Creating Your Future

2.5 MW Wind Turbine Technology
Model of W100 / 160 m Lattice Tower
Scale 1:500

Note: Banner and seagull are in the model not to scale
W2E specializes in the design and testing of multi-megawatt wind turbines. Our wind turbines are receiving highest marks for their innovative, flawlessly performing and trend-setting features - developed in close co-operation with leading industry suppliers. To show that our design work was carried out in accordance with respected engineering principles, we commissioned an independent agency to fully certify our wind turbine design. We operate and extensively test at least one prototype of each design. We deliver designs as qualified and comprehensive documentation which allows for the expert manufacture, marketing, installation, commission and maintenance of the wind turbine as a product.

Each of our wind turbine designs starts with a solid design foundation: our highly-rated Compact DriveTrain concept, LARUS Compact®. This concept ingeniously integrates industry-proven components and guarantees to transmit only torque into your gearbox. Industry experts and gearbox manufacturers confirm that W2E’s design approach is trend-setting.

LARUS Smart® stands for a Pitch Logic Unit that provides for enhanced control over the wind turbine’s response to certain operational events. LARUS Smart® also stands for a power backup solution with lithium ion accumulators and ultra capacitators ensuring stable and maintenance-free operation. LARUS Smart® also stands for a number of additional features that improve your product even further.

Instead of the conventional “Safety Chain”, LARUS Safe® by W2E presents a “Matrix Safety System” that is tried and tested in other industries. The Matrix Safety System, which W2E added to wind turbines as an innovation, provides designated shut-down procedures, since it can selectively respond to a wide range of triggers. This unique feature means that the overall wind turbine design complies with the strict requirements of the European Machine Guideline.
Constructing the lattice tower

Insert modules 4a-4c between angular supports of part 4

Glue warning lights - parts 4d diagonally on the corners

Parts 2, 2a, 3 and 3a are constructed in the same way

1. Base plate
2. 1-1.5 mm-thick cardboard
3. 0.8 mm cardboard

Constructing the lattice tower

Design of model: www.kartonmodelle.eu
Constructing the rotor blades

Bend end of the sheet slightly to form a curve.

Score part 6 along the dash-dot line and bend forwards by 5°

Bend the root of the blade around a thin circular rod to form a cylinder and glue edge to edge.

Glue 30-35 mm-long axis (pin) in place

Parts 6, 6a and 6d - pierce openings for the rotor blade prior to assembly.

Design of model: www.kartonmodele.eu
1a

1.5 mm-thick cardboard

1.0 mm-thick cardboard

Shape to form a ring

Reinforce on 0.8 mm cardboard

Flagship of 2.5 MW Technology concerning rotor diameter and hub height

Optimal energy output for Low Wind Sites (IEC 3a).

Scale 1:500

World highest Wind Turbine W100, 160 m lattice tower

Design of model: www.kartonmodelle.eu
Constructing the nacelle

Parts 5c, 5d, 5e and 5f - pierce openings for the rotor blade prior to assembly.

Bend upper edge of nacelle to form a curve.

Insert part 5d at the point where part 5a is folded.

Module parts 5 to 5k

Module parts 6 to 7

Design of model: www.kartonmodelle.eu
A few tips for making the model wind turbine

Tools
- A craft knife or modelling scalpel to cut along straight or slightly curved lines
- Scissors for curved parts
- Pointed tweezers for small parts
- A ruler for scoring or cutting along straight lines
- When cutting components with the knife, we recommend using a green cutting mat.

Glue
Solvent-free glues are not suitable for making cardboard models. They contain water, which will permeate the cardboard and soften the structure. This leads to deformation, and the modelling cardboard loses its malleability and elasticity. Similar problems occur with adhesive sticks, as they are based on soap. As a basic principle, all glues containing solvents develop a capillary action when applied, meaning that they permeate the paper. This means that it is best to apply the glue as thinly as possible. To glue certain surfaces, you should first spread a thin, even layer of glue on both reverse sides to close the pores in the paper. Then re-apply glue to one of the two surfaces after they have dried. When applying glue from the tube, you should always press the tube lightly at the far end to prevent air being sucked in due to underpressure. The following glues are particularly suitable for making cardboard models:
- Adhesives containing solvents
- Contact adhesives

Accuracy of fit
Each model is an exact reproduction of its original. All parts fit together precisely, as they are checked many times over prior to printing. To increase stability, several components must be reinforced by the model maker by gluing them onto cardboard. Components to be reinforced (frames, fins) should not exceed a thickness of 1.0 mm following reinforcement. Make sure that the external dimensions of the parts remain unchanged. If they have become too large after being stuck together, they should be reduced to their original dimensions using sanding paper. The edges of some parts remain white for technical reasons after being cut out and assembled, and can be coloured using a felt-tip pen.

Techniques
Before you begin cutting out the individual parts, you should find them on the model-making sheet using the construction instructions and arrange them in the correct order in your head. It is important to picture how the model is constructed before you actually start cutting out the parts. In addition to continuous lines, some parts also have dashed lines or dash-dot lines that are used to determine where they are folded.
This means:
- A continuous straight line indicates the outline of the part, meaning that you should cut along the length of this line.
- A dash-dot line is a fold line, along which you should score from the front (the printed side) so that the part can subsequently be folded backwards.
- A dashed line is also a fold line, along which you should score on the reverse side (the non-printed side) so that the part can subsequently be folded in the direction of the printed side.
- A dash-double-dot line is a boundary line and indicates where another part is to be glued or attached.
- Hatched lines in closed demarcation areas indicate areas that are to be cut out.

As a rule, the various components are numbered in the sequence in which the parts are to be constructed and can be processed in the order of numbering. You shouldn’t cut out more parts at a time than you need to assemble a particular module. Any exceptions to this rule are explicitly mentioned in the instructions. To print the sheets cost-effectively, we have sometimes had to position various parts on different sheets, i.e. not together in numerical order. A clear numbering system makes it quite straightforward to locate the various parts. The black numbers are the part numbers. The smaller, red numbers are generally position numbers and indicate where the part with the corresponding black number is to be glued. Parts are attached and glued together either using glue tabs or edge to edge (especially in the case of very small parts). When gluing edges together, you should remove any glue that oozes out at the edges, ensuring wherever possible that joins are not visible. Where two parts are glued together at right angles, first apply a thin line of glue to one of the parts, then attach the edge of the other part to it. When gluing strips, rings or curved hollow parts, you should pre-round the parts first until they are the correct shape. This allows the parts to be glued together without tension. To pre-round a part, you should carefully draw it over a table edge, ruler or similar until it is curved as required. You can also achieve the same effect in the case of small parts by rolling them around a circular pencil or rod. How tight the curve is then depends on the diameter of the pencil or rod used. The best way to round very small parts is to wind them round a circular rod using the tip of your finger. Cylinders or cones can be shaped as required in this way.
1 Hub with LARUS Smart® the intelligent pitch system
2 Main Bearing
3 Main Shaft Coupling
4 Gearbox
5 Mechanical Brake

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LARUS Compact® the clever drive train

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6 Low – Voltage Unit
7 Medium – Voltage Transformer
8 Inverter
9 Generator
10 Yaw Drive
11 Onboard Crane Rail Frame
12 Water Cooling System
13 Central Lubrication System
14 Main Bearing Lubrication
15 Tower
### Technical Data W100

<table>
<thead>
<tr>
<th>Design wind class</th>
<th>GL / IEC 3a</th>
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</thead>
<tbody>
<tr>
<td>Nominal Power</td>
<td>2,500 kW</td>
</tr>
<tr>
<td>Cut-in wind speed</td>
<td>3.5 m/s</td>
</tr>
<tr>
<td>Nominal wind speed</td>
<td>11.5 m/s</td>
</tr>
<tr>
<td>Cut-out wind speed</td>
<td>25 m/s</td>
</tr>
<tr>
<td>Noise prediction</td>
<td>104.5 dB(A)</td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Rotor</strong></td>
<td></td>
</tr>
<tr>
<td>Rotor blade</td>
<td>LM 48.8</td>
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<tr>
<td>Speed range</td>
<td>7,854 m²</td>
</tr>
<tr>
<td>Tilt</td>
<td>5°</td>
</tr>
<tr>
<td>Blade coning</td>
<td>5°</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Brake System</strong></td>
<td></td>
</tr>
<tr>
<td>Pitch</td>
<td>Electric, triple-redundant, fail-safe</td>
</tr>
<tr>
<td>Pitch backup power supply</td>
<td>Lithium-ion accumulator</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drive train</strong></td>
<td></td>
</tr>
<tr>
<td>Main bearing</td>
<td>Rigid moment bearing, three-row roller</td>
</tr>
<tr>
<td>Gearbox</td>
<td>Two-stage planetary gear, one spur gear stage</td>
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<tr>
<td>Gearbox ratio</td>
<td>1 : 79.2</td>
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<tr>
<td></td>
<td></td>
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<tr>
<td><strong>Generator</strong></td>
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</tr>
<tr>
<td>Type</td>
<td>Asynchronous with slipring</td>
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<tr>
<td>Power factor</td>
<td>0.95 capacitive to 0.95 inductive</td>
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### Transformer

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<th>Type</th>
<th>Silicone-oil immersed</th>
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<tr>
<td>Nominal voltage</td>
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### Yaw System

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<tr>
<th>Bearing</th>
<th>Ball bearing</th>
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<tbody>
<tr>
<td>Motor</td>
<td>Three-phase asynchronous motors with short-circuit rotor</td>
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<tr>
<td>Gearbox</td>
<td>4-step planetary gear</td>
</tr>
<tr>
<td>Number of drives</td>
<td>4</td>
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<tr>
<td>Yawing speed</td>
<td>0.5° /s</td>
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<tr>
<td>Brake</td>
<td>Hydraulic disc brake</td>
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<tr>
<td>Material brake lining</td>
<td>Organic</td>
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<tr>
<td>Number of brake calipers</td>
<td>4</td>
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</table>

### Tower

| Tubular               | 85 m, 100 m              |
| Lattice               | 117 m, 141 m, 160 m      |

### Control

| WP4100                 |                          |

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