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Reading the Signs ...

Road signs are essential to motorists. Many warn drivers of what's ahead. For example, they tell you to slow down if you're approaching a roundabout. These warnings help prevent a lot of accidents.

Signs should be seen at all times. So, when it gets dark, many signs have to be lit up. This can be done using powerful light emitting diodes (LEDs) which are powered by wind turbines and/or solar cells.

What you have to do

In a bid to be 'green', the local council has decided to start using the wind to power LEDs on the area's road signs. And you've been asked to design the wind turbines.

The Highways Department of your local council has provided you with the design brief below which outlines all the requirements of the wind turbine.

Jellybourne Town Council
Highways Dept.
Jellybourne,
Staffordshire

Dear Sir/Madam,

Re: Design Brief

The wind turbines should turn when the wind speed is 0.75 m/s, and the power output should be between 7.5 and 13 watts.

The wind turbine should have three blades (unless you can convince us otherwise).

The wind turbines should be resistant to corrosion and moisture. They should also be able to withstand very high winds and exposure to hot sun. Also, as they will be on the side of the road, they should be resistant to fuel and exhaust fumes.

The wind turbine will turn whenever the wind blows, but the light should always be on when it is dark. You may like to consider a plan to power the road signs when there is no wind.

If the power output gets too high the LED might break; so please include some sort of system to control the power.

We need an initial batch of 25. However, if they are successful we may need more, and there will be an opportunity to sell your ideas to other local councils.

Please - as always - keep costs as low as possible.

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How to set about it ...

What exactly do they want?

1. Draw a table like the one below (you may need more rows). Use the first column to list the **key design features** from the **design brief**. In the second column, "Initial thoughts", make a few notes about what you'll have to bear in mind as you begin to come up with possible solutions.

Key design feature	Initial thoughts

2. You can now write your **design specification**. This should explain exactly what's required, and the implications of each design feature.

Generating ideas and shortlisting

3. Using the internet, library and/or resource centre, carry out some research into wind turbines. Here are a few places you might like to try:

   http://www.bergey.com/ (Bergy is a company specialising in making small wind turbines)

   http://www.eren.doe.gov/wind/feature.html (an excellent site showing how wind turbines work - and providing drawings of all the internal workings)

   http://www.otherpower.com/ (see the section a science fair wind generators)

   http://www.led.net/datasheets/Pages/trafficled/136aa.htm (for background information on LED traffic signs)

4. Produce a number of **design ideas** using simple freehand sketches to try to visualise them.
5. Shortlist three of your ideas, explaining the decisions behind your choices. Even at this stage you should be pretty sure your design ideas will work. Scientific principles will help, for example, the knowledge that you can convert energy from a rotating propeller into electrical energy is essential.

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And then there was one ...

6. You must now work out the pros and cons of your three design ideas. There are a number of ways to help you work these out. A few of them are:
    - You could carry out simple tests on scale models of particular components. For example, test different types of propeller blades to see which one turns the fastest. In some cases you may want to test a scale model of the whole structure.
    - Think about costs. Which of your wind turbines would be most expensive to manufacture?
    - What's the rough life expectancy of your different designs? Is one much more hard-wearing than another?
    - Do any of your designs have more than one use? You've designed them to power a road sign LED, but could they be used to power something else (with a simple modification and a change of marketing you might be able to sell your designs to a wider client base).
7. Having weighed up the pros and cons, you've probably got a decent idea which design you think is the best. But the client is the paymaster. So, to help choose a final **design solution**, you should get feedback (comments and suggestions) from an expert who understands your client's needs.
    - Make 2-D and 3-D drawings and/or scale models of your three design ideas. These should be of good enough quality to allow you (and anybody else for that matter) to visualise exactly what your wind turbines will look like.
    - Present your designs to the expert, and write down their comments and suggestions. (but if you're adamant one design is better than another, make sure you can explain why - you have to give the client what they want, but YOU are the designer!).
    - Consider the expert feedback and decide what modifications you need to make, if any, to make sure your designs meet the client's needs.
8. Choose your final design solution and summarise the reasons behind the choice, including how your **design solution** fulfils the **key design features** in your **design specification**, and how you have used expert feedback.

Presenting your solution

9. Decide on a suitable engineering drawing technique to present your final solution. Make 2-D and 3-D engineering design drawings, or use computer aided design (CAD) to produce them. Make sure you stick to engineering standards and conventions.

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You've done the design job ...

10. You've successfully produced a **design solution** from a **design brief**. But what now? You've done the job of the designer, so you need to put your engineer's hat on. The design solution has to be turned into a **product specification** - giving the manufacturer the information needed to actually make the product.

    A product specification details all the materials needed to make a product; it includes its dimensions, tolerances and details of how the different components will be joined together.

    You need to decide which materials will be best to make your wind turbine. To decide which materials are best you should look back at the design brief and your initial research. You should also use databases and other resources to find out properties of materials.

    You might also want to try tests for materials, joints and finishes to show how these can vary and influence your choice for the product specification.

    COMPARATIVE TESTS