

PS - II



Name : S.GOPAL REDDY
Designation Assoc.Prof
Dept : Electrical& Electronics Engg

Subject : Power System II

Topic : Insulators

Recap

- Insulator is one of the main component used in overhead lines
- These are installed between supporting poles/towers and conductors
- Bare conductors (without insulation) are used for transmission lines
- To protect from leakage currents passing through supports to earth insulators are installed between supports and line conductors

Objectives

On completion of this period ,you would be able to know

- Insulators
- Requirement
- Materials used
- Types of insulators
- Puncture
- Flash over

Insulators

Properties Insulators

- High mechanical strength
 - To bear the weight of conductor ,wind pressure and ice weight
 - High relative permittivity
 - To provide high dielectric strength
 - High insulation resistance
 - To prevent leakage of current to earth

properties Insulators (contd..)

- High ratio of puncture strength to flash over voltage
- Should withstand to large temperature variations
- Should not be porous
- Should not change its properties due to the fluids and gases in atmosphere
- Free from internal impurities and cracks

Materials Used For Insulators

- Porcelain
- Glass
- Steatite
- Special artificial materials

Porcelain Insulator

- Is produced by firing with controlled temperature a Mixture of Kaolin, feldspar and quartz
 - It is mechanically stronger than glass
 - Less trouble from leakage
 - Less susceptible to temperature variations

Porcelain Insulator (Contd..)

- Surface is not effected by dirt deposits
- Does not withstand if tensile strength exceeds 5kg/sqmm
- Dielectric strength is 6.5kv/mm
- Compressive strength is of 700kg/sqmm

Glass Insulator

- Cheaper than porcelain in the simpler shapes
- Receptivity and dielectric strength increases to 4KV/mm if Properly toughened and annealed
- Due to high dielectric strength it is simple in one design. It can withstand to higher compressive strength than porcelain
- Lower coefficient of expansion Can be used up to 25KV under ordinary atmospheric conditions
50KV in dry atmosphere



Steatite

- Naturally occurring magnesium silicate
- It is found combined with various proportions of oxides
- It has much higher tensile and bending stress than porcelain
- Used for tension towers and at sharp turns of transmission lines

Special Artificial Materials

- Insulators made with these materials are used for low voltages
- Can be moulded into any shape without any internal stress
- Insulation properties deteriorate rapidly in bad climatic conditions due to which flash-over

Types of Insulators

- Pin
- Suspension
- Strain
- Shackle
- Stay



Pin Type Insulator

Up to 33 KV these insulators are economical

- Above 33KV these insulators weight is more and uneconomical
- One piece insulators are used up to 25KV as
- Multi pieces insulators are used 33to 66KV as



Elevation of LT pin type insulator

Cross sectional view of LT pin type insulators

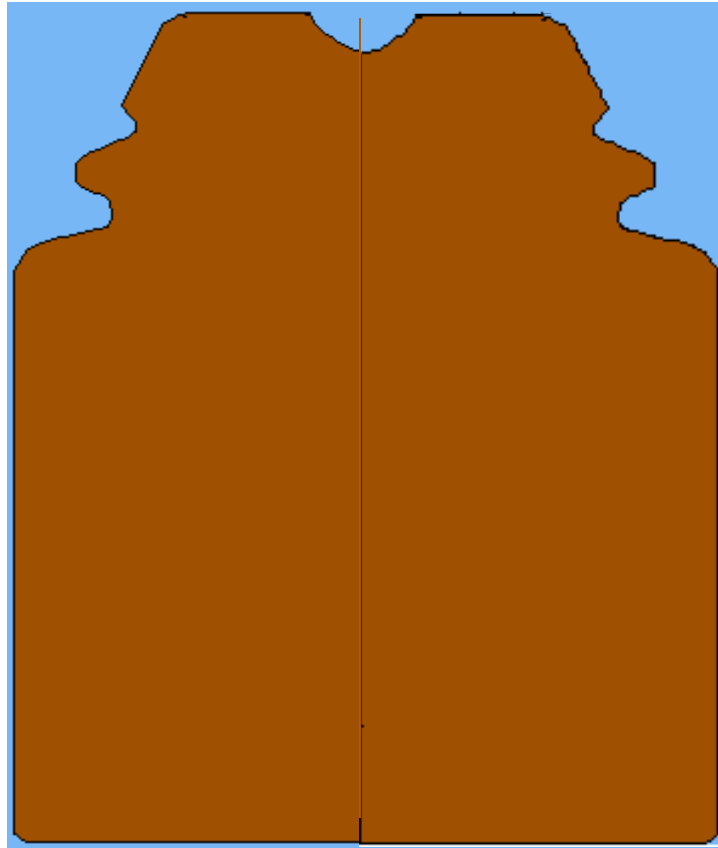
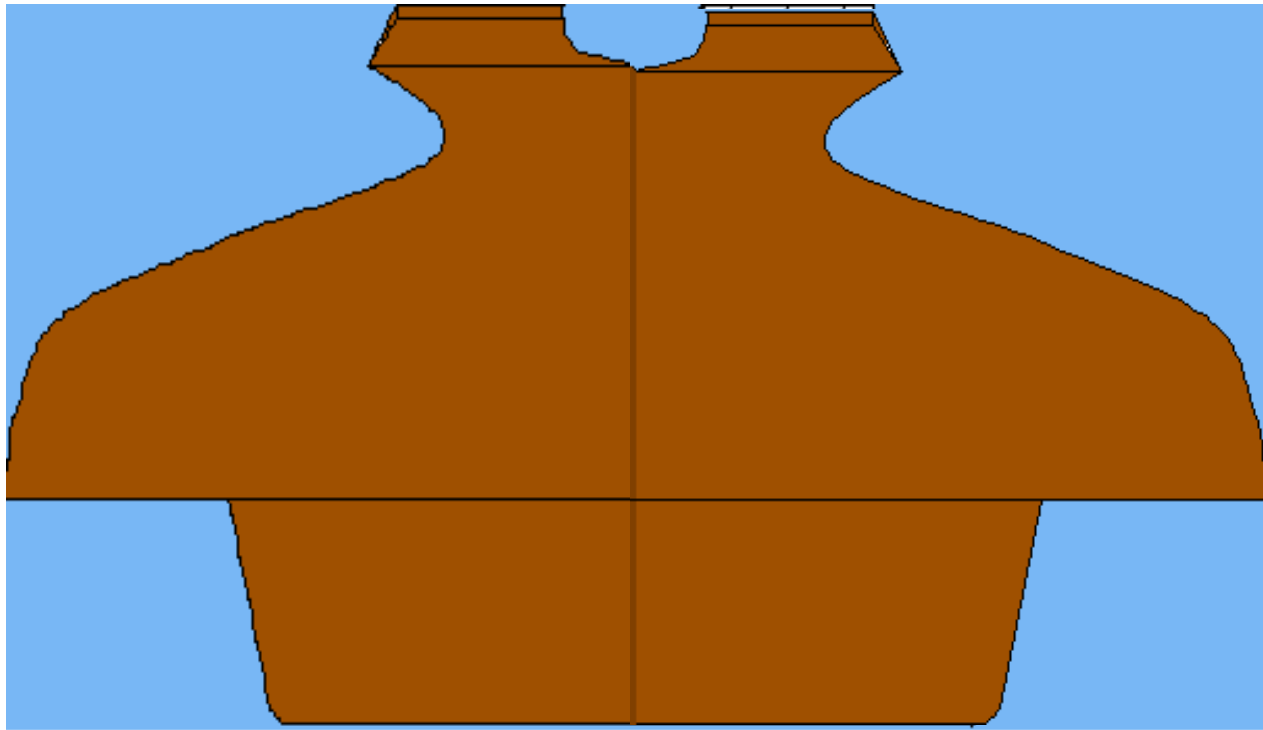


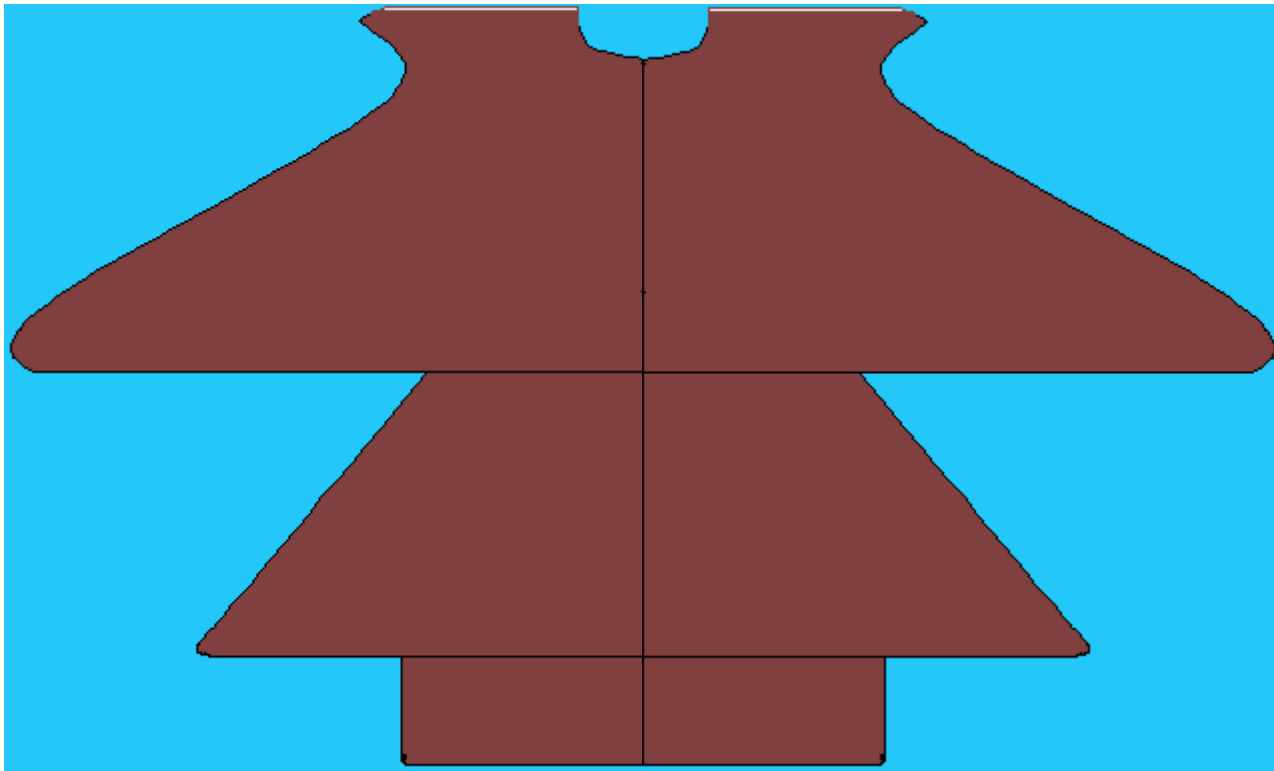
Fig .1



25 KV pin type insulator

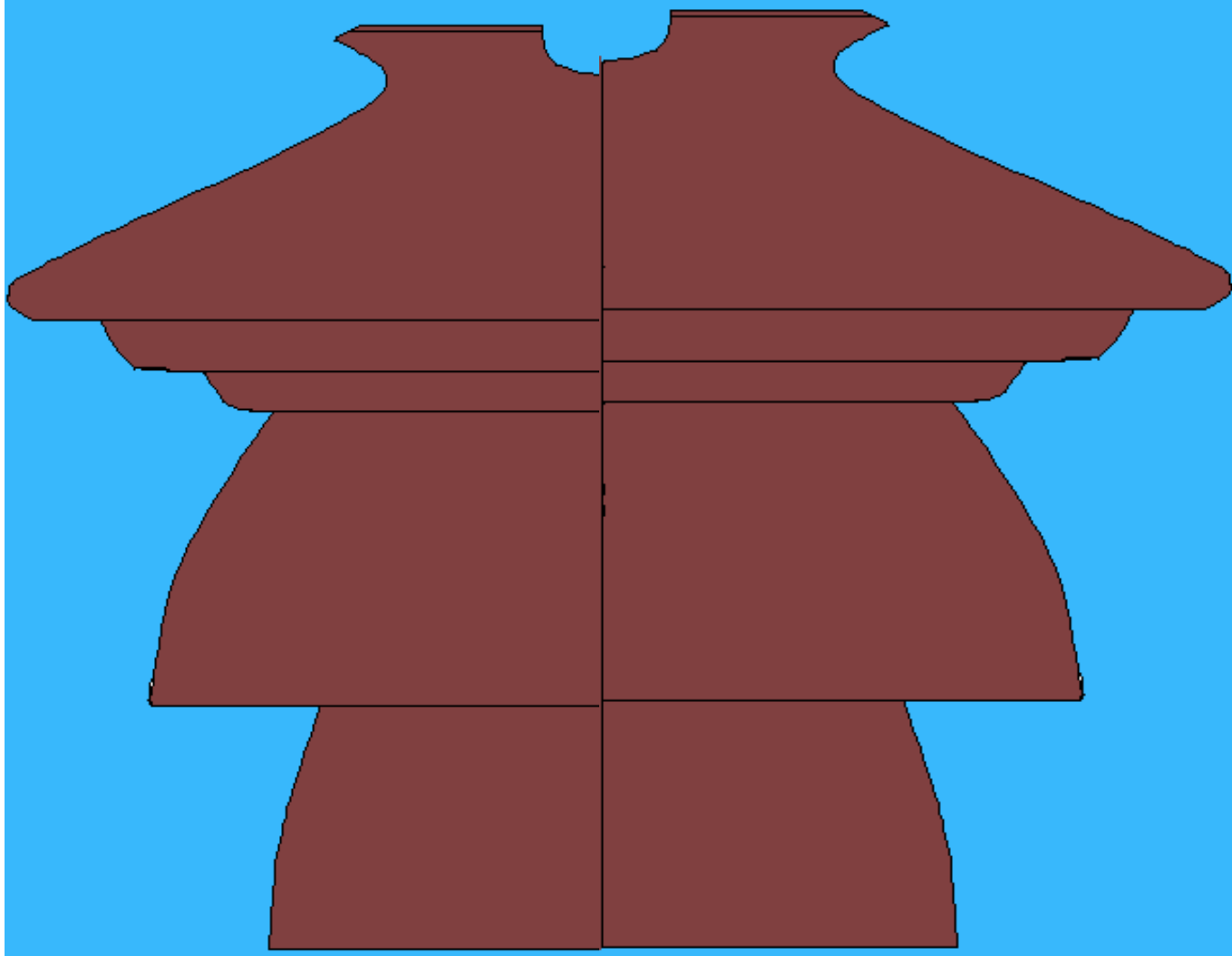
Cross-sectional view of 25KV pin type insulator

Fig .2



Multi piece pin type insulator
Cross-sectional view of multi piece pin type insulator

Fig .3



3rd layer pin type insulator
Cross-sectional view of 3rd layer pin type insulator

Fig .4

Pin Type Insulator (Contd..)

- Multi pieces insulators are fastened with Portland cement
- Leakage current path length is increased by proper design of petty-coats or rain sheds
- Due to rain outer surface becomes wet
- Rain sheds are so designed that inner sheds kept dry
- Inner dry surface length is sufficient to protect from leakage current
- Steel pin is so designed that one end is fixed at bottom of the insulator and other end is mounted on cross arm

Pin Type Insulator (Contd..)

- Conductor is binding on the top of the insulator with a soft conducting wire.
- Pole height is reduced as conductor runs above cross arm.
- These insulators are used for intermediate poles on straight run.
- These insulators cannot take any tension
- The ratio of the spark over voltage to the working voltage must be high for low voltage



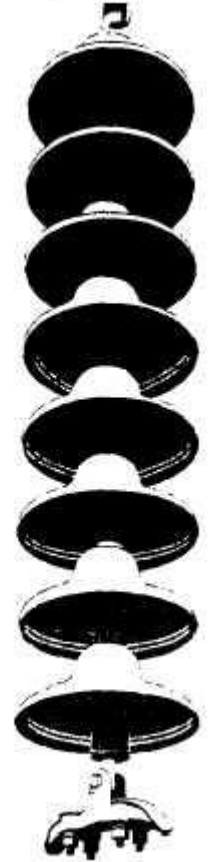
Suspension Type Insulator

- This type of insulators are suspended below the cross arm
- Conductor is clamped below the insulator
- Most commonly used metal cap cemented suspended insulator is shown in fig.5
- It is made with one piece porcelain insulator



Suspension type Insulator (Contd..)

- At the bottom a metallic (steel) pin is fastened with cement
- At the top a metallic cap is fastened with cement as
- Each insulator can with stand from 11KV to 16KV
- Two suspended type insulators joined together either by pin and clevis or ball and socket joints as shown in fig.6
- Porcelain, cement and steel have different coefficient of cubical expansion



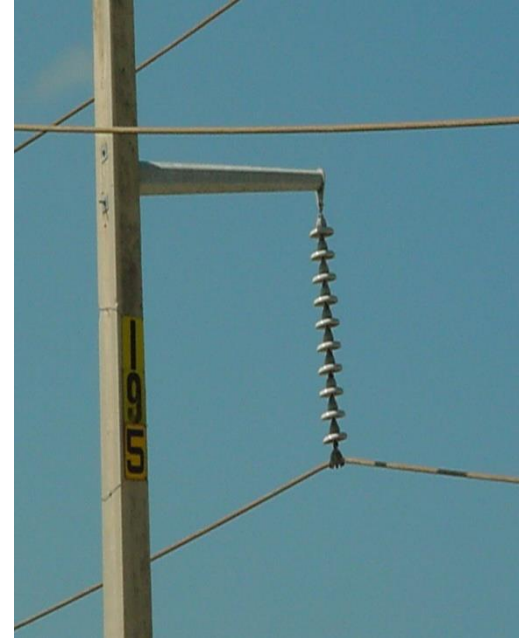
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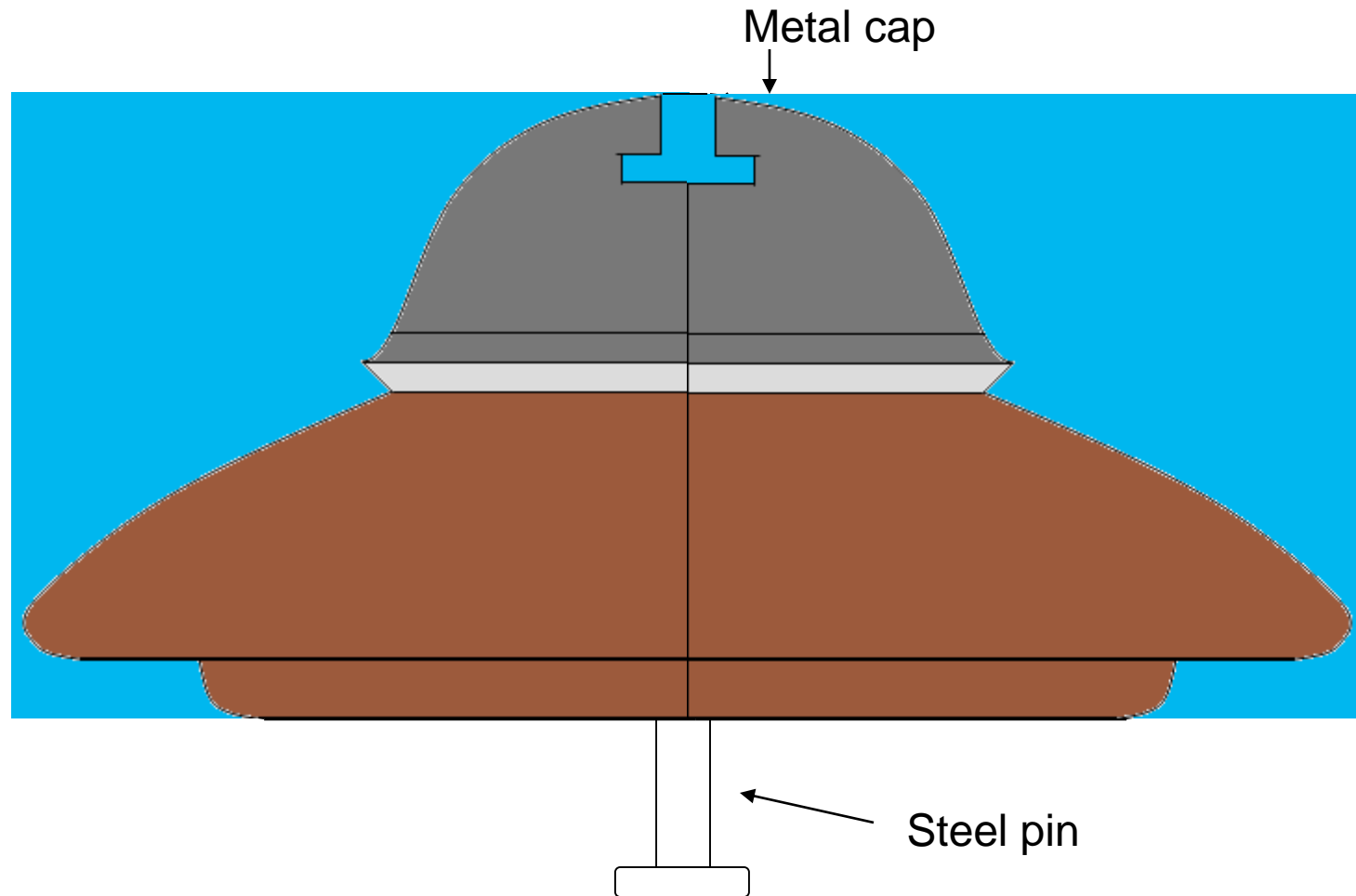
Suspension type Insulator (Contd..)

- sudden change in temperature internal stresses are developed
- Due to stresses cracks developed in porcelain which leads to electrical failure
- These insulators are used in horizontal plane

There are 3 types of suspension insulators

1. Hewlett or inter linking type
2. Cemented cap type
3. Core or link type





Cross section of suspension type insulator

Fig .5

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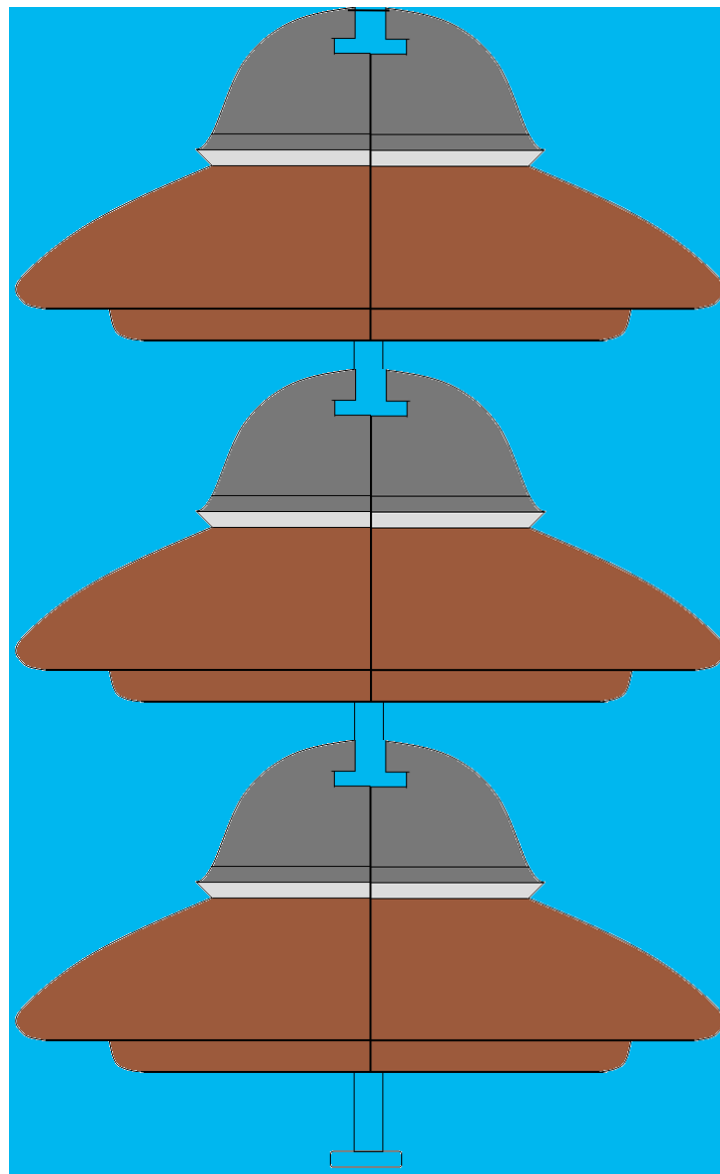


Fig.6
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STRING OF INSULATORS

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Hewlett Type



Strain Insulator

Over head line conductors are under greater tension at

1. Termination of line (dead end)
2. At corners
3. At sharp turns
4. Line crosses river

For HT lines strain type disc insulators are used Depending on the HT voltage No of insulators are used as shown in fig.7

These insulators are used in vertical plane



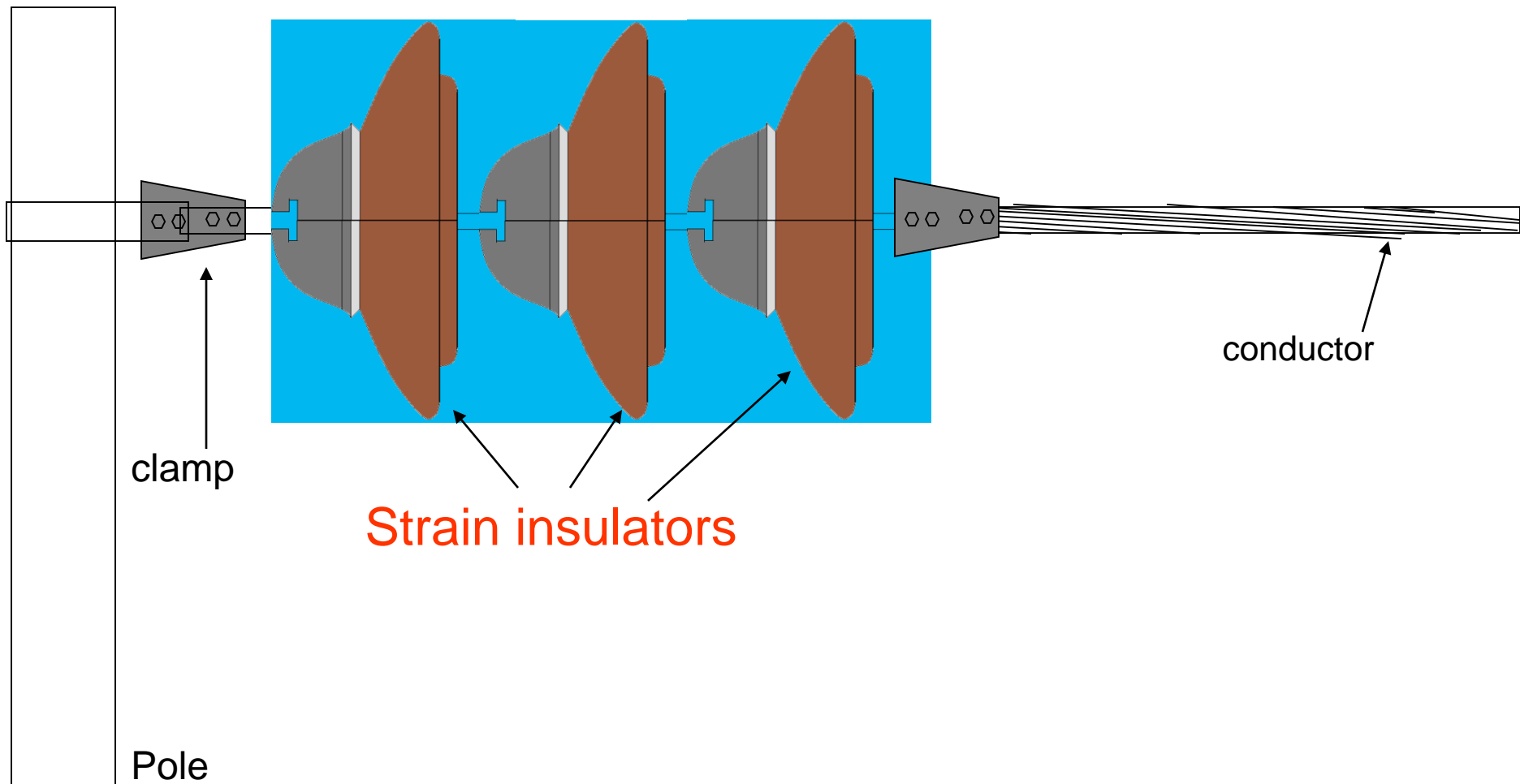


Fig.7

Shackle type insulator

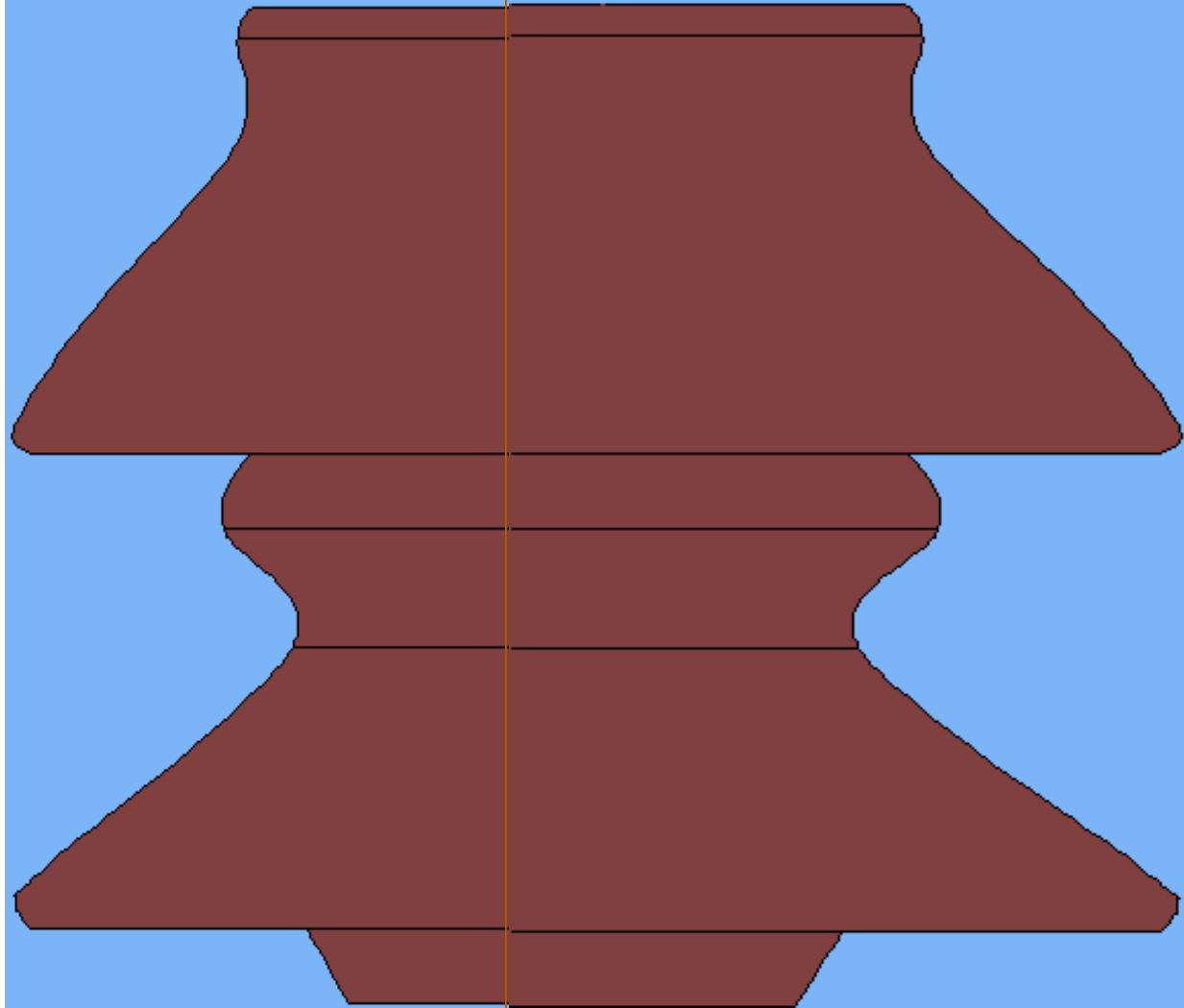
- Used for LT lines at
 1. Termination of line (dead end)
 2. At corners
 3. At sharp turns
 4. Line crosses river
- Used for vertical or horizontal plane
- Wet flash over voltage is 10KV



Shackle Type Insulator (Contd..)

- Dry flash over voltage is 25KV
- The hole in the insulator distribute the load more evenly and reduces the possibility of breakage
- Conductors are fixed in the grooves by binding with a soft conducting wires





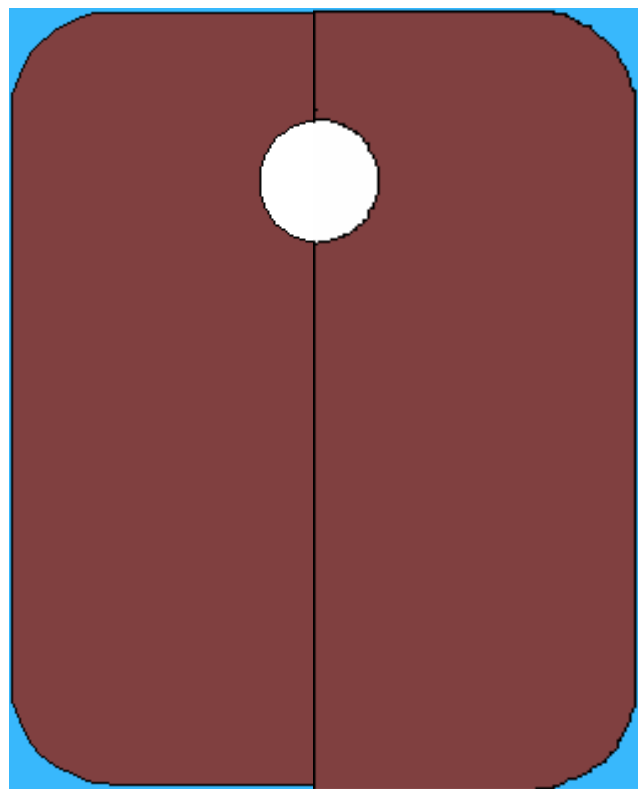
Shackle type insulator
Cross-sectional view of shackle type insulator

Fig.8

Stay Insulator

- Stay insulators are also called as guy insulators
- It is used for insulating the stay or guy wire
- To protect the people and animals from grounding
- It consists of two holes at right angles to each other as shown in fig.9





Stay Insulator
Cross-sectional view of stay
insulator Fig.9

Stay Insulator (Contd..)

- Two ends of the guy or stay wires are looped through the two holes
- These two loops produce a compressive stress on porcelain
- Insulator is provided at a height of about 3m above ground level

Summary

We have discussed about

- Requirement of insulators in transmission and distribution system
- Materials used in manufacturing insulators.
 - Porcelain
 - Glass
 - Steatite
 - Special artificial materials

Summary (Contd..)

Types of insulators

- Pin
- Suspension
- Strain
- Shackle
- Stay

Quiz

1. Insulators used for EHT transmission lines are made of

- a) PVC
- b) Porcelain
- c) Glass
- d) Steatite

Quiz

2. HV transmission line uses

- Shackle insulator
- Suspension type insulator
- Both (a) and (b)
- None of the above

Quiz

3. Pin type insulators are generally not used for voltages exceeding
- a) 66KV
 - b) 33KV
 - c) 25KV
 - d) 11KV

Quiz

4. Strain type insulators are used

- At dead ends
- At river crossings
- On street runs
- Any of (a) or (b)

Frequently Asked Questions

1. List the types of insulators used for HT overhead lines.
2. State applications of pin and suspension type insulators.
3. State applications of strain and shackle type insulators.

Frequently Asked Questions (contd..)

4. Name and explain the commonly used materials for overhead line insulators.
5. List and explain commonly used insulators for overhead lines.
6. Explain with neat sketch the constructional features of pin type insulator.
7. Explain with neat sketch the constructional features of suspension type insulator

Assignment Questions

1. List the types of insulators used for HT overhead lines.
2. State applications of pin and suspension type insulators.
3. State applications of strain and shackle type insulators.
4. Name and explain the commonly used materials for overhead line insulators.
5. List and explain commonly used insulators for overhead lines.
6. Explain with neat sketch the constructional features of pin type insulator.

THANK YOU