Review of Sag Calculation and It's Important in Electrical Engineering

Mr.G.D.Khadsane
Assistant Professor
R.C.P.P. Shirpur, Maharashtra, India

Abstract— In Electrical Engineering sag are very important because of its advantages and its necessary to keep all Electrical components and tower at safe whatever may be weather condition. Most of people are not aware about sag so this paper will be helpful to understand concept in easy way with modern impact of calculation of sag.

Key words: Sag-Tension, Overhead Conductor, Span Length

I. INTRODUCTION

Basically Sag are found when we see longer route transmission line but most of people don't understand its important and history behind keeping this sag to transmission line.

A. Definition of Sag:-

The Sag is nothing but difference between two tower and lower point on conductor.

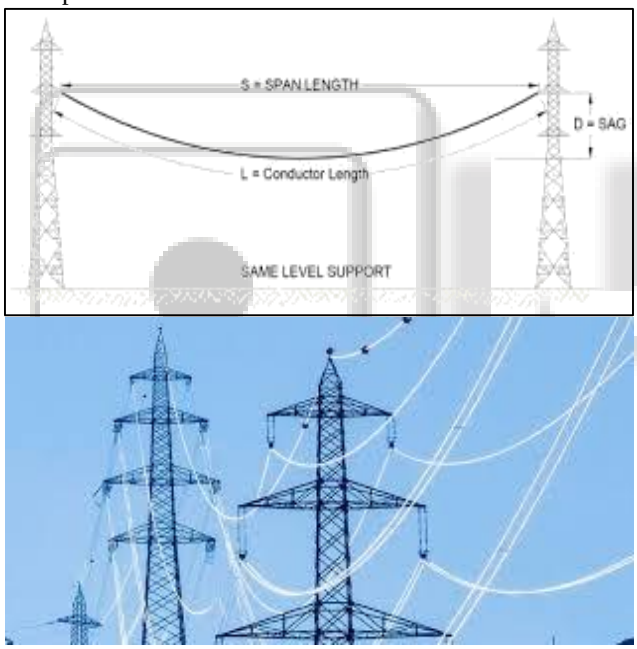

Fig-A-Sag in Transmission Line

II. WHY WE NEED TO KEEP SAG IN TRANSMISSION LINE..?

There is a lot of reason to keep sag in power transmission line of Longer and medium distance but most of are follows:

1) It provides safety to tower and conductor.
2) It reduces excessive stress on conductor.
3) In order to provide safe tension in conductor, it should not be fully stretched and allow sag.
4) If conductor is fully stretched then there may be chances to break conductor because of continuous stress and wind pressure on it.

A. Important points in Sag

– When same level two support hold conductor then bend are formed in conductor due to its weight. Sag are very small with span between two tower.
– Sag is look like parabolic curve.
– Tension on conductor act tangentially.
– Tension at support is nearly eaqual to tension at any point of conductor.

B. Process to calculate Sag

There is two method to calculate sag

1) When support are Equal.
2) When support are Unequal.

1) When support are Equal.

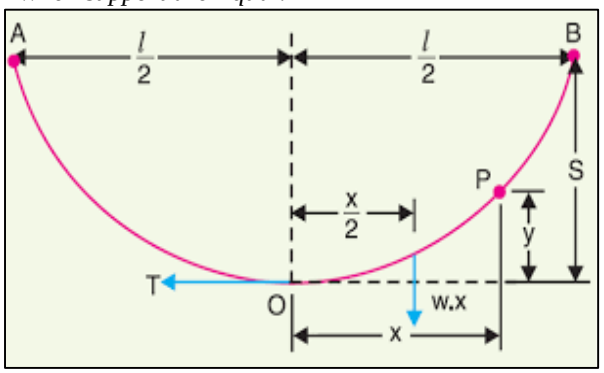

Fig-B-Sag in Equal support systems

Let AOB is conductor, point O is lowest point and midpoint of conductor.
L-length of span
w-weight of conductor.
T-tension on conductor, choose any point on conductor say point P,Then distance of P from lowest point O is x and height is y from point O to point P. Equating two forces we get,

$T_y = wx \times \frac{x}{2}$

If $y=\frac{wx^2}{2T}$ where y=s and x=L/2

Then

$$\text{Sag}(S)=WL^2/8T$$

2) When support are Unequal.

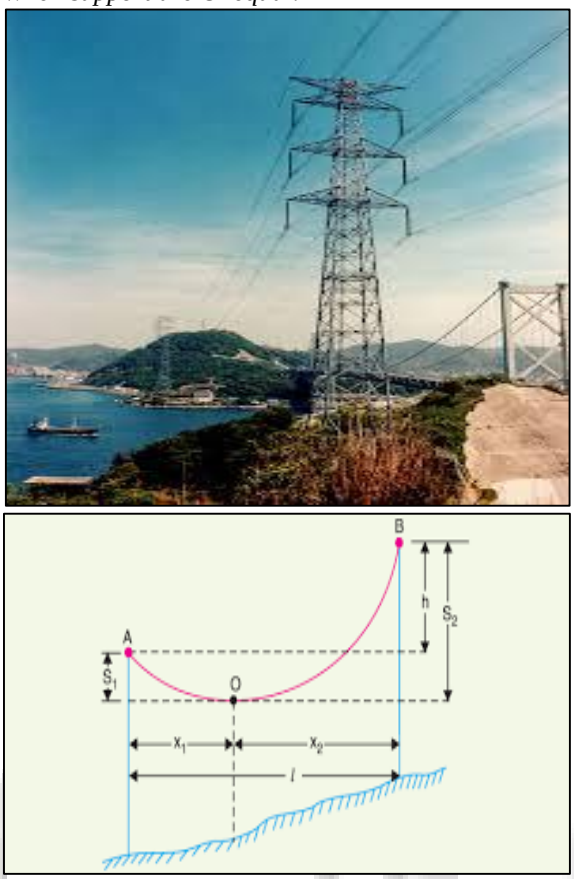

Fig-C -Sag in Unequal support systems

Let AOB are conductor and O is
Mid- point on conductor which is unequal-Span of conductor, h-difference in height of two tower.
X1-distance of support at lower level point A from O and X2 is distance of support at upper level point B from O.
T is tension on conductor.
w-weight of conductor then
sag (S_1)=$wx^2_1/2T$
and Sag (S_2)=$wx^2_2/2T$
Also $x_1+x_2=L$…….. Equation no-1
Now $S_2-S_1=w/2T(x^2_2-x^2_1)$
$=w/2T(x_2-x_1)(x_2+x_1)$
So $S_2-S_1=wL/2T(x_2-x_1)$
Again $S_2-S_1=h$
So $h=wL/2T(x_2-x_1)$
Or
$(x_2-x_1)=2Th/wL$……Equation no-2
By solving equation 1 and 2
We get,
$x_1=(L/2)-(Th/wL)$
And $x_2=(L/2)+(Th/wL)$
So from above by putting value of X1 and X2 we can calculate sag of Unequal support.

C. Atmospheric Effect on Sag

1) Weight of conductor get changes when wind blows at certain forces on conductor and ice deposited on conductor.
2) Ice loading on conductor increases conductor weight vertically downward.
3) Wind increase tension on conductor.
4) High temperature in summer day increases conductor length and Sag.
5) Age is another factor that affect sag.

D. Way of Reducing Excessive Sag.

1) Reduce distance among tower.
2) Raising tower height.
3) Observed sag & it should not be above limit, if it is then re-construction required.
4) Monitoring is easy approach that can manage problem of sag

III. Safety Measures:

Minimum clearance between Electrical Line crossing each other as per Indian Electricity Rule

Voltage	Clearance between two line
66kv	2.4meter
132kv	3meter
220kv	4.5 meter
400kv	5.4meter

Minimum clearance between Electrical Line crossing and High way Road.

Voltage Level	Ground Clearance	Over NH
66KV	6.1Meter	8 Meter
132kv	6.1Meter	8.6Meter
222kv	7 Meter	9.8Meter
400kv	8.8Meter	10.8Meter

Minimum clearance between Electrical Line crossing Telephone Line

Voltage Level	Ground Clearance
66KV	2.4Meter
132kv	2.7Meter
220kv	3 Meter

Minimum clearance between Electrical Line crossing Railway track.

Voltage Level	Ground Clearance
66KV	14Meter
132kv	14.6Meter
220kv	15.4Meter
400kv	17.9Meter

References

[1] Electrical Engineering portal, Electrical safety standard in india
[2] Oluwajobi F. I., Ale O. S. and Ariyanninuola A Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 3 (4): 627-630. Effect of Sag on Transmission Line
[3] Electrical power system by V.K.Mehta
[4] www.Electrical4u.com
[5] Electricalbaba.com
[6] Power System Analysis by John Grainger,William Stevenson Jr.
[7] Ramachandran, P.; Vittal, V. On-line monitoring of sag in overhead transmission lines with leveled spans. In Proceedings of the 38th Annual North American Power Symposium (NAPS 2006), Carbondale, IL, USA, 17–19 September 2006; pp. 405–409

[8] IEEE. IEEE 738-2012 Standard for Calculating the Current—Temperature Relationship of Bare Overhead Conductors; IEEE Power and Energy Society: Piscataway, NJ, USA, 2012
[9] Balangó, D.; Németh, B.; Göcsei, G. Predicting conductor sag of power lines in a new model of dynamic line rating. In Proceedings of the IEEE Electrical Insulation Conference (EIC), Seattle, WA, USA, 7–10 June 2015

