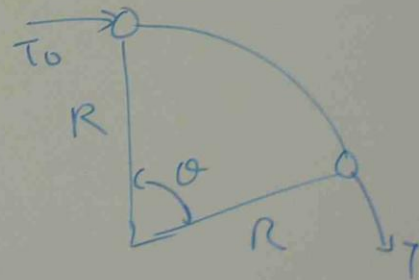
$$T = T_0 + WL (\sin \theta + \mu \cos \theta)$$

DOWNWARD INCLINE



$$T = T_0 - WL (\sin \theta - \mu \cos \theta)$$

HORIZONTAL BEND



$$T = T_0 \cosh \mu \theta + \sqrt{(T_0)^2 + (WR)^2} \sin(\mu \theta)$$

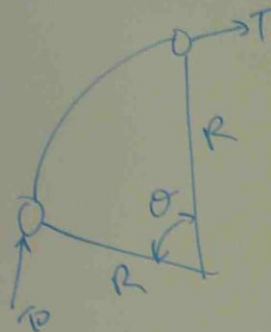
$$\cosh \theta = \frac{e^{\theta} + e^{-\theta}}{2}$$

UPWARD CURVE



$$T = T_0 e^{\mu \theta} +$$

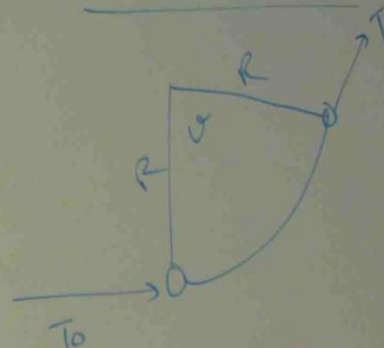
UPWARD CONVEX BEND



$$T = T_0 e^{\mu \theta} + \frac{WR}{1 + \mu^2}$$

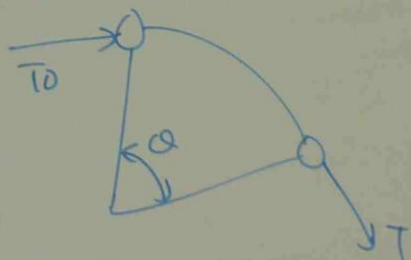
$$\left[2\mu e^{\mu \theta} \sin \alpha + (1 - \mu^2) \left(1 - e^{\mu \theta} \cos \alpha \right) \right]$$

UPWARD CONCAVE BEND



$$T = T_0 e^{\mu \theta} - \frac{WR}{1 + \mu^2} \left[2\mu \sin \alpha - (1 - \mu^2) (e^{\mu \theta} - \cos \alpha) \right]$$

DOWNWARD CONVEX BEND



$$T = T_0 e^{\mu \theta} + \frac{WR}{1 + \mu^2} \left[2\mu \sin \alpha - (1 - \mu^2) (e^{\mu \theta} - \cos \alpha) \right]$$

DOWNWARD CONCAVE BEND

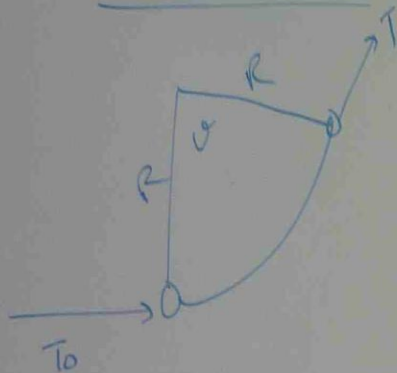


$$T - \mu \cos \alpha$$

$$\sqrt{(T_0)^2 + (WR)^2} \sin(\mu \theta)$$

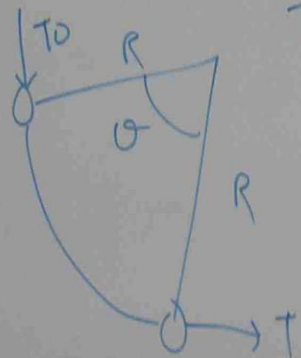
$$\frac{e^{\mu \theta} + e^{-\mu \theta}}{2}$$

UPWARD CONCAVE BEND



$$T = T_0 e^{\frac{\rho\theta}{1+\mu^2}} - \frac{WR}{1+\mu^2} \left[2\mu \sin\theta - (1-\mu^2)(e^{\frac{\rho\theta}{1+\mu^2}} - \cos\theta) \right]$$

DOWNWARD CONCAVE BEND



$$T = T_0 e^{\frac{\rho\theta}{1+\mu^2}} - \frac{WR}{1+\mu^2} \left[2\mu e^{\frac{\rho\theta}{1+\mu^2}} \sin\theta + (1-\mu^2)(1 - e^{\frac{\rho\theta}{1+\mu^2}} \cos\theta) \right]$$

SPECIFICATION

THE CONTRACTOR MUST APPLY APPROPRIATE TENSION OF

THE CONDUIT WITH RESPECTIVE INSTALLATION ARRANGEMENT

FORMULA.

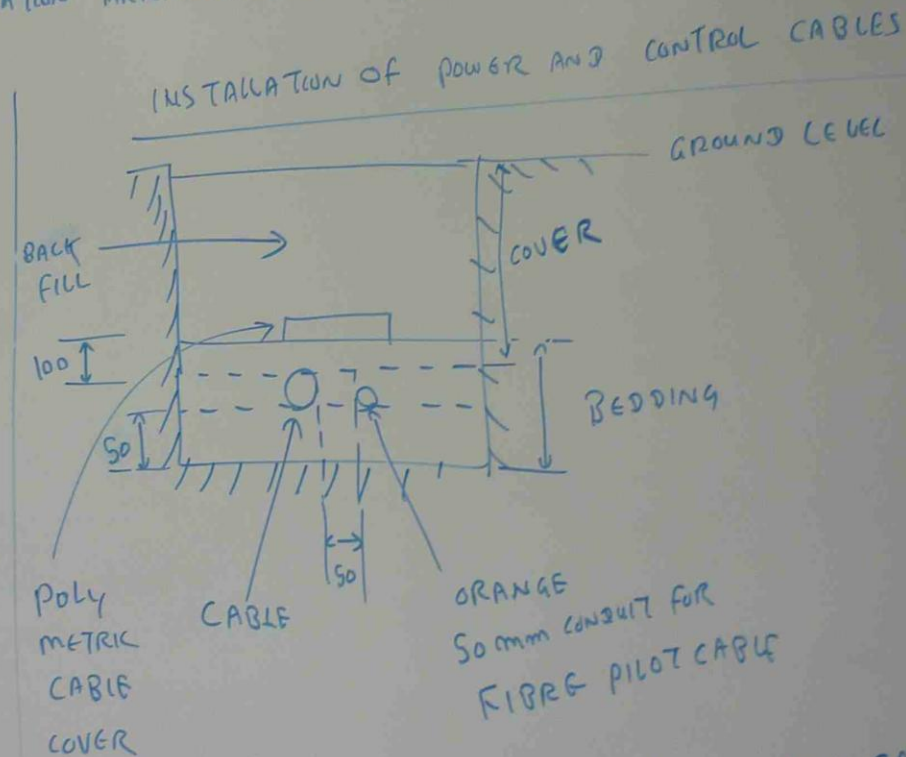
$$0 - (1-\mu^2)(e^{\frac{\rho\theta}{1+\mu^2}} - \cos\theta)$$

SPECIFICATION

THE CONTRACTOR MUST APPLY APPROPRIATE TENSION OF CABLE TO PULL THE CABLE IN TO THE CONDUIT WITH RESPECTIVE INSTALLATION ARRANGEMENTS BY USING THE GIVEN

FORMULA-

$$\left[\frac{P_0}{P} e^{\sin \alpha} + (1 - \frac{P^2}{P^2}) (1 - e^{\cos \alpha}) \right]$$



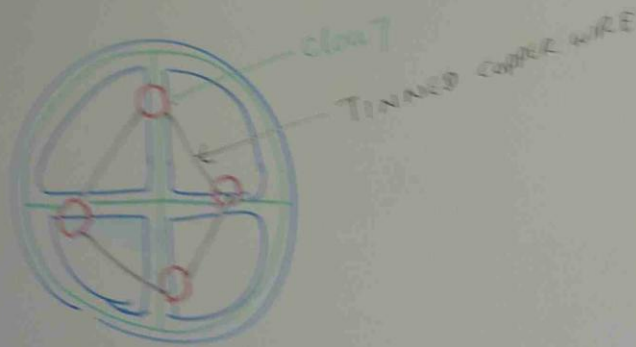
SEALING OF CABLES - ALL POWER AND CONTROL CABLE SHALL BE PROTECTED AGAINST MOISTURE INGRESS AT ALL TIMES.

SEALING - USE OF SUITABLE HEAT SHRINK END CAP.

SHORTING OF CABLE CORES

MULTI CORE CABLES

THE CONDUCTORS OF MULTI CORE CABLES SHALL BE SHORTED OUT USING CLOUTS AND 10 TURNS OF 1.63mm TINNED COPPER WIRE



- CABLE LAYING OPERATIONS SHALL EMPLOY SUFFICIENT CONTROL TO ENSURE THAT NO DAMAGE IS CAUSED TO NEWLY LAID CABLES (OR) TO EXISTING CABLE INFRASTRUCTURE.
- CABLE JOINTS SHALL BE INSTALLED IN A STRAIGHT SECTION OF TRENCH WITH AT LEAST 2 METRES OF STRAIGHT CABLE AT EITHER SIDE OF THE JOINT. REFER NS172

THE FOLLOWING TABLE MUST BE UTILIZED TO DETERMINE THE BENDING RADIUS.

MINIMUM INTERNAL BENDING RADIUS

CABLE TYPE	DURING INSTALLATION	AFTER INSTALLATION
LESS THAN OR EQUAL TO 25mm DIAMETER	60	40
GREATER THAN 25mm DIA:	40	60
ALL LOW VOLTAGE CABLES	120	80
11 KV PVC	180	120
11 KV NYLOW SHEATHED CABLE	300	200
11KV MULTICORE LEAD SHEATHED HDPE OVER SHEATHED	250	150

MUST BE UTILIZED TO DETERMINE THE BENDING RADIUS.

MINIMUM INTERNAL BENDING RADIUS

	DURING INSTALLATION	AFTER INSTALLATION
CUR	6D	4D
mm DIA:	4D	6D
CABLES	12D	8D
	18D	12D
SHEATHED	30D	20D
RE	25D	15D
THED		
ATHED		

MINIMUM INTERNAL BENDING RADIUS

11 kV XLPE

$\textcircled{300 \text{ AL}}$ $\textcircled{3 \times 0}$ mB $\textcircled{\text{Cu}}$ (ws) 2 40 | 356 560 mm
 \downarrow \downarrow
 500 AL 3 4 TR 40 4 35 Cu (ws) 2 40 | 356 630 mm

ELECTRICAL CONTRACTING

MANAGEMENT AND PLANNING

SERVICE WORK

SERVICE WORK IS NOT FOR EVERY CONTRACTOR NOR CAN IT BE DONE WELL IN EVERY LOCATION. IT IS IMPORTANT TO MAKE A BOLD DISTINCTION BETWEEN SERVICE WORK AND NEW CONSTRUCTION WORK. CERTAINLY THEY BOTH INVOLVE INSTALLING ELECTRICAL MATERIALS.

- IT NEEDS A LARGE ENOUGH MARKET TO SUSTAIN A SERVICE BUSINESS
- USUALLY THIS REQUIRES A POPULATION OF AT LEAST 250,000 IN YOUR AREA

COMPETITION CAN MAKE DIFFICULT TO GET A STEADY WORK

- YOU NEEDS TO HAVE AN ELECTRICIAN WHO CAN HANDLE THE PRESSURE THAT SERVICE WORK PLACE UPON THEM
- IT NEEDS TO HANDLE MORE PAPER WORKS FOR SERVICE WORK
- IT NEEDS A GOOD ESTIMATOR / SALES PERSON TO HANDLE THE LARGE NUMBER OF ESTIMATES
- GOOD ESTIMATOR
- GOOD PUBLIC RELATION SKILL

GETTING WORK

- ADVERTISING
- PHONE YELLOW BOOK
- ADVERTISING NEEDS PEOPLE ATTENTION

CREATIVITY IN ADVERTISING

COST EFFECTIVENESS

GOOD SALESMANSHIP

PHONE SOCIALISATION

FINANCIAL BACKGROUND

BANK GUARANTEE.

DOING THE WORK

- UAN
- ENOUGH TOOLS TO HANDLE DIVERSE RANGE OF JOBS
- ELECTRICAL + MECHANICAL + ELECTRONICS EQUIPMENTS / Tools
- RELATED FIELDS & MULTI SKILLS

E-g → ELECTRICAL + PLUMBING

HOUSEWIRING + DATA CABLING + TELECOM: CABLING

ELECTRICAL FITTING + SHEET METAL + MECHANICAL FITTING ETC

- DIVERSED RANGE OF CATALOGUES AND SUPPLIER INFORMATIONS.
- SOURCE OF SPARE PARTS AND ORDERING INFORMATION.
- MATERIAL REQUEST PREPARATION SKILLS.

MATERIAL REQUEST

JOB NAME _____ ADDRESS _____ JOB NUMBER _____ PHONE _____ DATE _____
PO. _____, FILLED BY _____

ORDERED BY	WHEN NEEDED	DISCRIPTION	SHIPPED	
ORDERED	BA			
RECEIVED BY _____		DATE _____		

CONCRETE CONSTRUCTION WORK

ALL CONCRETE SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF IS 3600.

(a) CEMENT

CEMENT SHALL BE TYPE GP GENERAL PURPOSE PORTLAND CEMENT (OR)
EQUIVALENT COMPLYING WITH IS 3972.

(b) FINE AGGREGATE

FINE AGGREGATE MUST BE CLEAN, SHARP, HARD, DURABLE GRAIN.
UNIFORM IN QUALITY AND FREE FROM HARMFUL AMOUNT OF SOFT (OR)
FLAKY PARTICLES, DUST, LUMPS, LOAM, CLAY, SLAG, ORGANIC OR
OTHER DETRIMENTAL SUBSTANCES COMPLYING WITH IS 2758.1

(c) COARSE AGGREGATES

COARSE AGGREGATES SHALL COMPLY WITH IS 2758

(d) TESTING AGGREGATES

TESTING AGGREGATES SHALL COMPLY WITH IS 1141

(e) WATER

WATER SHALL COMPLY WITH THE PROVISIONS OF IS 3600.

(f) REINFORCEMENT

REINFORCEMENT SHALL BE EITHER STEEL BARS COMPLYING WITH IS 4671 (OR) HARD DRAWN STEEL WIRE COMPLYING WITH IS 4671.

REINFORCEMENT SHALL BE ACCURATELY CUT TO SIZE AND BENT TO SHAPE AND SHALL BE FREE FROM SCALE OIL AND LOOSE RUST.

SITE MIXED CONCRETE

CONCRETE MIXING CARRIED OUT ON SITE SHALL BE BY ROTATING BATCH MIXERS ONLY, UNLESS SPECIFICALLY APPROVED ON SITE BY SITE BASIS

READY MIXED CONCRETE

READY-MIXED CONCRETE FROM AN APPROVED CENTRAL MIXING SHALL BE ACCEPTABLE THAT BOTH ITS USE AND PROPERTIES COMPLY WITH AS 1379.

CONCRETE CONSTRUCTION

(a) Form work

FORM WORK SHALL COMPLY WITH AS 3610. FORMS SHALL CONFORM TO THE SHAPES, LINES AND DIMENSIONS SHOWN ON THE DRAWINGS. ALL FORMS AND SUPPORTS SHALL BE SOUND TIMBER (OR) STEEL, PLY WOOD (OR) SIMILAR MATERIALS OF SUFFICIENT STRENGTH AND BE ADEQUATELY TIGHT TO PREVENT LEAKAGE OF MORTAR.

FORM WORK TIES SHALL BE USED TO MAINTAIN CORRECT SEPARATION OF VERTICAL SURFACES.

TIMBER FORM WORK FOR EXPOSED SURFACES SHALL BE DRESSED. ALL FORMING SURFACES SHALL BE COATED WITH APPROVED FORM RELEASE AGENT BEFORE POURING COMMENCES. COATING SHALL BE DONE BEFORE ANY

REINFORCEMENT IS FIXED IN POSITION

CONCRETE TESTING

TESTING OF CONCRETE SHALL COMPLY WITH IS 3600.

TEST CYLINDERS SLUMP TEST SHALL BE TAKEN

CONSTRUCTION JOINTS

BEFORE FRESH CONCRETE IS PLACED AGAINST HARDENED CONCRETE AT CONSTRUCTION JOINTS, THE JOINT SURFACE OF THE HARDENED CONCRETE SHALL BE CLEANSER BY REMOVING ALL LOOSE AND SOFT MATERIALS.

CONCRETE FINISHING

UNRENDERED OFF FORM SURFACES SHALL COMPLY WITH THE TOLERANCES AND SURFACE FINISH REQUIREMENTS DESCRIBED IN CLASS 3 FORM WORK OF IS 3610. SURFACE FINISH SHALL COMPLY WITH CLASS 4 FORMWORK OF IS 3610

CABLE PULLING

THE PULLING TENSION OF POWER CABLE SHALL NOT EXCEED CABLE MANUFACTURER'S SPECIFICATION

INSTALLING CABLES IN SUB STATIONS & SWITCHING STATIONS

NOTICE FOR ACCESS MUST BE REQUESTED.

NECESSARY SCREENS (OR) PROTECTIVE DEVICES SHALL BE INSTALLED.

WEATHER PROOF LABELS SHALL BE ATTACHED TO ALL CABLE ENDS INSTALLED IN SUB STATIONS.

INSTALLING CABLES IN KIOSK TYPE SUBSTATION

ALL CABLES SHALL BE LAID SO THAT THEY ENTER PERPENDICULAR TO H.V & L.V ACCESS DOORS OF THE KIOSK.

INTERNAL BENDING RADIUS SHALL NOT BE LESS THAN MANUFACTURER'S SPECIFICATION

INSTALLING CABLES IN CABLE RISERS

CABLES INSTALLED IN CABLE RISERS SHALL BE CLAMPED AT A MAXIMUM OF 1MTRG INTERVALS. CABLE CLAMPS SHALL BE

TO CABLE RISER WALLS

(USED WITH BOLTS, NUTS, WASHERS OF)

CABLE JOINING
NS 129/177

CABLE TEST
NS 161

BACK FILL MATERIALS

THE BACK FILL MATERIALS SHOULD RESTORE THE SUB GRADE OF ORIGINAL CONDITION WHICH MAY BE ACHIEVED BY REPLACING THE EXCAVATED MATERIALS IN THE SAME POSITION FROM WHICH THEY WERE EXCAVATED.

RTA, LOCAL COUNCIL MUST SATISFY BACK FILL MATERIALS.

BUILDING MATERIALS (Eg. CONCRETE, BRICKS, PAVERS, ROCK, ROOFING TILES, RUBBLE) AND CONTAMINATED SUBSTANCES INCLUDING HAZARDOUS MATERIALS. MUST NOT BE USED IN BACK FILLS.

ELECTRICAL CONTRACTING

SPECIALITY WORK

SPECIALITY WORK IS ALMOST ALWAYS MORE PROFITABLE THAN REGULAR ELECTRICAL INSTALLATION ON A PERCENTAGE BASIS.

THERE ARE TWO DIVISIONS OF SPECIALITY WORK

- ① SPECIAL TYPES OF INSTALLATIONS
- ② SPECIAL SERVICE TO SPECIFIC TYPES OF CUSTOMERS.

SPECIAL TYPES OF INSTALLATION

TELEPHONE WORK

FIRE ALARM SYSTEMS

SECURITY SYSTEMS

TELEVISION SYSTEM (CLOSED CIRCUIT T.V)

LIGHTNING PROTECTION SYSTEM

TRAFFIC LIGHTING INSTALLATIONS.

HIGH VOLTAGE WORK

LIGHTING MAINTENANCE SERVICE

EMERGENCY MANAGEMENT AND PROGRAMMABLE CONTROLLERS

GROWING AREAS OF SPECIALIST WORKS

— ENERGY MANAGEMENT

— LIGHTNING PROTECTION — GREATLY DETERMINED BY GEOGRAPHY

— FIRE ALARM WORK — (RELATED TO BUILDING IN INDUSTRY)

— TELEPHONE WORK / CABLE

T.V TELECOMMUNICATION

DESIGN AND BUILD WORK

- THE AMOUNT OF COMPETITION FOR JOB IS FAR LESS, SOMETIMES NON EXISTENT
- THE ELECTRICAL CONTRACTOR IS COMPENSATED FOR PROVIDING THE DESIGN SERVICE THAT ARE USUALLY DONE BY AN ENGINEER.
- THE CUSTOMER USUALLY GETS A BETTER PRICE FOR THE SAME QUALITY OF WORK BY USING A QUALIFIED DESIGN/BUILD CONTRACTOR
- CO-OPERATION DURING THE CONSTRUCTION PROCESS IS USUALLY BETTER ON DESIGN/BUILD PROJECTS THAN ON CONTRACT BID PROJECTS
- DESIGN/BUILD WORK USUALLY CARRIES LESS RISK THAN OTHER TYPES OF ELECTRICAL CONTRACTING.

REQUIREMENTS

- THE CONTRACTOR MUST DEVELOP A GREAT DEAL OF TRUST IN HIS CUSTOMERS
- THE CONTRACTOR MUST OFFER THE CUSTOMER A BETTER VALUE FOR MONEY
- THE INSTALLATION MUST BE DONE IN A FIRST CLASS MANNER
- THE CONTRACTOR AND ALL OF HIS PERSONNELS MUST MAINTAIN A HIGH STANDARD OF COURTESY TO THE CUSTOMERS
- THE CUSTOMER'S INTEREST MUST TAKE PRECEDENCE OVER THE CONTRACTOR'S
- X THE PROJECT MUST MEET ALL LOGS
- X THE ELECTRICAL CONTRACTOR MUST HAVE ABILITY TO PERFORM INSTALLATION PROPERLY
- // THE ELECTRICAL CONTRACTOR'S ABILITY TO HANDLE ALL DETAILS OF DESIGNS.