

## Optimization of wind turbine foundations

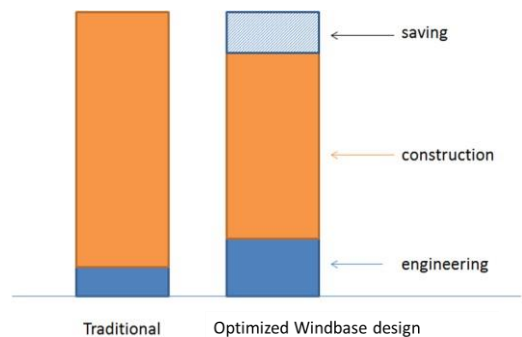
The mission of Windbase is to design the most optimal foundation possible for her clients. Depending on the wishes of the client this can be optimization in terms of costs, environmental impact, safety etc. These different criteria have a relation:

- Reduction of the use of materials will impact both costs and environment.
- A less dense and simpler reinforcement layout is easier and safer to execute and is less vulnerable for construction faults.

Windbase is able to achieve these optimizations thanks to our extensive experience working with a wide range of turbine brands, sizes and models. By utilizing advanced modelling as a design tool, our logic is that investing more in engineering will return in lower construction costs, lower environmental impact, safer and quicker execution and a higher end quality. While this approach may not always be the simplest, we are confident that it will provide additional value for our clients.

### Example

Below we have made a comparison between a Windbase design and a traditional design. A saving of about €50.000 per base was accomplished. The material reduction results in a reduction of CO<sub>2</sub>-emissions of about 30 tons per base. Optimization of concrete mixture design may result in even further reduction of CO<sub>2</sub>-emissions.

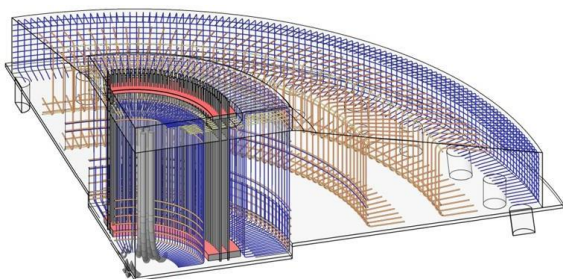


#### Windbase design

concrete 600m<sup>3</sup> x 150 €/m<sup>3</sup> = € 90.000,-  
 reinforcement steel 85kg/m<sup>3</sup> x 600x 2,30 €/kg = € 115.000,-  
**€ 205.000,-**

#### Colleague engineering firm

concrete 650m<sup>3</sup> x 150 €/m<sup>3</sup> = € 98.000,-  
 reinforcement steel 105kg/m<sup>3</sup> x 650x 2,30 €/kg = € 157.000,-  
**€ 255.000,-**



### Statistic facts based on a large number of projects:

- Traditional vs. optimized design
- 2% total cost benefit on project
- 20% total cost benefit on foundations
- 30% total saved concrete
- 40% total saved CO<sub>2</sub> emission
- 50% total saved reinforcement steel

Foundation designs by Windbase in most case have reinforcement - concrete - ratio's of 85 to 95 kg/m<sup>3</sup>, where traditional designs mostly show ratio's of 100 to 150 kg/m<sup>3</sup>.



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