TRANSMISSION LINE FOUNDATION PROFESSIONALS

DATABASE-DRIVEN FOUNDATION DESIGN PROCESS

DISTINCT PROJECT ADVANTAGES

- **Significant time savings** from soil borings to IFC design documents
- Improved design efficiency, including alternative analyses
- Improved design quality assurance and quality control
- Automated status tracking, including construction releases
- Improved construction cost controls
- Expedited record drawings

PROCESS

Hanson has developed a foundation design process that uses database and spreadsheet interaction to create maximum efficiency and reduce the chances of human error. This database-driven system allows the necessary design data to be imported, organized, sorted and combined into a standardized format for each foundation.

The data is then exported to Hanson-developed design spreadsheets for each foundation. The software minimizes data entry by the designer. Creation of design software data files, cost comparisons and construction document production are heavily automated. The process is managed by licensed professional and structural engineers, who sign and seal the construction documents in accordance with state regulatory requirements.

This methodology allows the design engineers to concentrate on optimizing each foundation design instead of repetitive data entry and bookkeeping tasks. Quality control is improved because key punch errors are reduced and repetitive hand calculations are eliminated. Once design is complete, the finished designs are checked and results are exported back into the database.

Queries for plan set information and quantity calculations are then completed by the database in seconds. All the data collected can be analyzed to show discrepancies or trends to further improve the design process. Foundation-specific quality assurance forms are generated with the “as-designed” information, and “as-built” data is automatically entered into the database from the forms completed in the field at the completion of construction of each foundation. The database system is then utilized to track concrete compressive strength test results to allow for tower and wire installation releases, and to generate record drawings.

In the past three years, Hanson has designed thousands of transmission line structure foundations using this methodology. Foundation types have included standard drilled piers, vibratory pile driving and tieback-augmented drilled piers.

SOURCES & INPUTS:

Client — Design criteria
Surveyor (Hanson) — Surveyed elevations
Line designer — Line design data
Structure manufacturer — Pole configuration and loads
Civil engineer (Hanson) — Floodplain and flood level information for required reveals
Geotechnical engineer (Hanson) — Gint boring log files, soil parameters, field-verified adverse conditions (adjacent slopes, floodplains, etc.)

OUTPUTS:

Designed structures planset table
Quantities sorted by pier type, size, segment, construction package
Summary of structural design output from design software
Cost comparisons
Status reports
Record drawings

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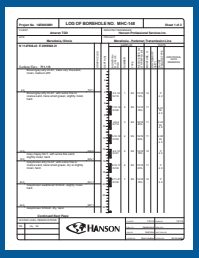
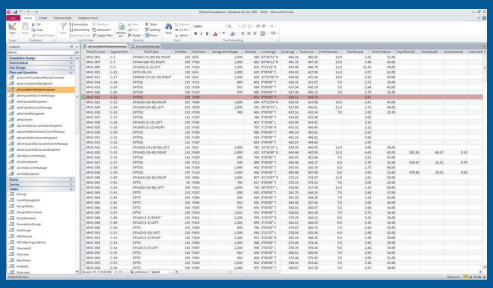
INPUTS



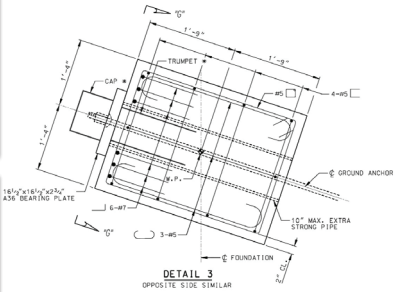
DATABASE



OUTPUTS

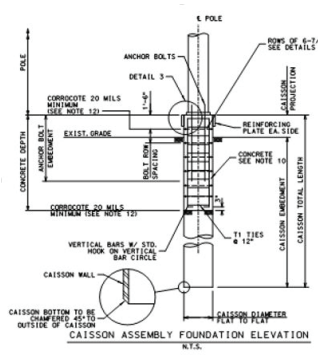
SPECIAL FOUNDATION DESIGNS

TIEBACK-AUGMENTED DRILLED PIERS



Extremely large lateral forces are passed to the foundation in cases of nontangent transmission line poles also known as “angle” or “dead-end” poles. In response to these forces, we work with the client to design an efficient foundation after a careful study of the transmission pole anchorage, available right of way, soil conditions, and various load cases and reactions. Hanson has developed a tieback-augmented drilled pier foundation design that uses two inclined earth anchors attached to a single drilled shaft with reinforced concrete corbels. **This design substantially reduces drilled pier size and construction costs** for certain load and subsurface conditions. Concrete volume reductions of more than 25 percent can be realized, with a 48 percent reduction realized on one project. This design may be thought of as using “subsurface guys” but avoids right-of-way corridor limitations and landowner objections frequently encountered with standard guyed tower designs. The design for these tiedback foundations has been incorporated into our database-driven foundation design process, further increasing alternatives analysis and design efficiency.

VIBRATORY DRIVEN CAISSONS



Hanson has used large diameter metal pipe “caisson” foundations in sandy soils, often in areas with high groundwater levels, to **reduce installation costs and improve construction schedules**. When our design alternatives analysis indicates that a caisson may be viable for cost and time savings because of subsurface conditions, Hanson performs a drivability analysis to confirm soil conditions would allow driving. Caissons are driven into position using vibratory hammers, and the soil within the upper portion of the “can” is excavated to allow for a reinforced concrete section where anchor bolts are embedded. Alternatively, all steel units with integral caps can be installed. Driving a caisson takes a matter of minutes compared to many hours or even days to excavate a similar size drilled pier in such soils. Drilled piers in such conditions would require temporary casing and/or slurry to prevent caving of the pier excavation.

RIVER CROSSING FOUNDATIONS

Hanson has recently provided geotechnical engineering, hydraulics and hydrology, and foundation design services on multiple high-voltage transmission line major river crossing projects. **Tower heights and spans for these projects have extended to 460 feet and 3,700 feet, respectively.** Foundation types designed by Hanson have included all-steel tripod foundations with driven H- and pipe piles to minimize wetland and floodplain permitting issues and pipe piles with reinforced concrete pile caps. The designs incorporated scour analyses completed by Hanson to account for potential erosion around the foundations during river flood conditions. Each location included significant and unique challenges associated with access, permitting, subsurface conditions and the varying and often unpredictable river levels.

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