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DESIGN OF TRANSMISSION LINE WITH USE OF PLS-CADD & MONITORING SAG AND TENSION

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Abstract:
Power is the basic key for growth of any country's economy. The increased demand of electricity, need to optimize the utilization of power generation capacity and increase in the interconnections are the major issues with which power sector is dealing with. Energy consumption per person is also rising tremendously in developing countries. However, installing a new power plant cannot be a solution every time. Dense population, availability of land, initial and installation cost can be the major issues in this case. Huge transfer of power from generating plants to load centre at long distance with bulky transmission lines is causing to upgrade voltage class to Extra High Voltage (EHV) from High Voltage (HV). [1]

Keywords: *PLS-CADD; Monitoring Sag and Tension; Transmission Line.*

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1. Introduction

GPS Survey

It is space based satellite navigation system that provides location and time information in all weather conditions any were on are near the earth where there is unobstructed line of sight to four or more GPS Satellites. Advances in technology and new demands on the existing system have now led to efforts to modernize the GPS system in addition to GPS other systems are in use or under development. The design of GPS is based partly on similar ground based Radio Navigation systems the first Navigation satellite system transit was used by US 1960. GPS is owned and operated by United States as a national resource. The satellites carry very stable atomic clock that are synchronized to each other and to ground clocks A GPS reviver monitors multiple satellites and solves equations to determine the exact position of the receiver and its deviation from true time.

Route Marking

The route of the transmission line shall be recorded using GPS of positional accuracy less than 3m.The co-ordinates of all the angle points as well as other important crossings, landmarks etc. shall be recorded using GPS for easy relocating. At the starting point of the commencement of

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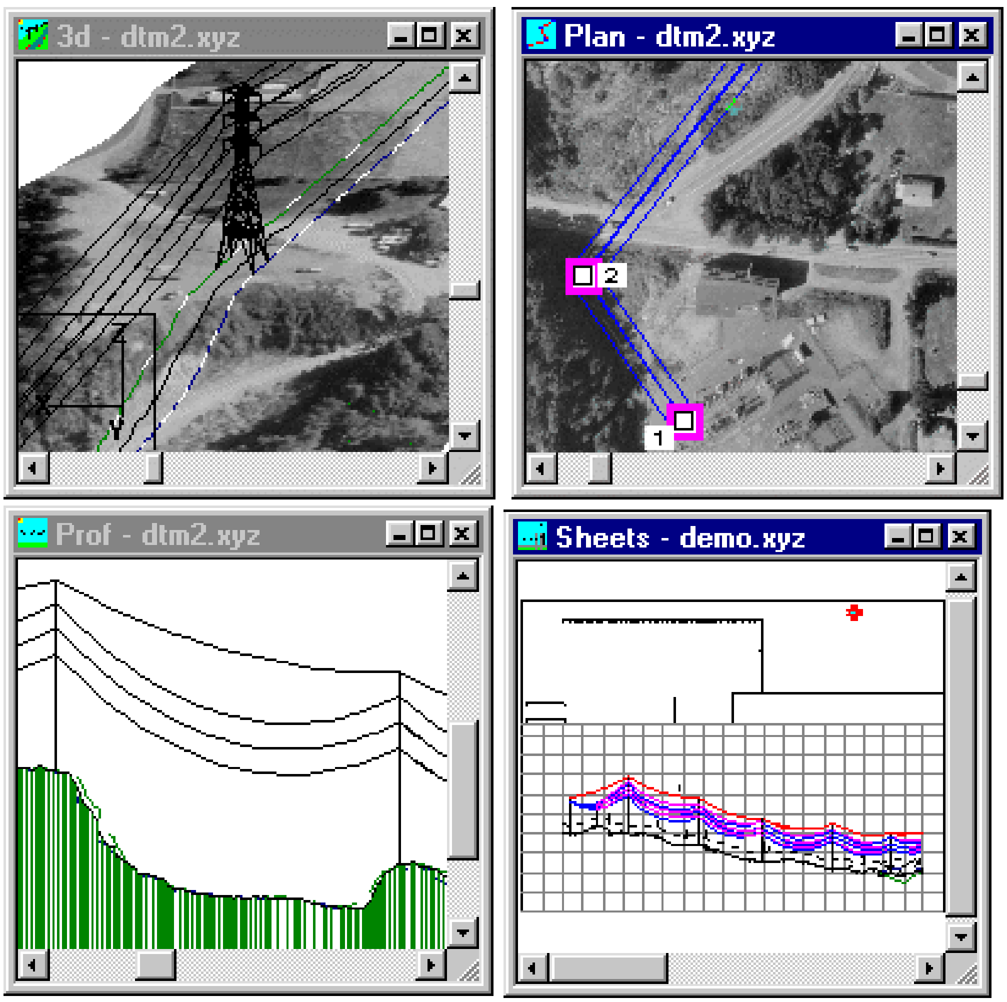
route survey the co-ordinates shall be recoded. The co-ordinates of the location of the survey instrument shall also be recorded.

PLS-CADD™ (Power Line Systems - Computer Aided Design and Drafting)

PLS-CADD is the most powerful overhead power line design program on the market. PLS-CADD runs under Microsoft Windows and features an easy to use graphical user interface. It integrates all aspects of line design into a single stand-alone program with a simple, logical, consistent interface. No other program can match the sophisticated engineering capabilities available in PLS-CADD. This sophistication and integration leads to more cost-effective designs being produced in only a fraction of the time required by traditional methods.

The PLS-CADD solution is so clearly superior to any alternative that it has been adopted by more than 1600 organizations in over 125 countries.



A Three-dimensional model

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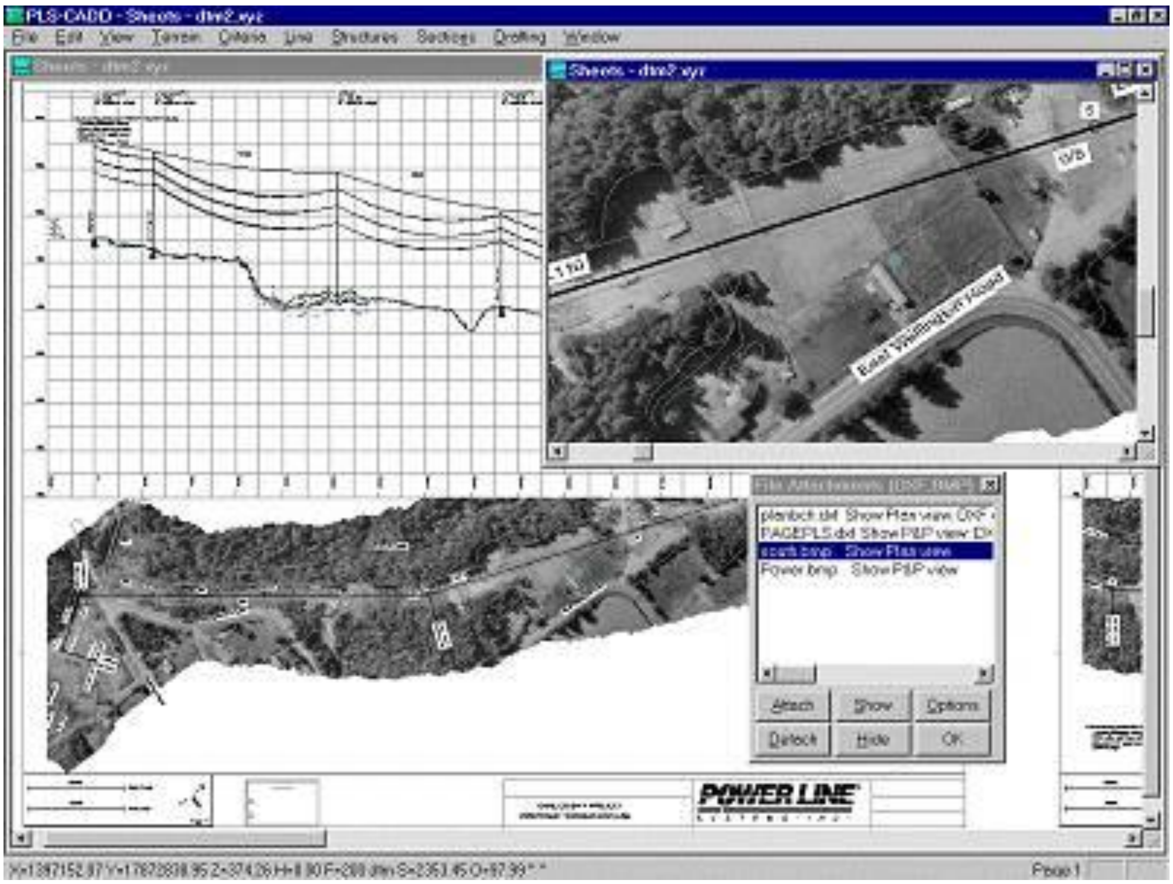
Drafting

PLS-CADD totally automates plan & profile sheet drafting. Your plan & profile sheets are updated real-time as you make changes to your design. With a few keystrokes, these sheets can be plotted to a Windows compatible printer/plotter or they can be imported into your CAD system.Planimetric drawings, aerial photographs, custom drawing borders, title blocks and company logos are all automatically integrated into these drawings. Once again, PLS-CADD adapts to your standards giving you full control over page size, page layout, text size, scales and many other sheet parameters. Customers typically report that PLS-CADD reduces their drafting time by over 95%.



Final Model

SAG Tension Measurement

Sensors in the transmission infrastructure have been primarily used to prevent power system failure and to respond quickly to unexpected events. Sensors are required to be selective in detecting mechanical faults in the transmission line and this characteristic demand that they be calibrated accordingly. Accurate real-time monitoring of sag involves measurement of temperature and tension of the conductor rather than weather based monitoring. Weather based sag monitoring uses anemometers which are quite fragile and prone to measurement errors unless calibrated frequently. More than one monitoring locations are required for long line sections making sensing expensive. Tension based monitoring of sag in suspension spans is done

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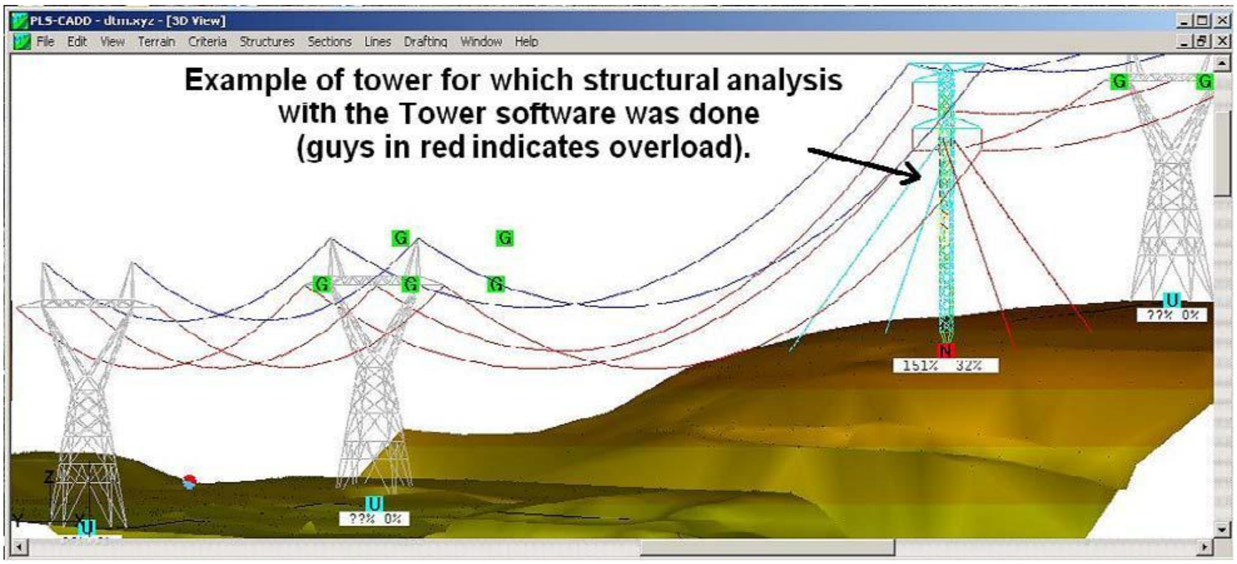
using load cells which get damaged under heavy surges, lightning strikes, vibration and seismic events. Load cells are expensive to purchase and install. The power donut which is used for conductor temperature sensing, monitors surface temperature rather than core temperature.. It requires a target to be placed on the conductor at the point of maximum sag to keep track of the line's position from the ground. It is an expensive method and requires regular maintenance. The direct measurement of sag by mounting of a Global Positioning System (GPS) receiver on the conductor has been proposed but not yet used on a high voltage transmission line.



Sensors in Electrical Transmission Infrastructure

SAG-Tension Measurements

The determination of sags and corresponding tensions for any conductor under various conditions of temperature and loading is of basic importance in transmission line design. This determination enables design elements, such as the most economical span length, to be established and permits the use of sag templates, stringing tables, and other aids. Two general criteria are in use as a basis for making sag and tension calculations:

1) Catenary curve.
2) Parabolic curve.

If a uniform, perfectly flexible and inelastic length of material, such as a conductor, hangs in still air between two fixed supports, it will take the form of a catenary. For the catenary, the mass of the conductor is assumed to be uniformly distributed along the arc of the conductor. The minimum tension in the conductor will be at the lowest point of the arc, and the maximum tension will be at the points of support. The tension at any point in the conductor will consist of two components:

1) Horizontal component which is uniform throughout the length of the conductor.
2) Vertical component which varies along the curve.

This means that the total tension in the conductor will also vary along its length. The vertical component of the tension at the low point of the conductor is zero. If it is assumed that the mass of the conductor is uniformly distributed along a horizontal line between the points of support,

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instead of along the conductor itself, the resultant mathematical equation for the curve of the cable is that of the parabola. The results of the two methods of calculation (catenary and parabola) are almost identical when the sag is small; however, the difference in results becomes increasingly greater as the sag increases. Since longer spans have larger sags, the difference increases as the span length increases.

Given below the case of railway crossing and calculate the sag and tension with the basic span with old and hot condition: -

SAG Calculations at (-)2.5˚ C (Minimum Sag point)

Minimum sag point of the crossing span from location No 01	Formula : b=l/2+Th/wl	
	Where, l=crossing span=194 mt.,Track crossing point =119 mt.	
	T= working tension= 3500 kg	
	h= level difference = 1.8 mt.	
	w = wt. of cond. per meter=1.62 kg	
	A=l/2+Th/wl=194/2+[3500x1.8/1.62X194]	117.05Mtr
Distance between minimum sag point and track crossing point	X=(117-119)	(-)02.00Mtr
Sag at minimum sag point	$S1=wA^2/2T=1.62x(117)^2/2x3500$	3.17 Mtr
Minimum Sag at the crossing point	$S = wX^2/2T = 0.974\ (-44)^2/2x2864$	0.0 Mtr
Minimum sag at the track crossing point in reference to loc No.01	S1-S = 4.03-0.33	3.17 Mtr
Clearance between lowest conductors to B.G. Railway Track		
Height of lowest cross arm above ground level at loc No.01	30.15	Meter
Less the Min. Sag at crossing point.	(-) 3.17	Meter
Level difference between railway track and Loc No 01	(-) 3.0	Meter
Clearance at the crossing point	23.98	Meter

As the result of this calculation the sag point is 23.98 in Hot condition with the railway crossing point.

SAG Calculations at 75˚ C (Maximum Sag point)

Minimum sag point of the crossing span from location No 01	Formula : b=l/2+Th/wl	
	Where, l=crossing span=194mt.,	
	Track crossing point= 119 mt.	
	T= working tension= 1960kg	
	h= level difference = 1.8 mt.	
	w = wt. of cond. per meter=1.62 kg	108.23Mtr

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Distance between minimum sag point and track crossing point	X = (108-119)	(-)11.00Mtr
Sag at minimum sag point	$S1=wb^2/2T=1.62 \text{ X } (108)^2/2x1960$	4.82 Mtr
Minimum Sag at the crossing point	$S= wx^2/2T =1.62 \text{ X } (11)^2/2 \text{ x } 1960$	0.05 Mtr
Minimum sag at the track crossing point in reference to loc No.01	S1-S=4.82-0.05	4.77 Mtr
Clearance between lowest conductors to B.G. Railway Track		
Height of lowest cross arm above ground level at loc No.01	30.15	Meter
Less the Min. Sag at crossing point.	(-) 4.77	Meter
Level difference between railway track and Loc No 01	(-) 3.0	Meter
Clearance at the crossing point	22.38	Meter

As the result of this calculation the sag point is 22.38 in Hot condition with the railway crossing point. Sag in the spans increase with increase in conductor temperature. In case 1 to case 2, a maximum change of 1.60 mtr is observed in the sag for a conductor temperature increase from -2.5ºc to 75ºc.

2. Conclusions

The new possibilities of analysis for typical engineering problems were presented, and the procedures suggested for the practical implementation of this technique were detailed. The integrated use of the two software's offers an important upgrade in the possibilities of engineering analysis for the design of TLs. It allows a quick check and optimizes the calculation of forces and moments for the design of tower foundations. All the calculations were done under the requirements of existing standards, also taking into account updated wind mappings and reviewed design criteria

3. Future Work

In future we also keep in mind, the effects of magnetic, electric field, and electromagnetic field on human life, animal life, and plant life. Also elucidates on the methods to reduce the adverse effects caused by these fields. There are many supporting documents and research papers in favour of and against the harmful effects of these high voltage transmission lines. Therefore, there is a controversy discussion regarding these effects, involving government regulation policy and power companies.

References

[1] Robert E. Nickerson, P. E., Electrical Transmission Line and Substation Structures-Structural reliability in a changing world, Proceedings of the Electrical Transmission Conference, Birmingham. Alabama, October 15-19, 2006.
[2] Poorani Ramachandran, Vijay Vittal and Gerald T. Heydt, "Mechanical state estimation for overhead transmission lines with level spans," IEEE Transactions on Power Systems, vol. 23, no. 3, pp. 908-915, August 2008.

 ISSN: 2454-1907
DOI: 10.5281/zenodo.914840

[3] U.S. – Canada power system outage Task Force, Final report on the august 14, 2003 black-out in the United States and Canada: Causes and Recommendations, April 5, 2004, [Online] (Date Accessed: November 2008),

[4] Interim report of the investigation committee on the September 28, 2003 blackout in the Italy, UCTE, October 27, 2003, [Online] (Date Accessed: November 2008), Available at: http://www.aei.it/ucte_fulltext.pdf

[5] Hongbiao Song and Mladen Kezunovic, "A new analysis method for early detection and prevention of cascading events," Electric Power System Research, vol. 77, no. 8, pp 1132-1142, June 2007.

[6] Application Notes, "Working with finite element multi-span sag-tension in PLS-CADD," Power Line Systems Inc., Madison, Wisconsin.

[7] Dale A. Douglass and Abdel-Aty Edris, "Field studies of dynamic thermal rating methods for overhead lines," IEEE Transmission and Distribution Conference, vol. 2, pp. 842-851,

[8] "A Primer on Electric Utilities, Deregulation, and Restructuring of U.S. Electricity Markets"] Check |url= value (help) (pdf). United States Department of Energy Federal Energy Management Program (FEMP). May 2002. Retrieved December 27, 2008.

[9] Hans Dieter Betz, Ulrich Schumann, Pierre Laroche (2009). Lightning: Principles, Instruments and Applications. Springer, pp. 202–203. ISBN 978-1-4020-9078-3. Retrieved on 13 May 2009.

[10] Thomas P. Hughes (1993). Networks of Power: Electrification in Western Society, 1880–1930. Baltimore: Johns Hopkins University Press. pp. 119–122. ISBN 0-8018-4614-5.

[11] Guarnieri, M. (2013). "The Beginning of Electric Energy Transmission: Part One". IEEE Industrial Electronics Magazine. 7 (1): 57–60. doi:10.1109/MIE.2012.2236484.

[12] National Council on Electricity Policy. "Electricity Transmission: A primer" (pdf).

[13] Guarnieri, M. (2013). "The Beginning of Electric Energy Transmission: Part Two". IEEE Industrial Electronics Magazine. 7 (2): 52–59. doi:10.1109/MIE.2013.2256297.

[14] Great Barrington 1886 - Inspiring an industry toward AC power.

[15] ethw.org - William Stanley, Jr.

[16] Arnold Heertje, Mark Perlman Evolving Technology and Market Structure: Studies in Schumpeterian Economics, page 138

[17] Carlson, W. Bernard (2013). Tesla: Inventor of the Electrical Age. Princeton University Press. ISBN 1-4008-4655-2, page 130

[18] Jonnes, Jill (2004). Empires of Light: Edison, Tesla, Westinghouse, and the Race to Electrify the World. Random House Trade Paperbacks. ISBN 978-0-375-75884-3, page 161.

[19] Parke Hughes, Thomas (1993). Networks of Power: Electrification in Western Society, 1880-1930. JHU Press. pp. 120–121.

[20] Garud, Raghu; Kumaraswamy, Arun; Langlois, Richard (2009). Managing in the Modular Age: Architectures, Networks, and Organizations. John Wiley & Sons. p. 249.

[21] Argersinger, R.E. (1915). "Electric Transmission of Power". General Electric Review. XVIII: 454.

[22] Kiessling F, Nefzger P, Nolasco JF, Kaintzyk U. (2003). Overhead power lines. Springer, Berlin, Heidelberg, New York, p. 5

[23] Bureau of Census data reprinted in Hughes, pp. 282–283 Hughes, pp. 293–295

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