

GIS for Design Optimization

Power Grid's experience in transmission projects

Power Grid Corporation of India Limited (PGCIL) currently transmits about 40 percent of the power generated in India. It is also responsible for management and development of the national grid. One of the corporation's mandates is to develop 60,000 km of transmission lines by 2012. That is, it has to achieve in about 10 years what was achieved in the last 50 years.

Recognizing the fact that the pace of development can not be accelerated using conventional methods. PGCIL's management has identified the use of GIS in surveying as a way to improve efficiencies at the project concept, detailing and execution stages. One of its geographically tough transmission projects, the Parvati-Koldam project, has demonstrated that the GIS can help contain cost and time overruns, which were the two common concerns in earlier projects.

Constructing 60,000 km of transmission lines at various voltages is a multi dimensional challenge. This is because transmission projects run cross-country as opposed to generation projects, which have a fixed location. Consequently, surveying becomes important for designing the optimal transmission line route covering multiple locations through topographical variations like hills, rivers, snow and forests and existing infrastructure like buildings, railway lines, gas lines and telecommunication lines.

Transmission towers are significant part of line projects. An estimated 75,000 transmission towers have to be erected for 60,000 km of double circuit lines. Each tower location is a mini project in itself. Surveying is important in identifying all the constraints in erecting towers beforehand. The constraints relate mainly to accessibility, construction feasibility, technical restrictions, conservation of environment, and right of way. One of the important future projects of PGCIL is the Srinagar-Leh transmission line. At an altitude of 4,000 m above sea level, it will be the world's highest transmission line when complete. This project typifies the constraints mentioned above. Because of the inaccessible terrain, it is not possible to conduct extensive ground surveys. Yet, a survey is absolutely necessary as resources have to be judiciously allocated, costs have to be determined in advance, and future surprises need to be avoided at the construction stage. For this, contractors have to be provided with correct and detailed information. Ideally, all that should be done before commencing construction is a sample study to verify the survey results. No change in plans should be incorporated at this stage.

After working with several surveying methods, PGCIL now uses a combination of techniques to determine the design for an optimal route map. Until, recently, the corporation used topographic sheets provided by the Survey of India (SOI). However, despite site visits, the route planning was not accurate as the maps were generally outdated and would not feature, say, a new construction that had come up subsequently. In addition, the SOI does not provide digitized information.

The, PGCIL resorted to aerial surveys of areas up to 300 km to get a more accurate picture. However, this mentioned involved an element of human judgement, which subjected the final design to errors. The National Remote Sensing Agency (NRSA) provided updated topographical maps in digitized form. However, these maps also failed on trials for initial optimization of routes. Specific features like route change of rivers or changes in forest cover could not be captured on the maps.

Finally, PGCIL implemented route alignment using high resolution satellite display from NRSA combined with updated SOI topographic sheets. It was now possible to perform digital terrain modeling with contours available, which helped in assessing appropriate locations for cutting and fitting. The alignment profile thus obtained was studied for GPS positioning at the site. This digitized information was processed using software to obtain tower spotting. Subsequent technology development has made it possible to convert all such, 2D images to 3D and have a fly-through model for terrain mapping. PGCIL is now testing the air-borne laser terrain mapping method for more accurate ground and contour mapping.

The use of GIS in the Parvati-Koldam projects has demonstrated how costs and execution time can be contained within the predetermined parameters before commencing on the project. Another benefit is that the working group of experts can work with a GIS mapped area without actually travelling to the location for physical examination. In addition, all documented information related to specific operations can be saved for further reference. Also, a reduction of 1-2 km obtained through GIS line route normally covers the entire cost of conducting the survey.

However, the use of GIS in the country is not standardized. As a result, the surveyed information can not be shared by several user groups. This results in each party conducting similar surveys separately. Based on projects completed using GIS mapping, the corporation aims to develop a countrywide database that will be standardized for all future developments.

**Based on a presentation by M. Krishnakumar,
Additional General Manager,
and Ashish Anand, Chief Design Engineer,
Power Grid Corporation of India**

Reference book:

Power Line
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