FACULTY OF ENGINEERING & TECHNOLOGY

Electrical Machine-ii

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Necessity of Starters / NEED FOR STARTING

- As it is seen that a 3 phase induction motor has positive finite starting torque 'T' when slip s=1. this mean that 3-pahse induction motor is a self-starting motor and begins to rotate on its own when connected to a 3-phase supply.

- At the instant of starting 3-phase induction motor behaves like a transformer with a short-circuited secondary.

- Consequently, a 3-pahse induction motor takes high starting current if started at full voltage. In order to limit this high starting current to reasonable limits starting methods are used.

Methods of Starting

- There are primarily two methods of starting the induction motor:-
  a) Full voltage starting.
  b) Reduced voltage starting.
- Full voltage starting methods consist of:-
  a) DOL (Direct-on-line starting)
- Reduced voltage starting consist of:-
  a) Stator resistor (or reactor) starting.
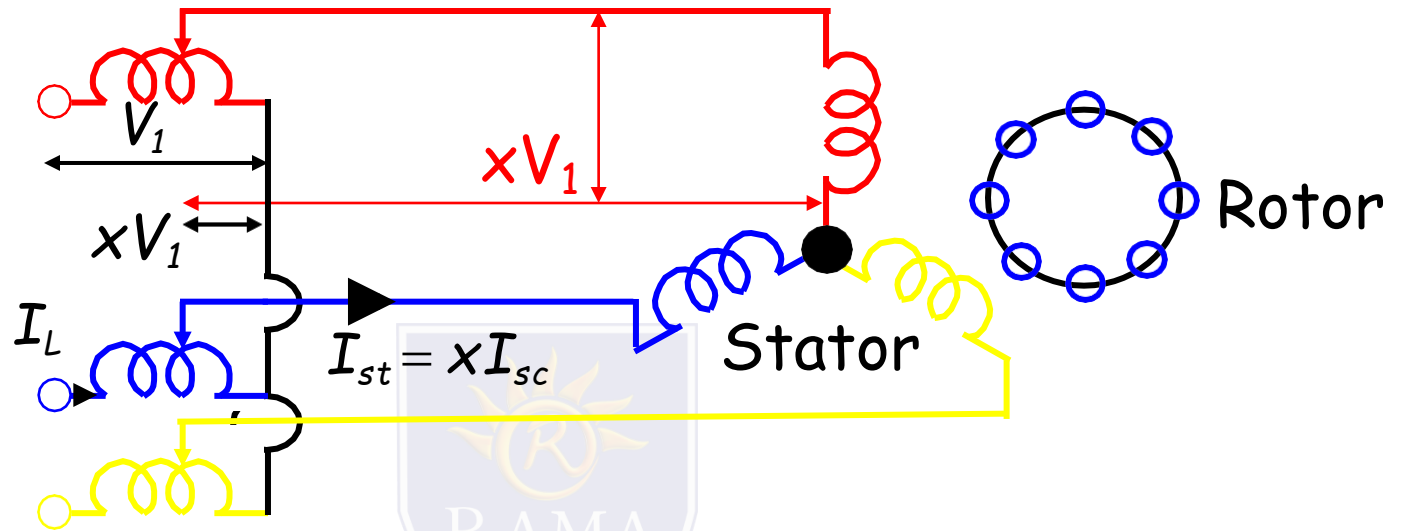 b) Auto-transformer starting.
 c) Star-delta starting.
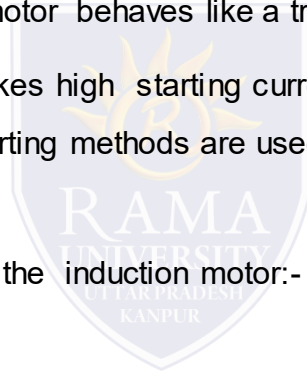
Fig: Auto-transformer starting

The fraction of xV_1 is applied to the stator wdg at starting. As speed increases, gradually voltage is increased Finally full voltage is applied to the motor

Advantages   1. Voltage is changed by transformer action and not by dropping voltage as that of reactor

2. So power loss and input current are less.

Fig: Auto-transformer starting
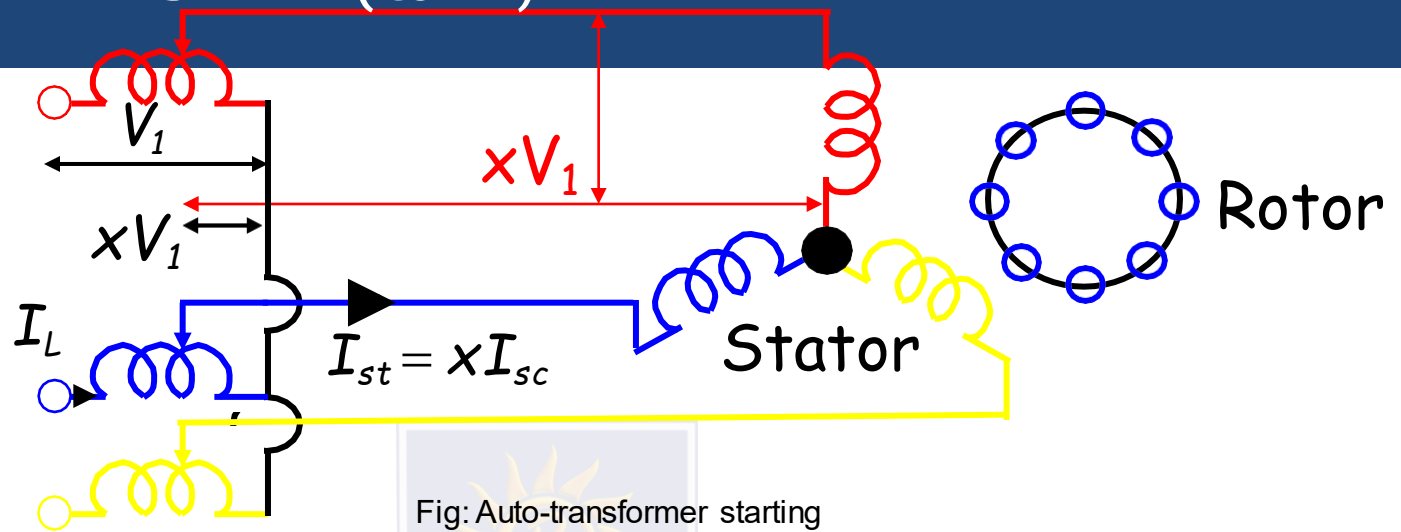
The stator starting current is

$$I_{st} = xV_1 / z_1 = xI_{sc}$$

For auto-transformer, input VA = output VA
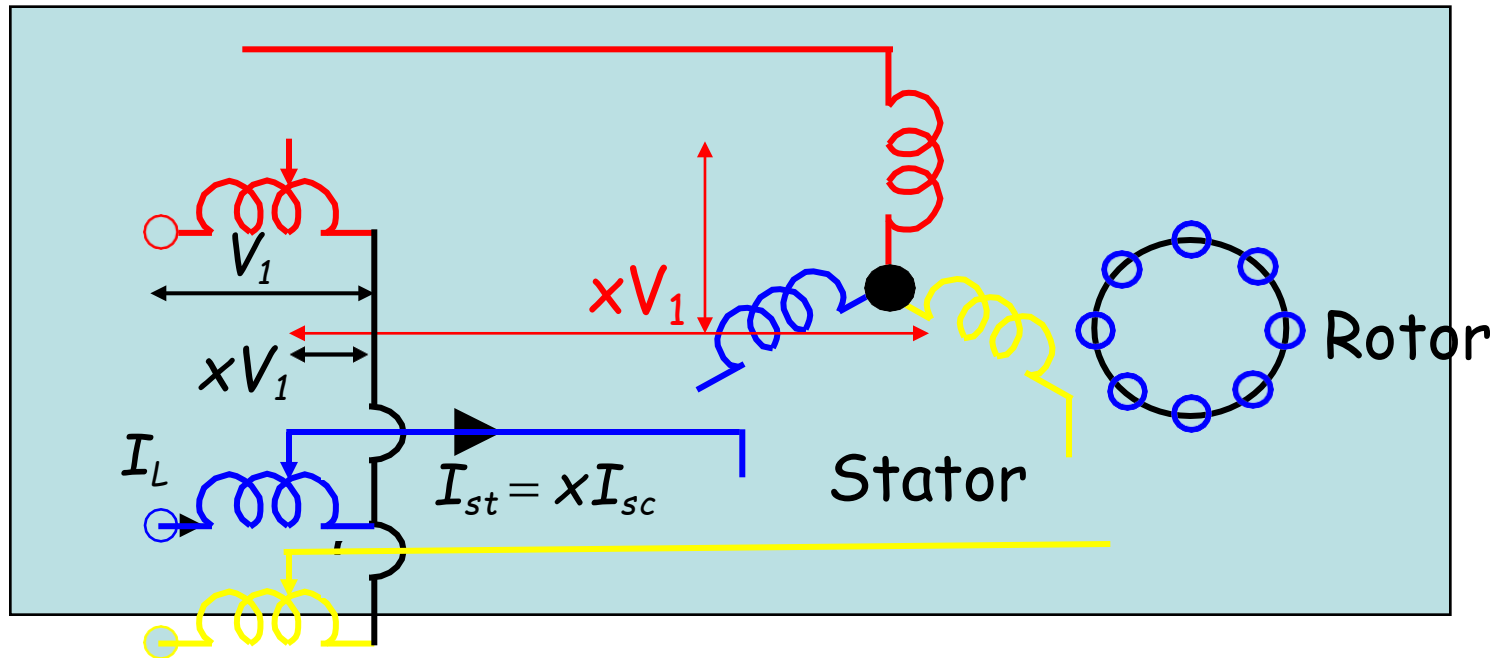
$$I_L V_1 = I_{st}(xV_1)$$

Therefore, line current at

$$I_L = xI_{st}$$

input is x^2 times the DOL current.

$$I_L = x^2 I_{sc}$$

Thus,

$$\frac{T_{est}}{T_{efl}} = \left(\frac{I_{1st}}{I_{1fl}}\right)^2 s_{fl} = x^2 \left(\frac{I_{sc}}{I_{fl}}\right)^2 s_{fl}$$

$$\frac{\text{Line current at input due to auto-transformer starting}}{\text{Line current at input due to stator reactor starting}} = x$$

$$\frac{\text{Line current at input due to auto-transformer starting}}{\text{Line current at input due to stator reactor starting}} = X$$

$$\frac{\text{Starting torque with auto transformer starting}}{\text{Starting torque with stator reactor starting}} = 1$$

$$\frac{\text{Starting torque with auto transformer starting}}{\text{Starting torque with DOL starting}} = x^2$$