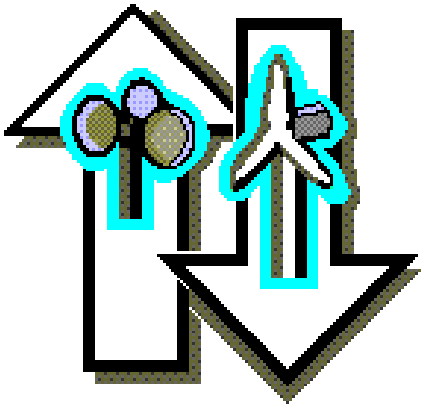
WindPRO / Loads

WAsP Engineering in WindPRO



EMD International A/S

Niels Jernes Vej 10, DK-9220 Aalborg, Denmark
www.emd.dk or www.windpro.com
phone +45 9635 4444, fax. +45 9635 4446
e-mail: windpro@emd.dk

Published by:

EMD International A/S
Niels Jernesvej 10
9220 Aalborg Ø
Tel: +45 9635 4444
Fax: +45 9635 4446
Email: emd@emd.dk
web: www.emd.dk

Author(s)

Lasse Svenningsen, PhD

Document history

21-12-2012 - 1st edition – Lasse Svenningsen, PhD, ls@emd.dk

Front cover

The front cover shows the WAsP, WAsP Engineering and WindPRO logos.

Table of Contents

1 WAsP Engineering in WindPRO/SITE COMPLIANCE

From version 2.8 WindPRO has a direct integration of the flow model WAsP Engineering. The integration works via the SITE COMPLIANCE module.

Contrary to WAsP, the linearized flow model WAsP Engineering is not focused on calculation of the mean annual flow or energy. WAsP Engineering is focused on predicting the flow characteristics and parameters needed to determine fatigue and extreme loads on wind turbines. These parameters are: speed-up and deflection (at neutral stability, i.e. high wind speeds), wind shear, flow inclination, and turbulence intensity.

1.1 Licensing of WAsP Engineering

WAsP Engineering (henceforth WEng) calculations from WindPRO via SITE COMPLIANCE require a local installation of WEng 3.0 or newer. Hence, a valid WEng license must be activated directly in the local WEng installation as illustrated below.

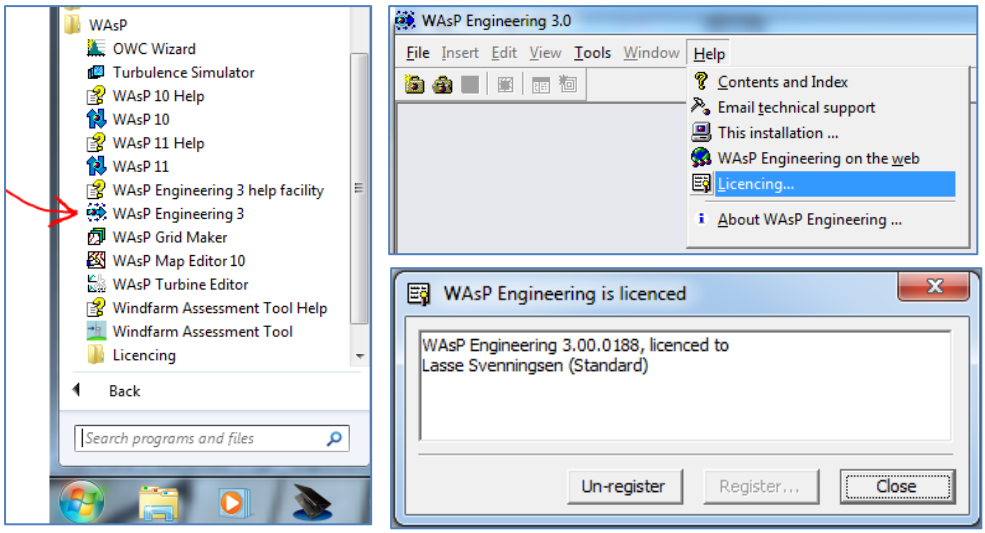


Figure 1. License activation of WEng.

It is important to note that the activation of WEng requires the PC to be on-line as the license program connects with a license server at Risø/DTU. Once activated WindPRO will recognize the active license and provide the license status in the calculation window to the lower right. The WEng license program will check against Risø/DTU's license server regularly, so during periods off-line the WEng license temporarily may not be valid/active.

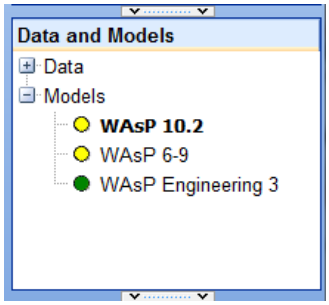


Figure 2. Indication of an active WEng license in WindPRO Calculation window.

1.2 Setup and run WEng in SITE COMPLIANCE

The integration of WEng 3 turns WindPRO into the GUI of the WEng flow model. This has enabled a significant simplification of setting up and running WEng. Contrary to WAsP, WEng is a grid-based model that calculates the flow parameters (except turbulence) for each grid point of a rectangular calculation domain defined by the user. In particular specifying the calculation domain has been made easy in the WindPRO integration.

The figure below illustrates the tab in SITE COMPLIANCE that works as the interface to invoking WEng.

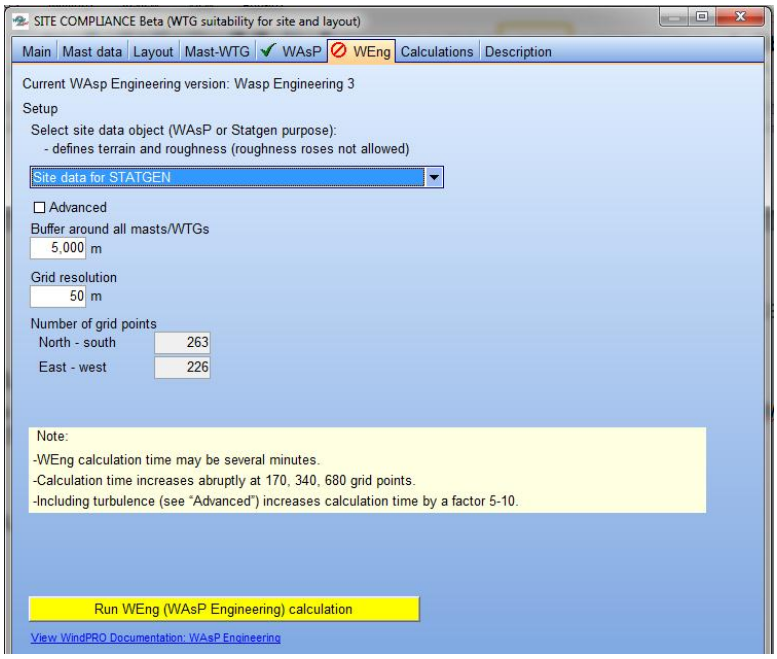


Figure 3. WEng tab in SITE COMPLIANCE.

The setup and running of WEng requires the following steps:

1) First a *Site data object* must be selected to define the terrain and roughness maps passed to WEng.
2) Then select a *Buffer around all masts/WTGs*. This buffer distance defines the extension of the calculation domain. Default is 5km, which is a compromise between accuracy and calculation time. In cases with prominent roughness changes just beyond 5km or large scale terrain features, the buffer should be extended as required.
3) Last setup the grid resolution. The default is 50m and typically acceptable. In sites with rapid variations in terrain such as a narrow ridge, a finer resolution should be chosen.

Notice that if the *Buffer* or *Grid resolution* is changed the *Number of grid points* will update accordingly. The calculation time of WEng is optimized if the *Number of grid points* stays just below 170, 340 or 680 …etc. in both directions. This is due internal zero-padding inside WEng.

In the current version of SITE COMPLIANCE use of obstacles is not supported in the WEng modelling.

Once appropriate settings are made, the calculation can be performed by clicking the yellow *Run WEng (WAsP Engineering) calculation* button. A WEng calculation may take several minutes. A main reason is that turbulence is predicted for each WTG and mast position.

Figure 4. WEng tab before and after successful calculation.

1.3 Advanced setup of WEng

Prior to running the WEng calculation the *Advanced* setup options may be reviewed and adjusted as illustrated below.

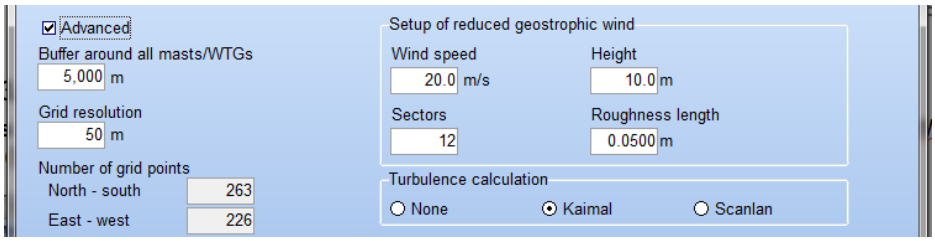


Figure 5. WEng tab, Advanced setup.

This setup illustrates how the flow modelling actually works inside WEng via the *Setup of reduced geostrophic wind* that allows adjustment of *Wind speed*, *Height*, *Roughness length* and the number of *Sectors*.

As WEng is a linearized model the results of the WEng flow modelling in terms of relative speed-up factors and turbulence intensity will not depend on this setup. Only in the special case offshore or semi offshore conditions, extra caution is needed as here the linearity does not hold due to increasing sea roughness with wind speed. In such special cases it is advised to run WEng and close SITE COMPLIANCE and export the WEng flow results via right-clicking on the calculation and choosing *Result-to-file*. The wind speeds predicted for each WTG in the result should match approximately the expected extreme wind speed for the WTGs. If the result is too low or high the reduced geostrophic *wind speed* can be adjusted accordingly in the WEng advanced setup to properly model the flow conditions during the on-site extreme wind conditions.

Turbulence calculation lets the user deselect calculation of turbulence via the option *None* or choose the alternative model *Scanlan*. However, it is recommended to use the default choice of including turbulence with the model *Kaimal*.

If a displacement height has been set either for a mast in the Meteo object or for a WTG object these will always be used in the WEng calculation. The usual effect is to decrease wind speeds whereas turbulence and wind shear normally increase.