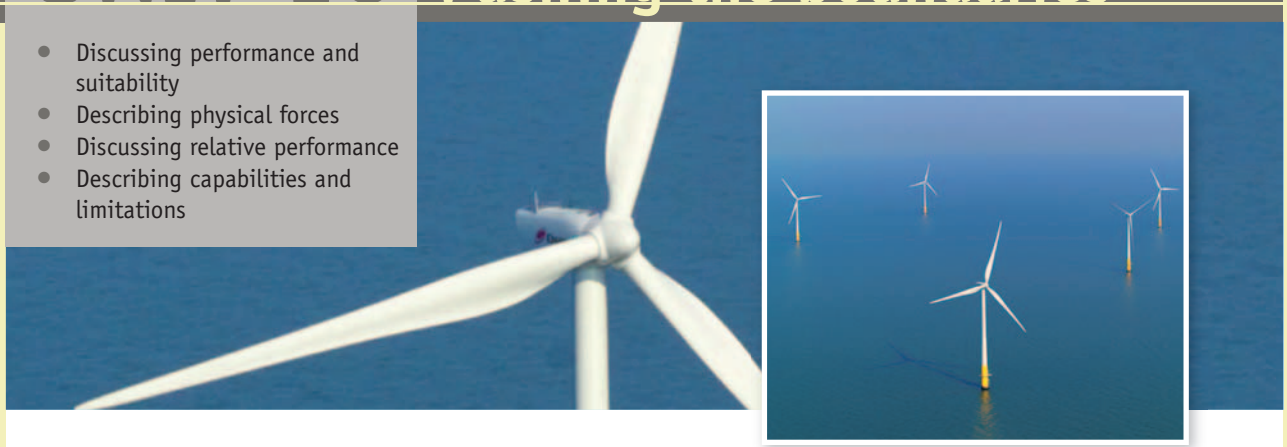
UNIT 10 Pushing the boundaries

- Discussing performance and suitability
- Describing physical forces
- Discussing relative performance
- Describing capabilities and limitations



Discussing performance and suitability

1 a **In pairs, answer the following questions about wind turbines.**

1 What function do wind turbines perform?
2 What are the main advantages and disadvantages of wind turbines?
3 What types of location are most suitable for wind farms?

b **In pairs, discuss the functions and technical characteristics of the following wind turbine components.**

blades tower generator

2 a ▶10.1 **Mike, Loreta and Hanif, engineers at a wind turbine constructor, are discussing performance and suitability issues relating to offshore wind turbines. Listen to the conversation and answer the following questions.**

1 Which wind turbine component do the engineers discuss?
2 What is the big problem with offshore installations?
3 Which two types of construction material are being compared?
4 Why are coastal defences mentioned?
5 What point does Hanif make about regular maintenance?
6 What comparison needs to be made with regard to lifespan?

b **Match the words (1–6) from the discussion to the definitions (a–f).**

1	appropriate/suitable	a	the right solution for a particular situation
2	consistent/reliable	b	good enough for the intended function
3	cost-effective/economical	c	performs a function well
4	effective	d	works quickly and well
5	efficient	e	makes the most of resources, isn't wasteful
6	sufficient/adequate	f	doesn't break down, always performs in the same way

c **Make the following words negative by adding the prefixes in- or un-.**

1 adequate inadequate
2 appropriate _____
3 consistent _____
4 economical _____
5 effective _____
6 efficient _____
7 reliable _____
8 sufficient _____
9 suitable _____

d ▶10.1 **Listen again. What issues do Mike, Loreta and Hanif agree and disagree on?**

3 **a** **The following information is from the web site of Sigma Power, a firm that advises corporate and government clients on wind energy projects. Complete the text using the words in Exercise 2c.**

Wind Turbines - FACT FILE

1 The fact that wind turbines consume no fuel and waste very little energy is clearly a fundamental advantage. But just how efficient are they? Key figures

2 Clearly, wind turbines need to be located on relatively windy sites in order to function. From a meteorological standpoint, what kinds of geographical location are the most _____ ?

3 Turbines are generally placed at the tops of tall towers, where wind speeds are higher, thus making them more _____ . What other positioning factors influence performance?

4 Wind turbines rarely function continuously, due to the fact that wind speeds are _____ . How significant is the impact of variable weather conditions on power generating capacity?

5 Transmitting electricity over long distances is inherently _____ , due to power loss from overhead or underground power lines. Find out more about the advantages of generating power locally.

6 The generating capacity of wind turbines is generally _____ for it to be relied upon 100%. What percentage of total generating capacity can wind turbines realistically provide?

7 Some early wind turbines were _____ , suffering breakdowns caused by inaxial stresses stemming from higher wind loads on the upper blade. However, this problem has been overcome on modern units. Learn more about the technical evolution of wind turbines.

b **You are engineers at Sigma Power. The marketing manager has asked you to provide some technical answers for the frequently asked questions section of the company's website. The FAQ section is aimed primarily at potential clients who are thinking of installing wind turbines at their sites – factories, office complexes, hospitals, and university campuses. In pairs, discuss the following questions and write the answers for the website using the information in the fact file and your own knowledge.**

Frequently Asked Questions

A common-sense introduction to wind turbines

1 What's the big advantage of having a wind turbine at my site?

2 How dependable are wind turbines as a source of power, given that weather conditions are changeable?

3 What kinds of site are most suitable for wind turbines, relative to natural factors such as hills, the coast, and height above sea level?

4 What's the most appropriate location for my wind turbine, relative to local features on the site, such as trees and buildings?

Describing physical forces

4 a **Read the following article. What is a solar tower and how does it use the forces of expansion and pressure?**

SOLAR TOWERS

The need to develop renewable energy is widely seen as a futuristic technological challenge. In reality, some of the most effective ways of harnessing horsepower from nature are based on concepts that have existed for donkey's years. The wind turbine is an obvious example. Another – less well known, but conceived almost a century ago – is the solar tower or solar chimney. And if the Australian company EnviroMission completes an ambitious solar tower project in the New South Wales desert, the technology could capture not just the sun's rays but the public's imagination worldwide. The firm is planning to construct a tower a colossal one kilometre high. If built, it will be the world's tallest structure by a huge margin.

How it works

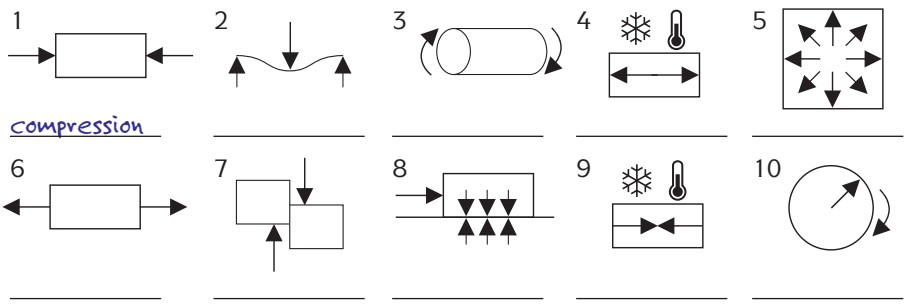
A large glass enclosure is built, with a chimney at its centre. The sun heats the enclosure, causing expansion of the air inside. At the top of the chimney, the lower temperature and lower pressure due to the higher altitude create a pressure differential known as stack effect. This causes air to flow up the chimney. Electricity is generated by turbines at the bottom of the chimney, which are driven by the flow of air. The bigger the area of glass and the taller the chimney, the greater the airflow and the higher the generating capacity.

b **What physical forces would act on a solar tower 1 km high?**

c ▶ 10.2 **Su, a structural engineer specialising in the design of very tall structures, is giving a talk to a group of engineering students. Listen to the talk. Which of the forces in the box doesn't she mention?**

bending centrifugal force compression contraction expansion
friction pressure shear tension torsion/torque

d **Label the diagrams using the forces in Exercise 4c.**

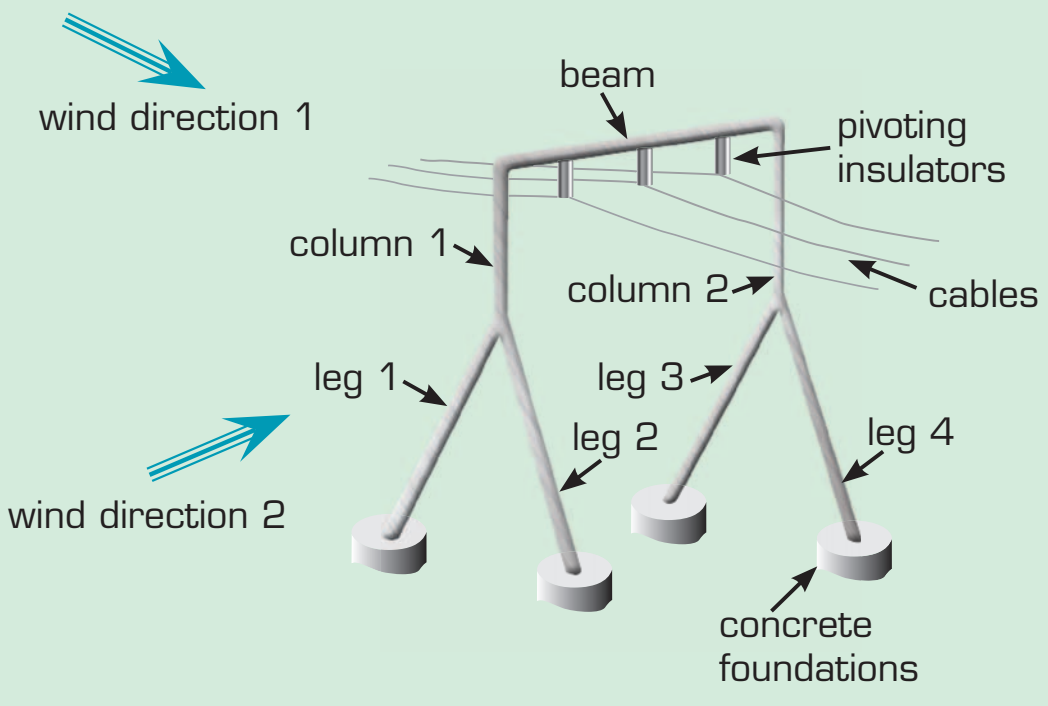


e ▶10.2 **Complete the following sentences from the talk using the forces in Exercise 4c. Listen again and check your answers.**

1 *So that downward force means the structure is in* compression *, especially near the bottom.*
2 *… a horizontal load, exerted by air* _____ *against one side of the structure.*
3 *Because the structure is fixed at ground level, and free at the top, that generates* _____ *forces.*
4 *… when elements bend, you have opposing forces:* _____ *at one side,* _____ *at the other.*
5 *… the wind effectively tries to slide the structure along the ground, and the foundations below the ground resist that. The result of that is* _____ *force …*
6 *… the foundations need to rely on* _____ *with the ground to resist the pull-out force, …*
7 *The action of the wind can also generate* _____ *. You get a twisting force …*
8 *When concrete absorbs heat from the sun, you get* _____ *; as soon as the sun goes in, there's* _____ *.*

f **You and your partner specialise in designing structures for electrical transmission grids. You are currently working on a cable support concept for power lines near wind farms exposed to severe weather. You have come up with the following design. In pairs, hold a short meeting to evaluate your design concept. Explain the forces acting on the structure.**

Severe weather cable support concept



Discussing relative performance

5 a **In pairs, discuss the advantages and disadvantages of air and high-speed rail travel. Focus on trips of between 500km and 1,500km, the journey length over which planes and trains often compete for the same passengers.**

b **Read the extract from an article about transport in a popular science and technology magazine and answer the following questions.**

1 What factors should be considered in the comparative analysis described?
2 What is the purpose of the comparative analysis?
3 What suggestion is made about Europe?

Speed, convenience, efficiency, and environmental-friendliness: four factors with which to assess the relative effectiveness of different long-distance, mass-transport solutions for passengers. Technology: the key criterion in determining what transport solutions are available. And distance: the main consideration when categorising routes. Blend these variables together in varying quantities, and you have a model for calculating the optimum way of moving people.
On a European scale, whichever way you mix the various criteria, the most advantageous way of getting people around the heart of the continent seems to be on high-speed, electric trains.

c **Find words in the text in Exercise 5b to match to the following definitions. Which one of the words has a plural form?**

1 standard by which you judge something _____
2 fact or situation which influences the result of something _____
3 number, amount or situation which can change _____

6 a **What do you know about France's high-speed train, the TGV? What is its normal operating speed? What is the approximate length of the train?**

b **Read the facts about the world speed record set by the TGV. Compare the world record journey with a normal TGV journey, using your answers in Exercise 6a.**

World Speed Record for an In-Service Passenger Train

Date	April 3, 2007
Location	France: Paris to Strasbourg line on slightly modified track
Train	Standard TGV with fewer coaches
Record	574.8 km/h

c ▶10.3 **Andrej, a consulting engineer specialising in rail technology, is talking about the TGV world speed record. Listen to the talk and answer the following questions.**

1 Overall, how heavily modified was the train?
2 How long was the record-breaking TGV?
3 Why was some of the bodywork modified?
4 Why was the diameter of the wheels changed?

d ▶10.3 **Listen again and complete the following table about the modified TGV using the figures in the box.**

+ 68% + 19% – 15% – 50% + 80%

Technical criteria	Modified TGV: % difference from standard model
Maximum speed	
Train length (with coaches)	
Aerodynamic drag	
Diameter of wheels	
Motor power output	

e **Complete the following sentences from the talk by underlining the correct words.**

1 *The record speed exceeded the standard operating speed by a* ***tiny/huge*** *margin.*
2 *The train was modified to a* ***certain/considerable*** *extent …*
3 *… the modified train was* ***significantly/slightly*** *shorter, …*
4 *… changes were made to the bodywork, to make it* ***slightly/much*** *more aerodynamic …*
5 *The wheels on the modified train were* ***marginally/substantially*** *bigger …*
6 *… the power of the electric motors was* ***marginally/substantially*** *higher than the standard units …*
7 *… standard high-speed trains can be made to go faster by a* ***slight/considerable*** *amount.*

f **Rewrite the following sentences to describe the modifications that were made to the TGV for the record attempt. Use the phrases in Exercise 6e to replace the words in bold.**

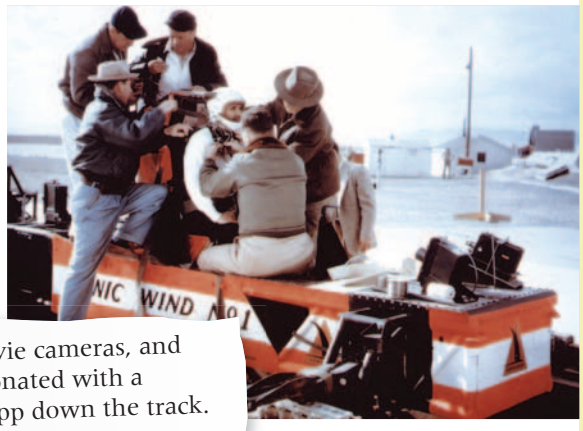
1 The supply voltage in the catenary cables had to be increased **from 25,000 to 31,000 volts**.
2 To limit oscillation, the tension of the catenary cables had to be increased **by 60%.**
3 On some curves, the camber of the track had to be increased **by a few centimetres**.
4 The 574.8km/h record beat the previous record, set in 1990, **by 59.5 km/h**.
5 In perfect conditions the TGV could probably have gone faster **by 5 to 10 km/h**.

7 **In pairs, choose a product or type of technology you know well and compare its performance and quality with an earlier model, describing the extent of the differences.**

Describing capabilities and limitations

8 a **Look at the photos and read the extracts from *The Story of John Paul Stapp*, by Nick T. Spark, and answer the following questions.**

1 When and where do you think it took place?
2 What do you think the aim of the test was?
3 What do you think John Stapp's profession was?
4 What equipment do you think was used?
5 What do you think happened in the experiment?



With five seconds to go Stapp activated the sled's movie cameras, and prepared for the shock. *Sonic Wind*'s nine rockets detonated with a terrific roar, sending out trails of fire and blasting Stapp down the track.

… *Sonic Wind* hit the water brake. The rear of the sled tore away. The front continued, hardly slowing at all until it hit the second water brake. Then, spray exploded from the back of *Sonic Wind*. It stopped like it had hit a concrete wall.

b ▶10.4 **Listen to an extract from a documentary about the experiment and check your answers to Exercise 8a.**

c **Complete the following data on the *Sonic Wind* test using the figures in the box.**

1.2	3	20	46	1015

1 Max speed: _____ km/h
2 Acceleration from 0 to max speed: _____ seconds
3 Acceleration force: _____ Gs
4 Deceleration time: _____ seconds
5 Deceleration force: _____ Gs

d ▶10.5 **Listen to the next part of the documentary and check your answers to Exercise 8c.**

e **Complete the following groups of synonyms using the words in the box.**

able to	capable of	cope with	exceed	incapable of
intended for	~~subjected to~~	surpass	unable to	withstand

1 exposed to (a force) / subjected to
2 resist (a force) / _____ / _____
3 go beyond (a limit) / _____ / _____
4 suitable for (a use) / _____
5 can / _____ / _____
6 can't / _____ / _____

f **Complete the following sentences about *Sonic Wind* using the correct form of the words in Exercise 8e.**

1 The bolts fixing the camera to the sled had to cope with high shear forces.
2 The sled's rockets were _____ generating enormous thrust.
3 The pools at the end of the track were _____ stop the sled rapidly.
4 The skids on the sled had to _____ high levels of friction.
5 At full speed, John Stapp was _____ several tonnes of air pressure.
6 The rear of the sled was _____ resist the shock of deceleration, and broke off.
7 Doctors thought people were _____ surviving forces of 17 Gs and above.
8 John Stapp _____ the 17 G limit by a huge margin.

9

a **You are a consultant engineer and your firm have received an email from an entrepreneur with an ambitious plan. Read the following email extract and note the key information.**

b **In pairs, discuss the key information in Exercise 9a and consider the following points.**

- the level of G force
- a safe length for the track
- the feasibility of using wheels
- the suitability of the braking systems suggested

c ▶ 10.6 **Jasmine and Andrew, consulting engineers, are discussing the issues in Exercise 9b. Listen and compare what they say with your ideas from Exercise 9b.**

d **In pairs, discuss the points raised in their conversation and make notes summarising your thoughts in preparation for a meeting with the entrepreneur.**

e **Prepare a short presentation for the entrepreneur using your notes from Exercise 9d. Student A, you are the consultant engineer. Give the presentation. Student B, you are the entrepreneur. Listen and ask questions about specific details. Swap roles and practise again.**

To: Jasmine Murray
Subject: Rocket sled ride

The proposal is to build a rocket sled ride on a desert site in Western Australia. The ride will be aimed at wealthy tourists, and will allow them to experience supersonic speeds. We envisage carrying two passengers at a time, seated behind the pilot. The idea is inspired by the Sonic Wind experiments, which I'm sure you're familiar with. However, it goes without saying that safety will be the number one priority, which means that extremes of acceleration and deceleration must be avoided. For instance, a water brake, like the one used in the Sonic Wind tests, is clearly out of the question.

The site is large enough to accommodate a track up to 16 km long, though I reckon 10 km would be adequate. According to my rough calculations, that would be sufficient to allow progressive acceleration up to and through the sound barrier to about 350 m/s, and progressive deceleration to a standstill without exceeding 2 G (20 m/s^2), while still leaving three to four kilometres of track as a safety margin. However, I'm not an engineer, so would appreciate your professional opinion on that.

In terms of basic technology, I assume the most suitable vehicle would be a rail-mounted sled, with steel skids that grip the track, above and below the rails, to prevent derailing, and avoid problems with aerodynamic lift. I assume wheels wouldn't be feasible given the speeds involved, though I'm not 100% sure about that. Perhaps you can advise. Propulsion would be provided by a rocket or aircraft jet. I already have a consultant sourcing a suitable engine, however, so that angle is being looked into.

As far as your input is concerned, the main area where I need your expertise is on the braking system. As I said, violent braking is out of the question. As I see it, suitably gentle options include systems that apply friction to the rails, aerodynamic flaps, parachutes, or reversed engine thrust. But, again, I'm not an engineer, so I look forward to discussing your thoughts on these issues.