UNIT-IV

ELECTRO STATIC FIELD & TRAVELLING WAVE THEORY

Calculation of Electrostatiac field of EHV AC lines

$$\frac{1}{2\pi e_0}[q] = [P]^{-1}[V] - [M][V]$$

where $[q] = [q_1, q_2, q_3, \ldots, q_n]_t$

$[V] = [V_1, V_2, V_3, \ldots, V_n]_t$

$[P] = n \times n$ matrix of Maxwell's Potential coefficients with

$P_{ii} = \ln(2H_i / r_{eq})$ and $P_{ij} = \ln(I_{ij} / A_{ij}), i \neq j$

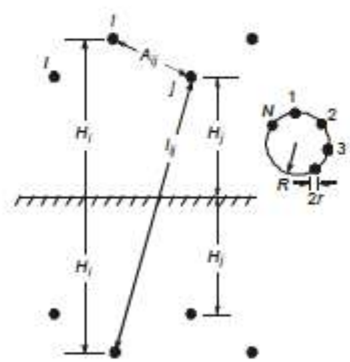

Fig. 7.2 *n*-phase line configuration for charge calculation.

Effect on humans, animals and plants

- (*a*) *Human Beings*
- (*b*) *Animals*
- (*c*) *Plant Life*
- (*d*) *Vehicles*
- (*e*) *Others*

Electrostatic induction in unenergised circuit of double circuit line

- This is a very specialized topic useful for line crew,
- telephone line interference etc. and cannot be discussed at very great length. EHV lines must
- be provided with wide enough right-of-way so that other low-voltage lines are located far enough,or when they cross the crossing must be at right angles.

Travelling wave expression and solution

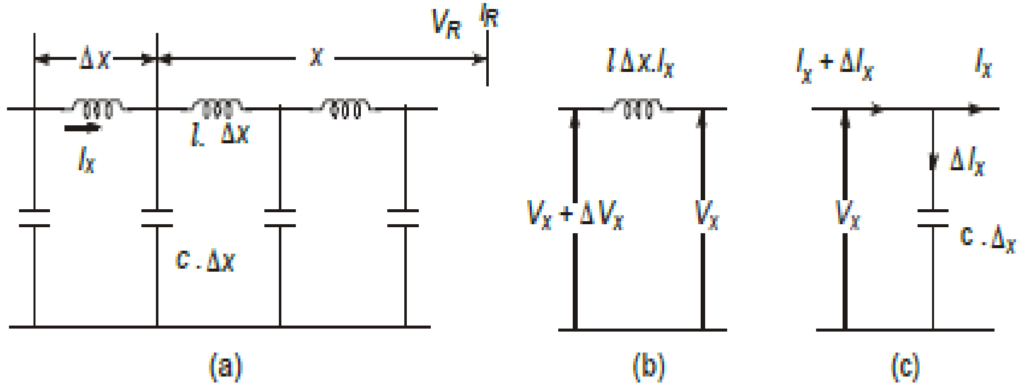

Fig. 8.1 Transmission line with distributed inductance and capacitance.

$$(V_x + \Delta V_x) - V_x = \Delta V_x = (jwl.\Delta x)I_x \qquad ...(8.1)$$

and

$$(I_x + \Delta I_x) - I_x = \Delta I_x = (jwc.\Delta x)V_x \qquad ...(8.2)$$

Travelling wave expression and solution

- **General Method of Laplace Transforms**
- These are the general equations for voltage *V* and current *I* at any point *x* on the line in
- operational forms which can be applied to particular cases as discussed below.
- *Line Terminations* For three important cases of termination of an open-circuit, a short circuit and $Zt = Z0$,the special expressions of equations (8.19) and (8.20) can be written.

Source of excitation, Terminal conditions

t	T	$2T$	$3T$	$4T$	$5T$	$6T$	$7T$	$8T$	$9T$...
V_0	$2V$	$2V$	0	0	$2V$	$2V$	0	0	$2V$...

A plot of the open-end voltage is shown in Fig. 8.4(*a*) from which it is observed that

(1) the voltage reaches a maximum value of twice the magnitude of the input step,

(2) it alternates between $2V$ and 0, and

(3) the periodic time is $4T$, giving a frequency of $f_0 = 1/4T$.

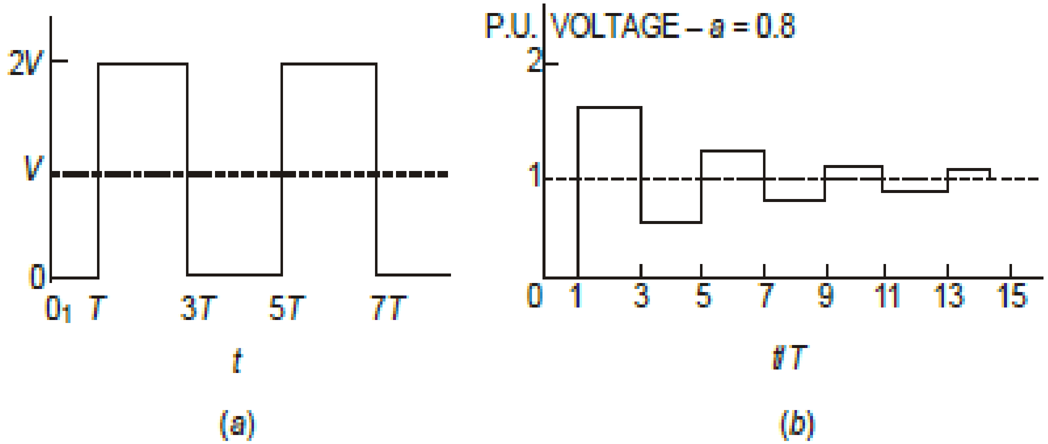

Fig. 8.4 Step response of transmission line. (*a*) Losses neglected. (*b*) Losses and attenuation included

Open circuited and short circuited end, Reflection and refraction coefficients

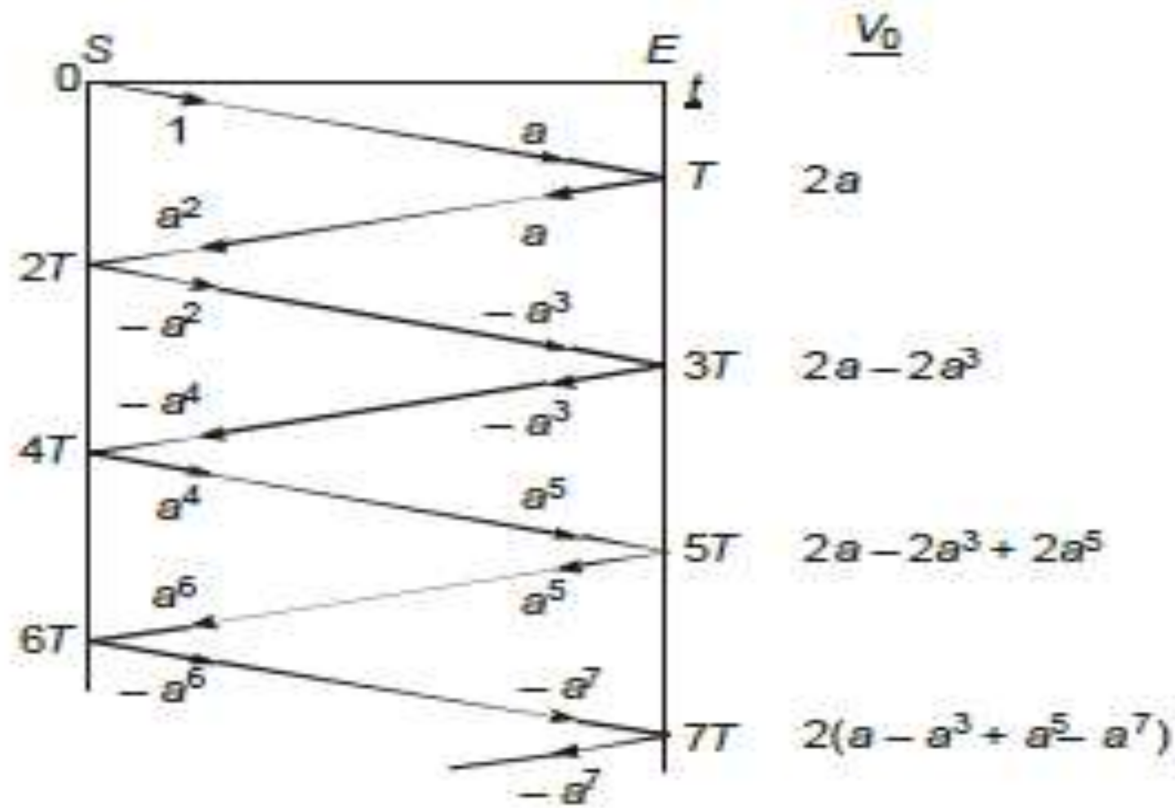

Fig. 8.5 The Bewley Lattice Diagram.

Lumped parameters of distributed lines generalized constants

No load voltage conditions and charging current