# EEP3060

## Power Engineering

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**Inductance and Capacitance Calculation**

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**By:**



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## Contents

# 1 Objective

To simulate the transmission line tower and determine the voltage regulation and efficiency.

# 2 Introduction

In this experiment, we analyze two transmission line towers with different load conditions using MATLAB Simulink.

# 3 Parameters of Transmission Line Towers

The parameters of the transmission line towers are as follows:

- Load: 45MW with a power factor of 0.8 lagging.
- Load: 495MW with a power factor of 0.8 lagging.

# 4 Circuit Diagrams for Part A

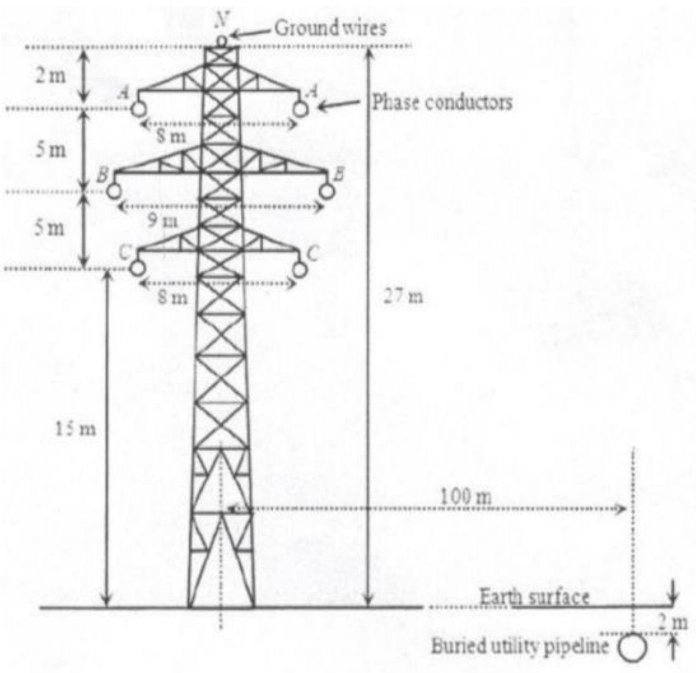



Figure 1: Tower A: 132KV Line, 160 KM Pheasant Conductor

## 4.1 MATLAB Simulink model of Tower A

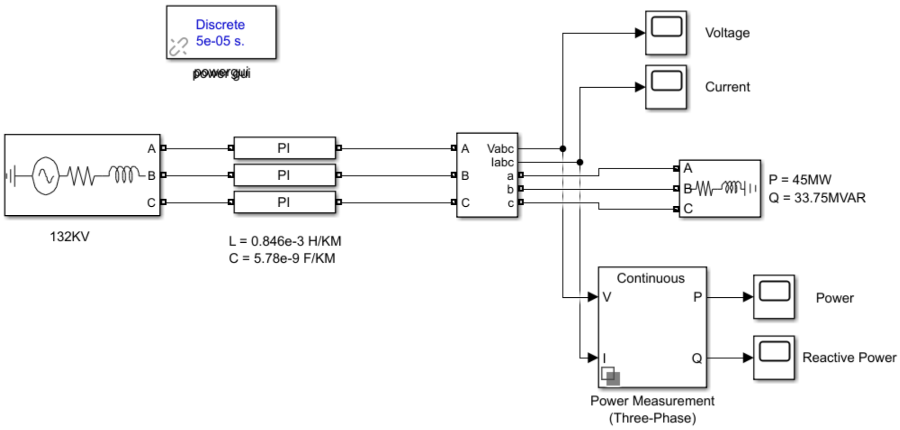


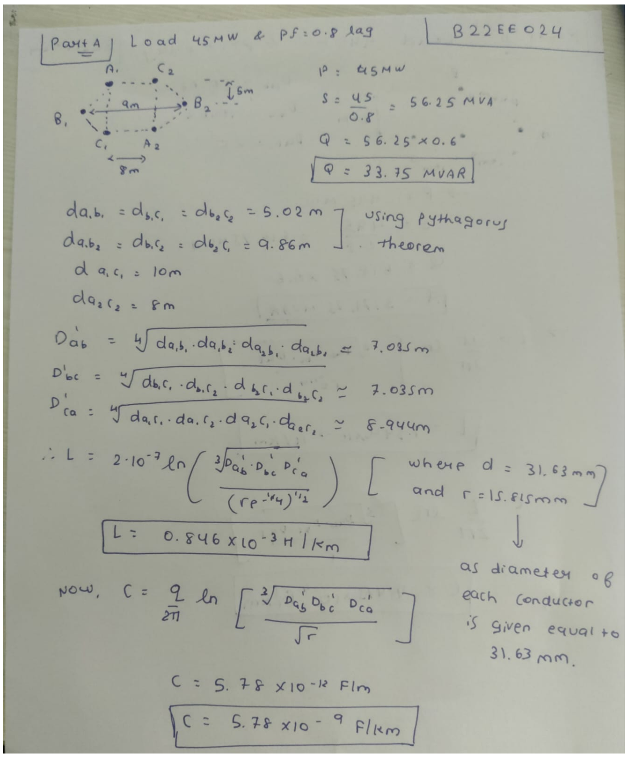

Figure 2: MATLAB Simulink model of Tower A

## 4.2 Conductor Details

| **Type** | **Diameter (mm)** | **Resistance (ohm/km)** |
|---|---|---|
| Phase Conductors | 31.63 | 0.05501 |
| Shield Wires | 12.60 | 0.642 |

Table 1: Conductor Specifications

## 4.3 Calculation for conductor A



Part A | Load 45 MW & pf = 0.8 lag | B22EE024

$P = 45\,MW$

$S = \frac{45}{0.8} = 56.25\ MVA$

$Q = 56.25 \times 0.6$

$\boxed{Q = 33.75\ MVAR}$

$d_{a_1b_1} = d_{b_1c_1} = d_{b_2c_2} = 5.02\,m$

$d_{a_1b_2} = d_{b_1c_2} = d_{b_2c_1} = 9.86\,m$ ] using Pythagorus theorem

$d_{a_1c_1} = 10\,m$

$d_{a_2c_2} = 8\,m$

$D'_{ab} = \sqrt[4]{d_{a_1b_1} \cdot d_{a_1b_2} \cdot d_{a_2b_1} \cdot d_{a_2b_2}} \simeq 7.035\,m$

$D'_{bc} = \sqrt[4]{d_{b_1c_1} \cdot d_{b_1c_2} \cdot d_{b_2c_1} \cdot d_{b_2c_2}} \simeq 7.035\,m$

$D'_{ca} = \sqrt[4]{d_{a_1c_1} \cdot d_{a_1c_2} \cdot d_{a_2c_1} \cdot d_{a_2c_2}} \simeq 8.944\,m$

$\therefore L = 2 \cdot 10^{-7} \ln\left(\frac{\sqrt[3]{D'_{ab} \cdot D'_{bc} \cdot D'_{ca}}}{(re^{-1/4})^{1/2}}\right)$ [ where $d = 31.63\,mm$ and $r = 15.815\,mm$ ]

as diameter of each conductor is given equal to 31.63 mm.

$\boxed{L = 0.846 \times 10^{-3}\ H/km}$

Now, $C = \frac{q}{2\pi} \ln\left[\frac{\sqrt[3]{D'_{ab} D'_{bc} D'_{ca}}}{\sqrt{r}}\right]$

$C = 5.78 \times 10^{-12}\ F/m$

$\boxed{C = 5.78 \times 10^{-9}\ F/km}$

## 4.4 Results for conductor A

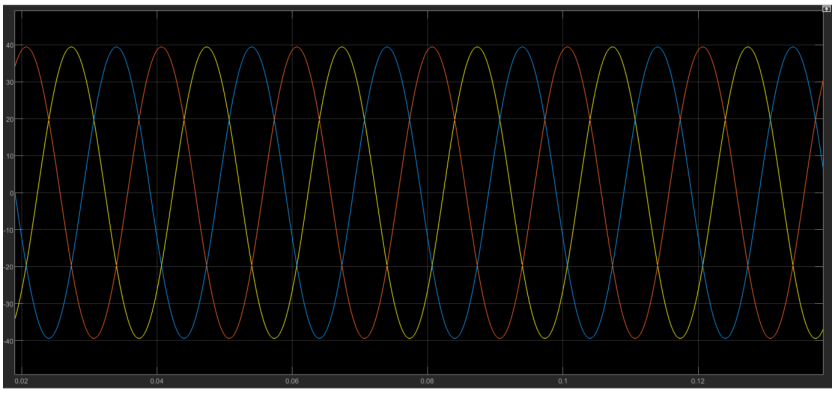



Figure 3: V(voltage)

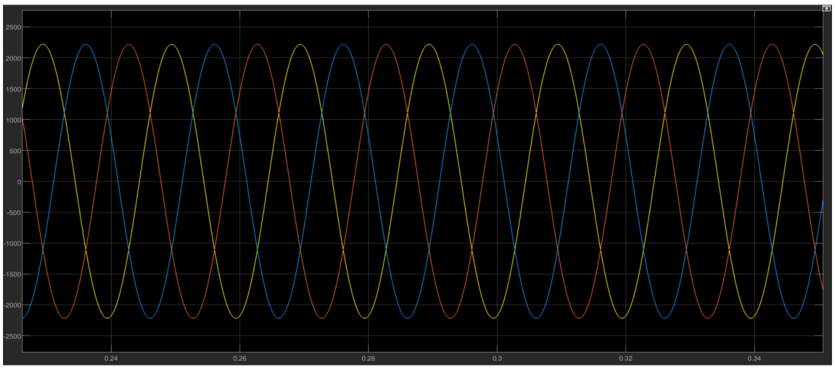


Figure 4: Current(A)

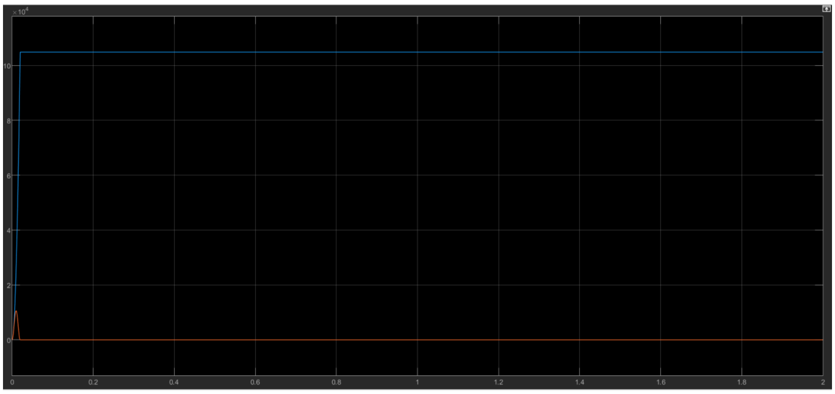


Figure 5: P(Active Power)

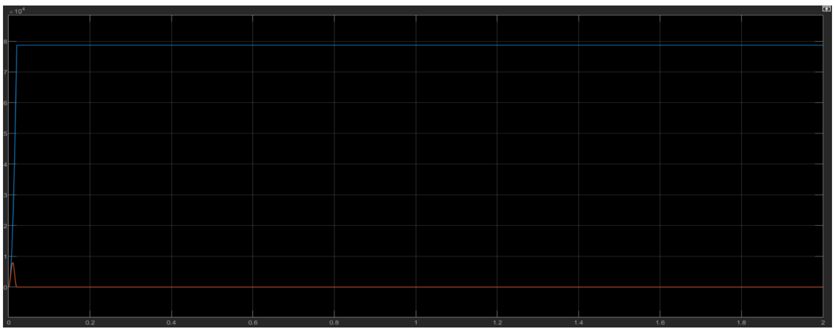


Figure 6: Q(Reactive Power)

## 5 Circuit Diagrams for Part B

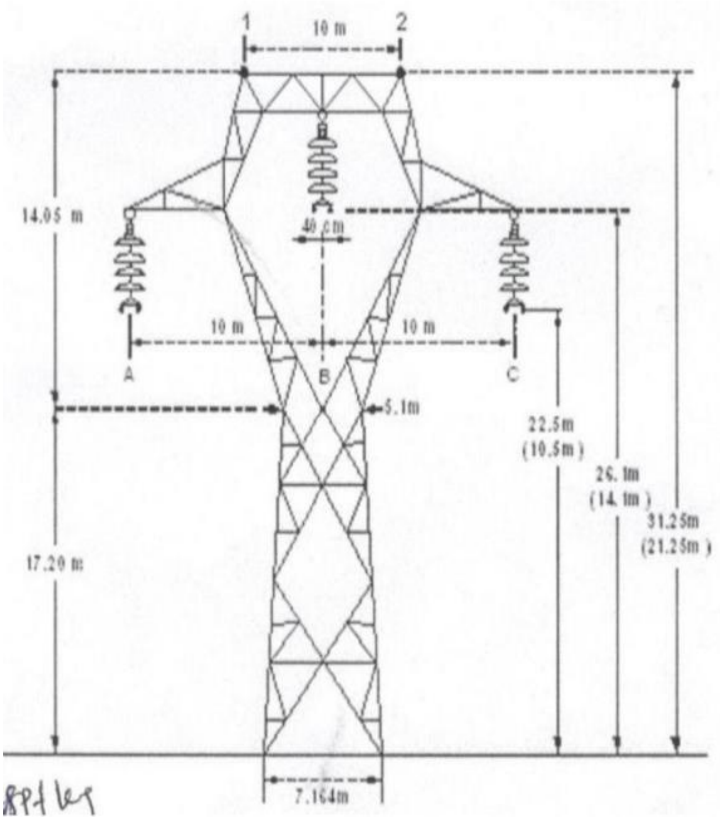



Figure 7: Tower B: 400KV Line, 160 KM

### 5.1 MATLAB Simulink model of Tower B

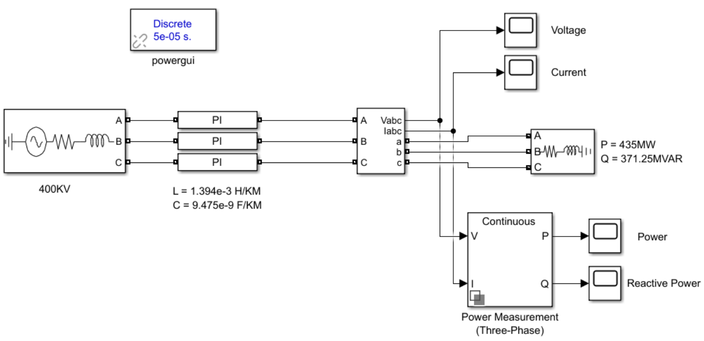
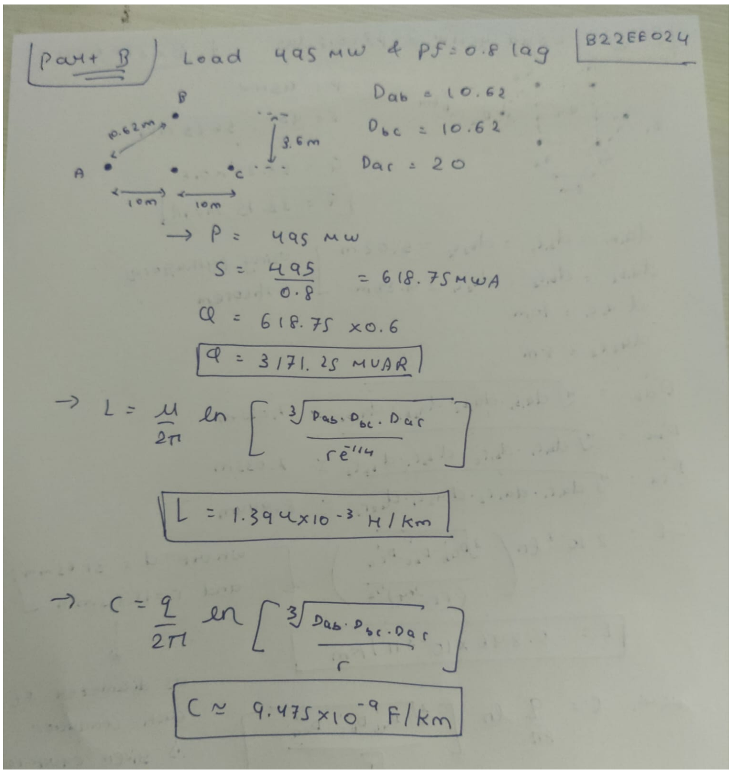



Figure 8: MATLAB Simulink model of Tower B

## 5.2 Calculation for conductor B




## 5.3 Results for conductor B

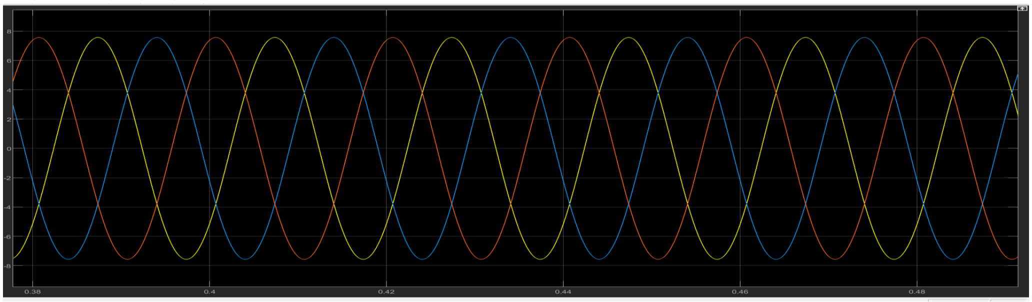


Figure 9: V(voltage)

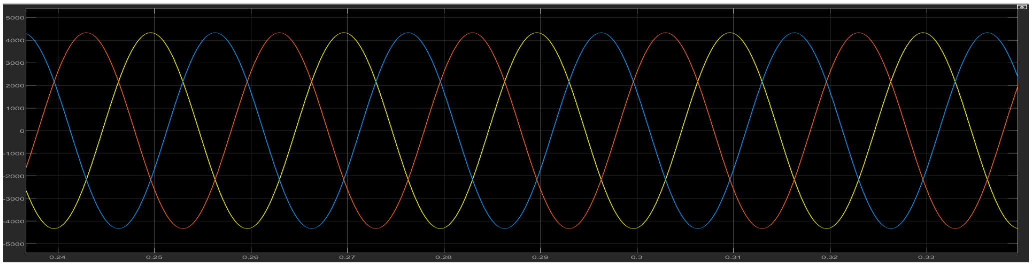


Figure 10: Current(A)

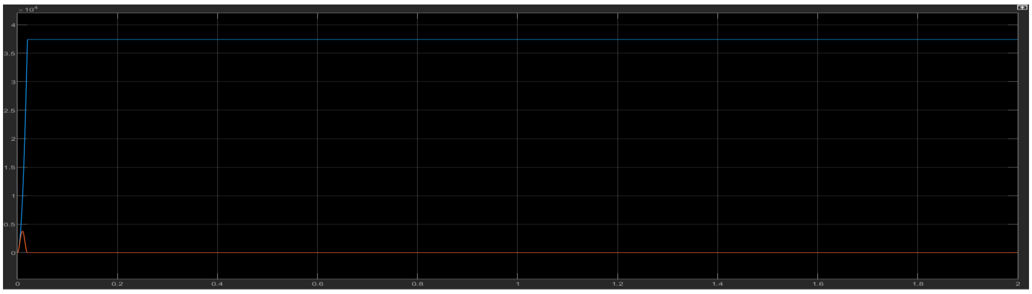


Figure 11: P(Active Power)

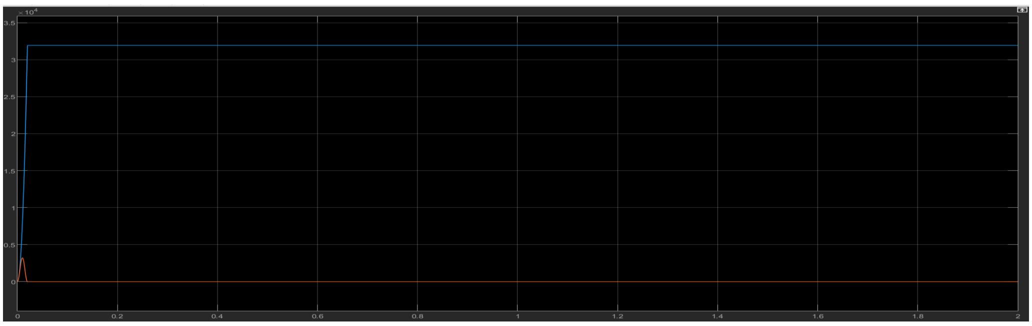


Figure 12: Q(Reactive Power)

## 6 Conclusion

Using MATLAB Simulink, we successfully analyzed the transmission line performance under different load conditions. The results provided insights into the voltage, current, active power, and reactive power for both transmission towers.