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3D SIMULATION OF POLYMER INSULATOR

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Abstract— *An insulator gets contaminated under wet and polluted conditions which are reported in coastal environments and in industrial areas. Polymer insulator is a type of insulator which features good hydrophobicity and adhesive property to improve or maintain the flashover voltage. The work proposed is to simulate Polymeric insulator using ANSYS simulation software.*

Keywords—*Room temperature valcanized, silicon rubber insulator, simulation of polymer insulator, 3D simulation of Insulator,Simulation RTV insulator*

I. INTRODUCTION

Insulator is very important part of power system. It provides isolation from earth and other phase or circuit. Main properties of insulator are flashover voltage and life span of insulator. Major type of insulators are Ceramic insulator which is made of glass or porcelain, Polymer insulator which is made of SR or EPR, Composite insulator which is made of a glass fiber reinforced resin rod with crimped end fittings, which carry the mechanical load and it is covered with a polymer housing. Outdoor insulator gets contaminated due to deposition of water, snow, salt or other pollutants. Due to contamination flash over voltage and life span of insulator is decreased. Polymer insulator which is made of silicon rubber consist hydrophobic properties which repel water due to which contamination of insulator is decreased. Ceramic insulator is not consists such kind of property because of which it has low flashover voltage and life span compare to polymer insulator. Silicone rubber has been used for many decades as housing material for composite insulators and for the cable accessories due to its unique features like substantial stability at high temperatures, hydrophobic properties, good UV radiation resistance and high elasticity. In this paper polymer insulators which is already been tested in paper [1] and which are used for mathematical modeling in paper [2] is simulated using ANSYS software.

II. SAMPLE

The samples are the short samples of four kinds of FXBW- 500/160 dc SIR composite long rod insulators, which are denominated by Type A, B, C and D. The profiles and technical parameters of the samples are shown in following Figures 1 to 4 and Table 1, in which *D*1 is the diameter of larger shed, *D*2 is the diameter of smaller shed, *h* is the arcing distance, *L* is the leakage distance, *d* is the diameter of rod, *S* is the ratio of the leakage distance to the arcing distance, *N*1 is the number of larger sheds and *N*2 is the number of smaller sheds.

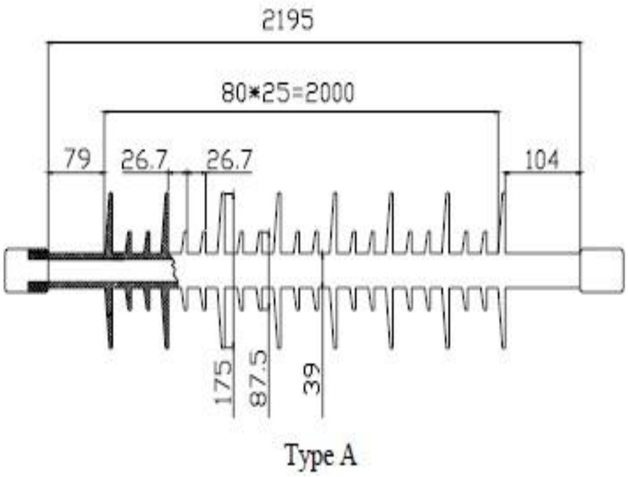
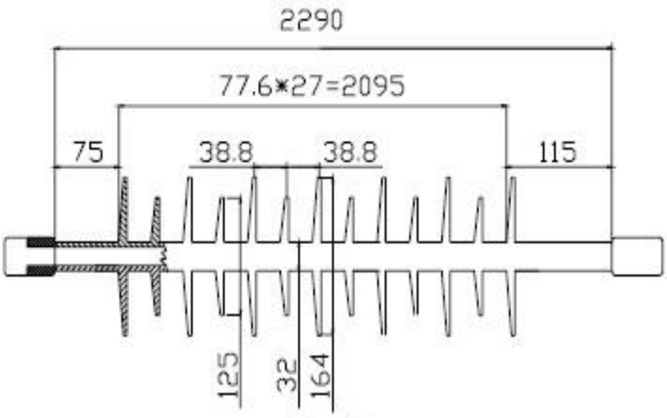
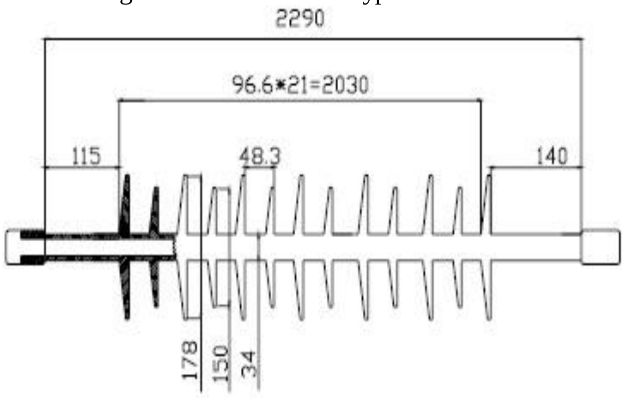


Figure 1 Dimension of Type A insulator



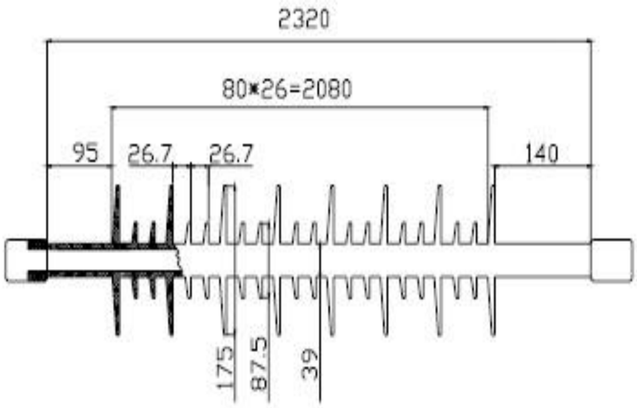
Type B

Figure 2 Dimension of Type B insulator



Type C

Figure 3 Dimension of Type C insulator



Type D

Figure 4 Dimension of Type D insulator

Table 1 Dimensions of insulators

Type	D1/D2(mm)	h(mm)	L(mm)	d(mm)	N1/N2
A	175/87.5	2195	7393	39	26/50
B	164/125	2290	7588	32	27/27
C	178/150	2290	7387	34	22/21
D	175/87.5	2320	7788	39	27/52

III. RESULTS OF SIMULATION

A. Type A

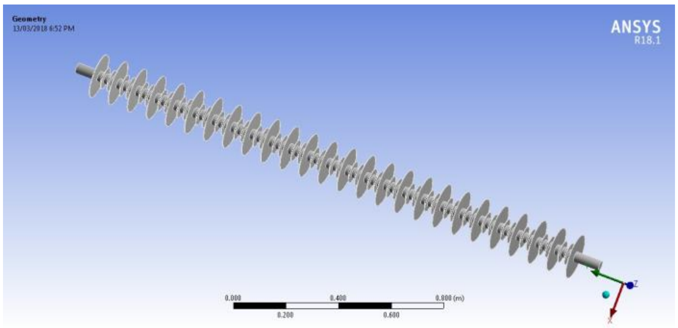


Figure 5 Geometry of Type A insulator

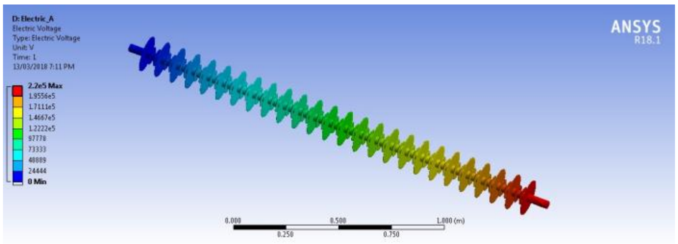


Figure 6 Voltage distribution in type A insulator at 220KV

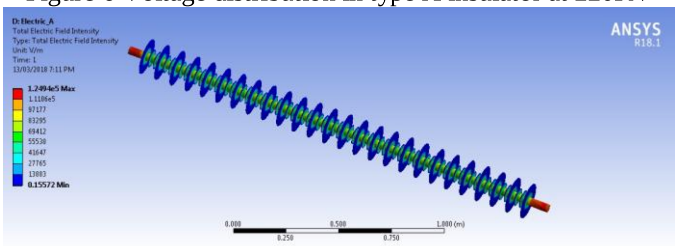


Figure 7 Electric field intensity in type A insulator at 220KV

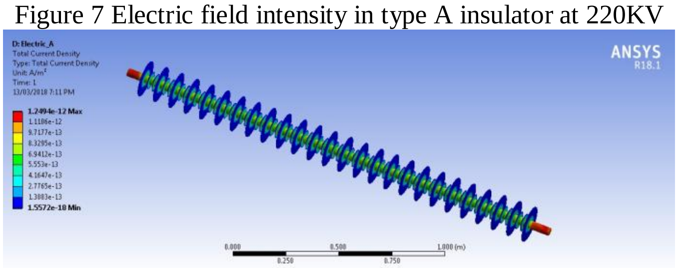


Figure 8 Current density in type A insulator at 220KV

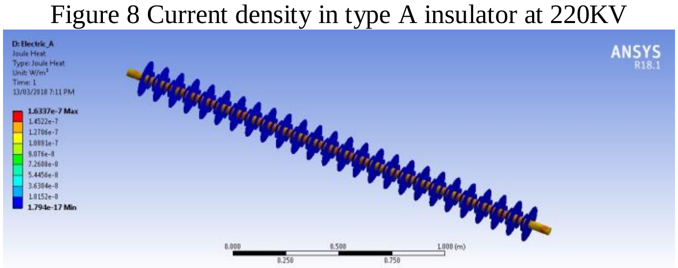


Figure 9 Heat dissipation in type A insulator at 220KV

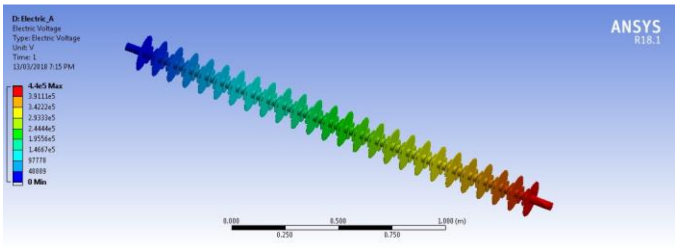


Figure 10 Voltage distribution in type A insulator at 440KV

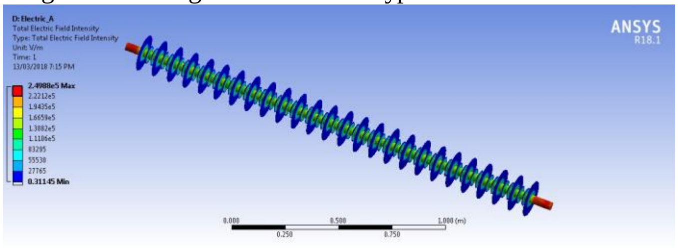


Figure 11 Electric field intensity in type A insulator at 440KV

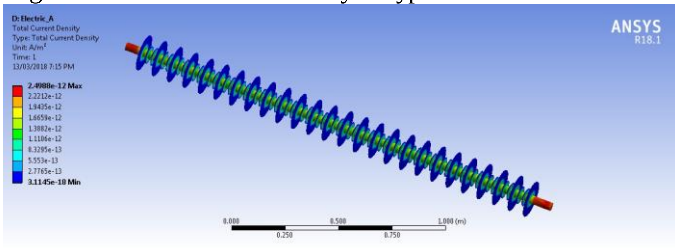


Figure 12 Current density in type A insulator at 440KV

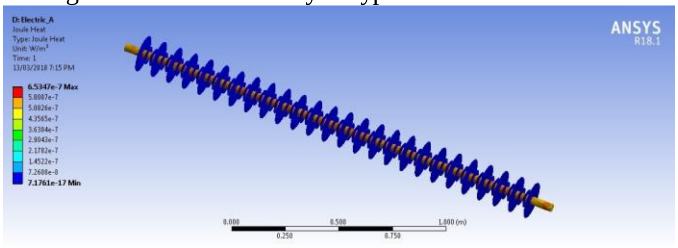


Figure 13 Heat dissipation in type A insulator at 440KV

B. Type B

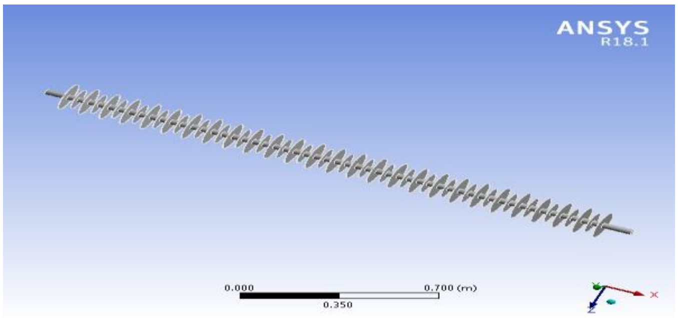


Figure 14 Geometry of Type B insulator

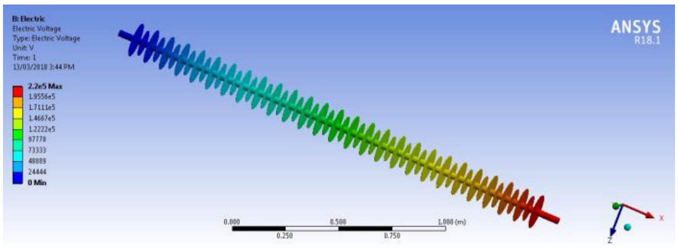


Figure 15 Voltage distribution in type B insulator at 220KV

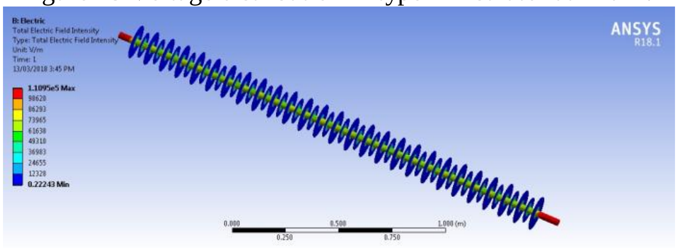


Figure 16 Electric field intensity in type B insulator at 220KV

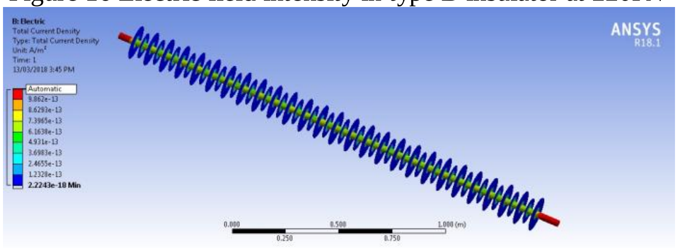


Figure 17 Current density in type B insulator at 220KV

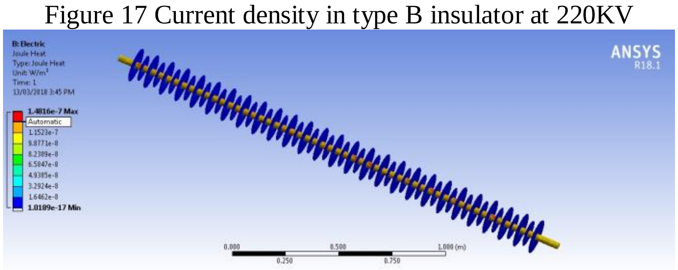


Figure 18 Heat dissipation in type B insulator at 220KV

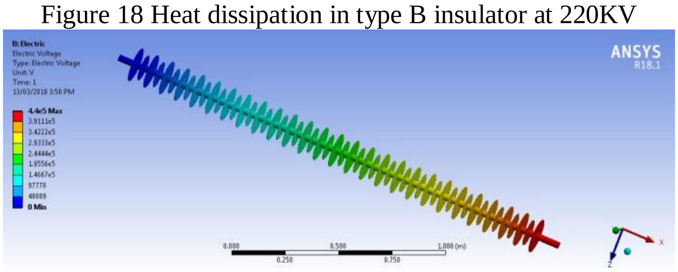


Figure 19 Voltage distribution in type B insulator at 440KV

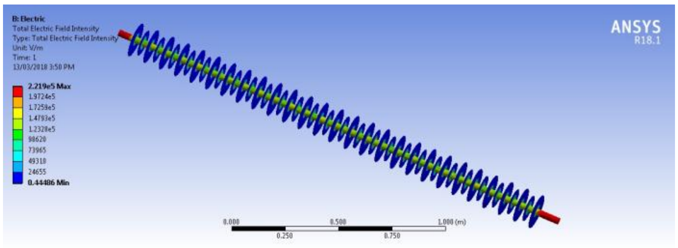


Figure 20 Electric field intensity in type B insulator at 440KV

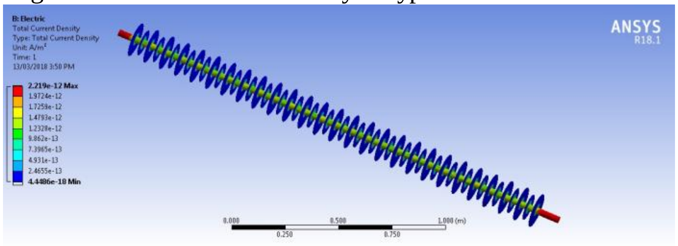


Figure 21 Current density in type B insulator at 440KV

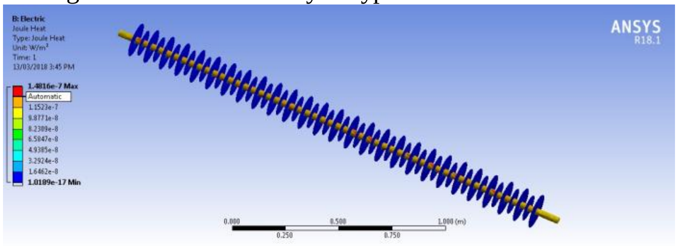


Figure 22 Heat dissipation in type B insulator at 440KV

C. Type C

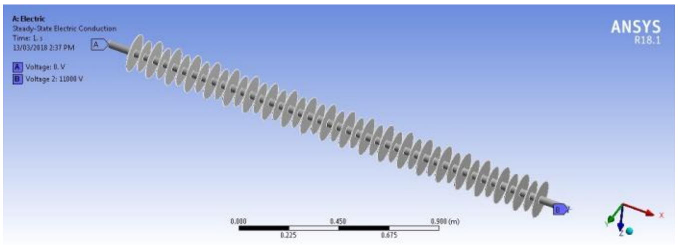


Figure 23 Geometry of Type C insulator
220KV

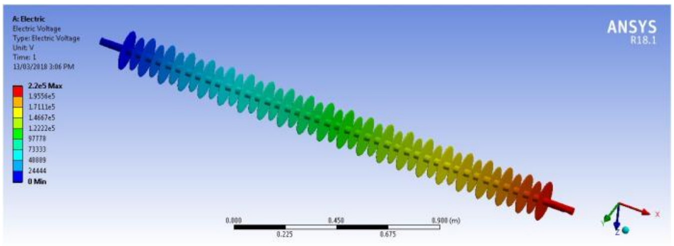


Figure 24 Voltage distribution in type C insulator at 220KV

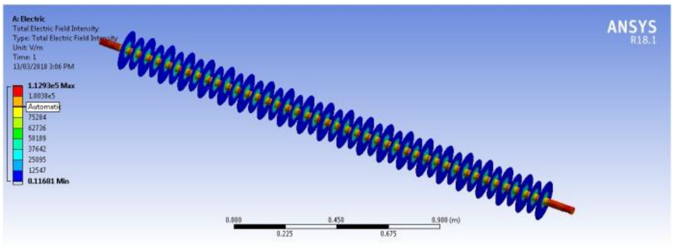


Figure 25 Electric field intensity in type C insulator at 220KV

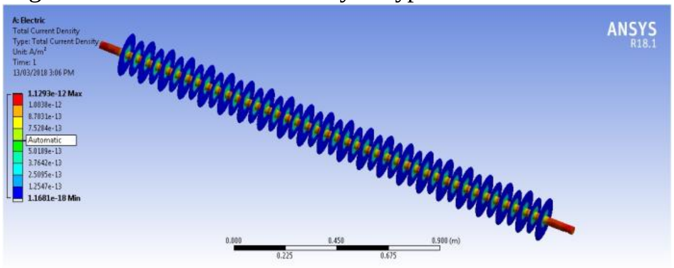


Figure 26 Current density in type C insulator at 220KV

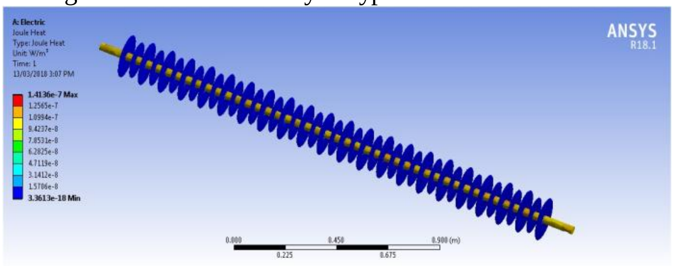


Figure 27 Heat dissipation in type C insulator at 220KV

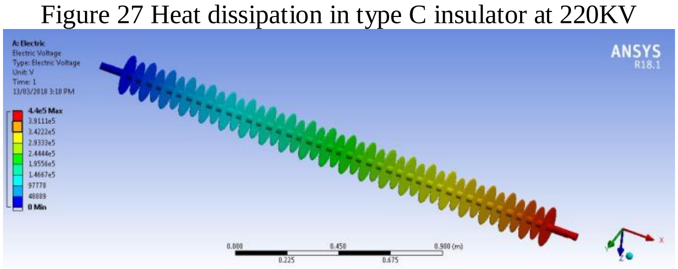


Figure 28 Voltage distribution in type C insulator at 440KV

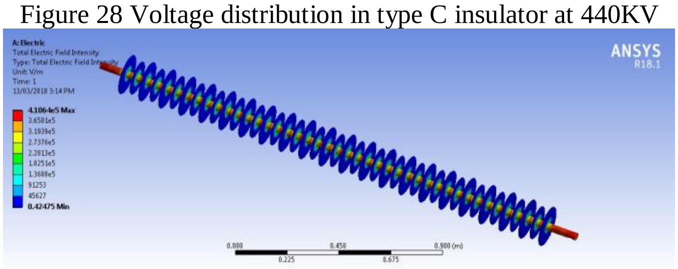


Figure 29 Electric field intensity in type C insulator at 440KV

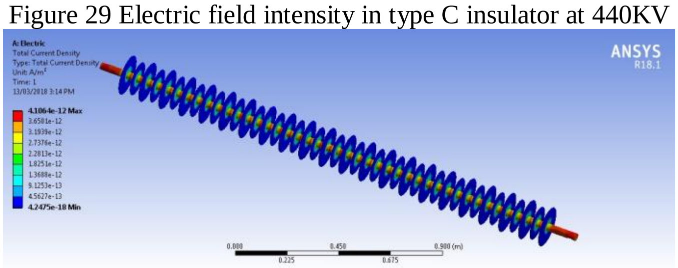


Figure 30 Current density in type C insulator at 440KV

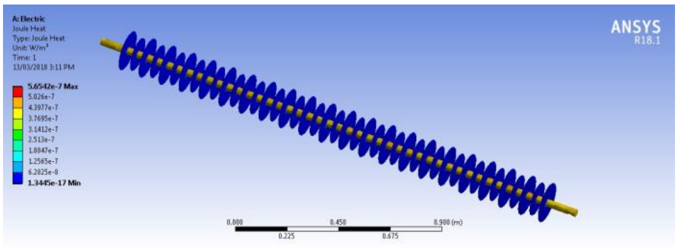


Figure 31 Heat dissipation in type C insulator at 440KV

D. Type D

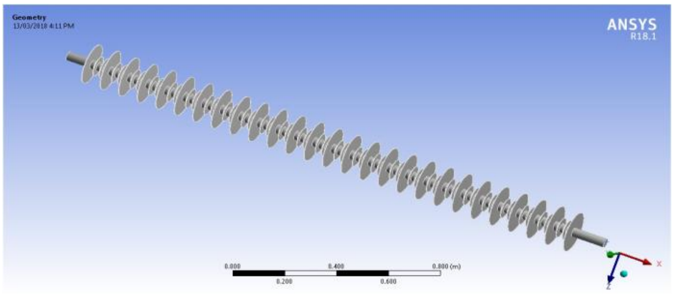


Figure 32 Geometry of Type D insulator

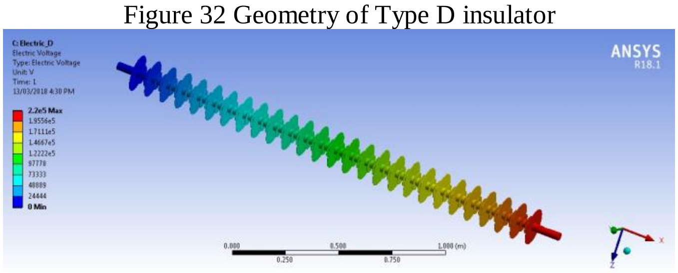


Figure 33 Voltage distribution in type D insulator at 220KV

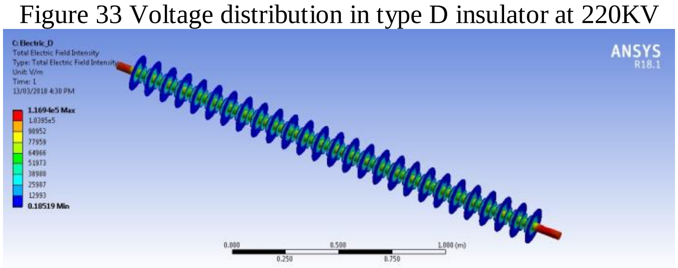
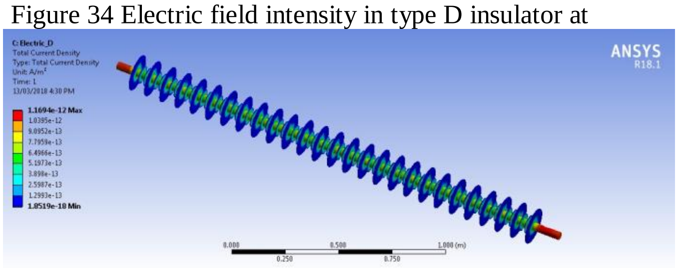


Figure 34 Electric field intensity in type D insulator at



220KV

Figure 35 Current density in type D insulator at 220KV

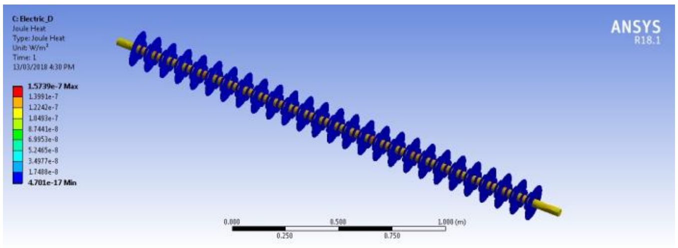


Figure 36 Heat dissipation in type D insulator at 220KV

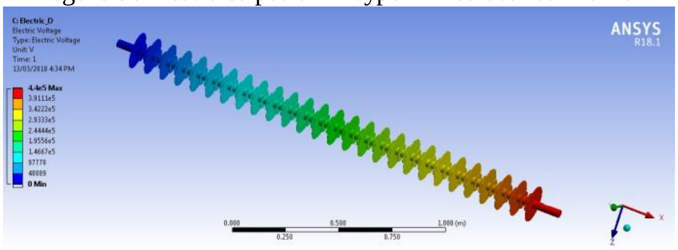


Figure 37 Voltage distribution in type D insulator at 440KV

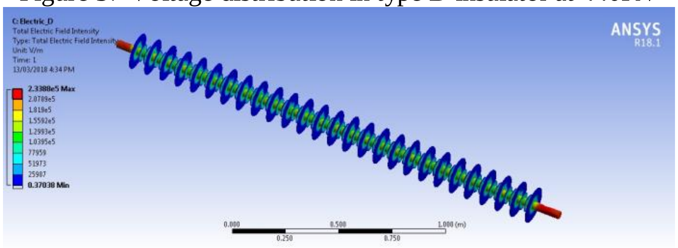


Figure 38 Electric field intensity in type D insulator at 440KV

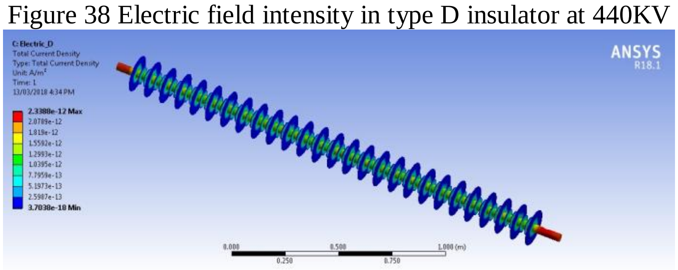


Figure 39 Current density in type D insulator at 440KV

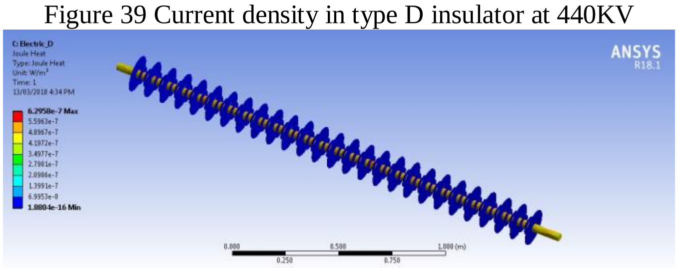


Figure 40 Heat dissipation in type D insulator at 440KV

IV. DISCUSSION OF RESULTS

Type A, B, C and D insulators are simulated at voltage 220KV and 440KV and results obtained are shown in above figures. In every simulation the bottom most part of the insulator is put on maximum voltage (220KV or 440KV) and top most part of the insulator is maintained at ground potential. The results that obtained for each type of insulators are voltage distribution, electric field intensity, current density and heat dissipation at 220KV and 440KV. From the figures of the voltage distribution of each insulator it can be seen that as we move from bottom to top of the insulator voltage is gradually decreasing. The electric field intensity of each insulator is also shown in above figures from which it can be observed that the field intensity is high at both ends of the insulator and equal in rest of the rod of the insulator. This is due to the capacitance effect and electric field intensity in the rod indicate the leakage current which is also observed in the figures of current density in insulators. This leakage current is very small and it can be ignored. Due to this leakage current there will be heat dissipation due to the high resistivity of silicon rubber which is also simulated and show in above figures.

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