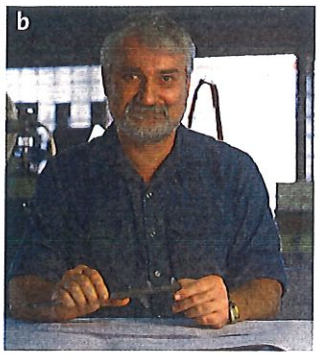
1 Engineering

Kick off

1 Match each picture with a description.



1 Technicians maintain and improve the products that engineers create.

2 Engineers apply mathematics and science. They create and improve products that people use.

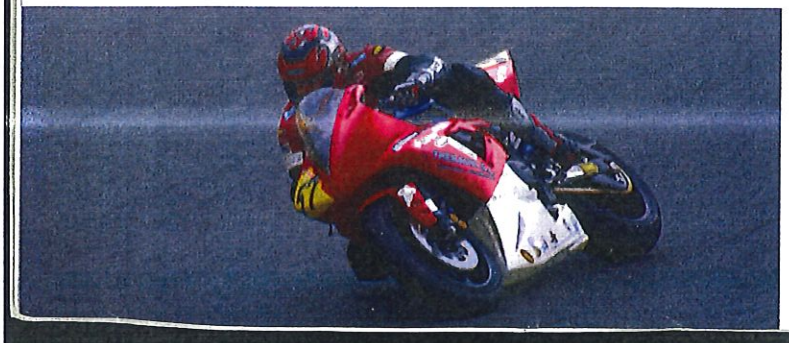
3 Scientists work to increase our understanding of the world. They make careful observations, then make predictions and test ideas to establish basic principles.

2 Who said it? A scientist, an engineer, or a technician?

1 I designed the front part of the motorcycle. It moves through the air very easily.

2 I'm responsible for repairs and maintenance.

3 I do research in aerodynamics – the study of the flow of air.



Vocabulary

Subjects within engineering

1 Before you read, answer the questions.

1 What subjects are the most important for people who want to be engineers?

2 What skills do engineers need for their job?

3 How many types of engineering can you name?

2 Read the Engineering foundation course description and check your answers.

Engineering foundation

Engineers shape our world. They imagine our houses, transport, roads, bridges, entertainment – and even our clothes, foods, and medicines. Then they apply science to create them. Almost everything we use every day is a product of science, technology, and engineering.

This course is the first step in a career in engineering.
In the foundation year you will study:

- mathematics
- physics
- communication
- information and communication technology
- materials
- design and manufacture.

The class will create a group project and will visit several engineering companies.
The course will help you develop:

- an understanding of basic engineering principles
- the numerical and mathematical skills you will need in the first year of an engineering degree course
- an appreciation of technology and a familiarity with a range of simple engineering components
- study, research, and presentation skills, including the ability to manage your time, undertake self-directed study, and communicate clearly
- computer and software skills.

Towards the end of the course you can choose one of the branches of engineering below to study for your degree.

- materials science and engineering
- aerospace engineering
- electrical and electronic engineering
- architectural engineering
- chemical engineering
- civil engineering
- mechanical engineering

In this unit

- subjects within engineering
- Present Simple and Past Simple
- listening for specific information
- scanning a text for information

3 Complete the table with words from the text.

Subjects	Examples of topics studied
mathematics	geometry, algebra, calculus
_____[1]	forces, velocity, radioactivity
_____[2]	speaking, writing, listening
_____[3]	computers, telecommunications, managing data
_____[4]	metals, plastics, concrete
_____[5]	inventing, drawing, making things
Skills	**Examples of uses of skills**
numerical and mathematical skills	doing calculations
_____[6]	learning about a topic and explaining what you've discovered
_____[7]	programming, doing computer-aided design, systems analysis, maintenance
Fields (types) of engineering	**Examples of projects**
materials	mining, artificial limbs, crash investigation
_____[8]	buildings, bridges, city planning
_____[9]	paints, fuels, medicines
_____[10]	roads, railways, dams
_____[11]	power stations, electric motors, lighting
_____[12]	engines, compressors, pipes, tanks
_____[13]	planes, space craft, satellites

4 Answer the questions.

1 Which subjects are the most interesting?
2 Which subjects are the most difficult?
3 Which skills are your best now?
4 Which skills do you need to learn?
5 What type of engineering would you like to study? Why?

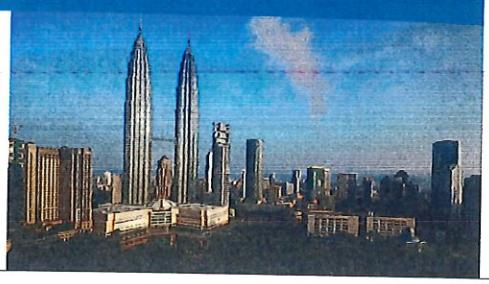
- The ending *-al* on an adjective usually means *related to*. For example, *architectural* means *related to architecture*.

5 Complete the list of adjectives. Seven of them are used in the reading on p.4.

Noun	Adjective
architecture	architectural
chemistry	1
electricity	2
mathematics	3
matter	4
mechanics	5
nation	6
number	7
physics	8
practice	9

6 Complete each sentence with the correct noun or adjective from **5**.

1 H_2O is the _____ symbol for water.
2 _____ is the science of movement and force.
3 Engineers try to create _____ solutions to everyday problems. This means solutions that work well and don't cause a lot of problems.
4 Most homes have a lot of _____ equipment, for example lights, ovens, and televisions.
5 _____ is the study of forces, heat, light, sound, etc.
6 I want to study _____ because I love buildings and I want to design them.
7 a + b = c is a _____ equation.
8 3.14 is the _____ expression of pi.
9 Abu Dhabi Water and Electric Authority is the Emirate's _____ supplier of electricity and water.

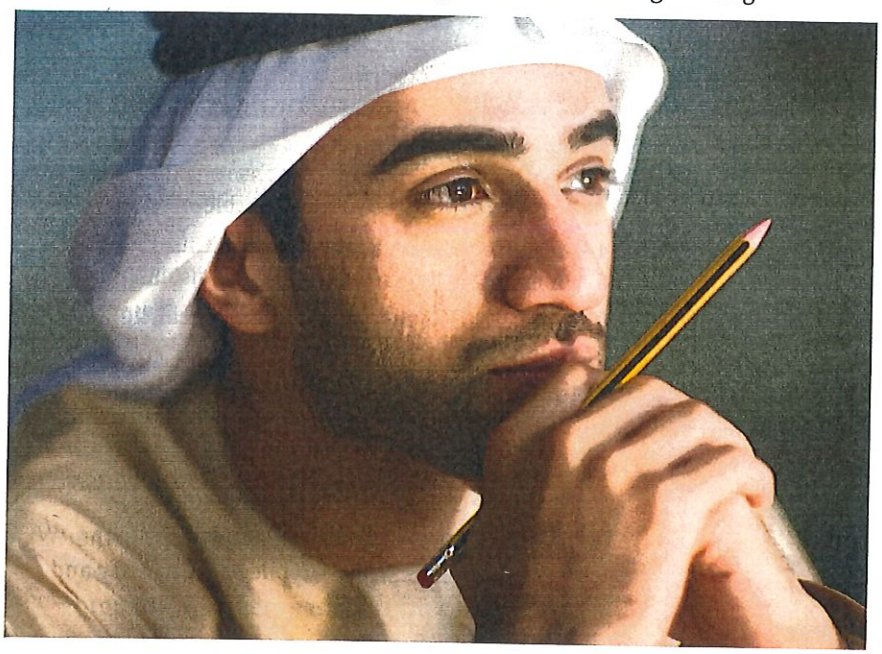


About 7000 engineers worked on the Petronas Towers in Kuala Lumpur. About the same number of workers actually built the towers.

It's my job

1 Hassan Abdul Mosaad works and studies in the United Arab Emirates. Match the words and phrases that describe his activities and interests.

1 employer	a maths and physics
2 job	b machinist
3 workplace	c a foundation course
4 favourite school subjects	d playing football and following motor racing
5 activities he enjoys at work	e a United Arab Emirates electricity supply company
6 current studies	f the workshop at a power station
7 next course	g using tools, repairing equipment, and reading drawings
8 planned university course	h a general engineering course leading to a diploma
9 hobbies	i a degree in electrical engineering



2 Listen and check your answers.

3 Write T (true) or F (false).

1 Hassan has a job now.
2 Hassan has a diploma in engineering.
3 Hassan helps to keep the plant operating.
4 Hassan hopes to get a different job after his foundation course.
5 Hassan visited the Formula One race track at Yas Island.

4 Listen again and check your answers.

5 Answer the questions.

1 Is Hassan a scientist, an engineer, or a technician?
2 What does Hassan mean by *downtime*?
3 What three levels of education does Hassan talk about?
4 Where does Hassan expect to learn more about the electrical supply business?
5 Would you like to do Hassan's job? Why / why not?

Language spot

Present Simple and Past Simple

1 Look at the sentences from *It's my job*. Underline the verbs.

1 I work for an electricity supply company.
2 I started the job two years ago.
3 I'm a machinist.
4 At school, my favourite subjects were maths and physics.

2 Which verbs in **1** refer to the present? Which refer to the past?

3 Which expressions do we usually use with the present? Which do we usually use with the past?

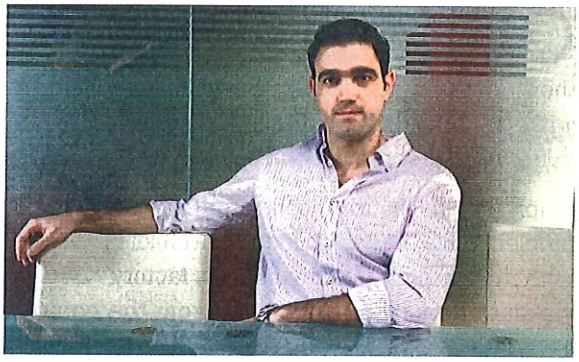
1 two years ago
2 these days
3 last year
4 every day
5 yesterday
6 in 2011
7 every Tuesday evening

Medicine and health engineers improve lives by creating artificial limbs.

4 Choose the correct words.

1 Pietro *finishes* / *finished* his course last year.
2 I love my job. I *worked* / *work* for a large engineering company.
3 When Fawaz *is* / *was* a teenager, he loved Formula One racing.
4 I'm a student now. My classes *start* / *started* every day at nine o'clock.
5 Matteus and his boss *had* / *have* a meeting at eight o'clock every Monday morning.
6 Ania *works* / *worked* in Singapore two years ago.

5 Put the verbs in brackets in the correct tense, Present Simple or Past Simple.



Adel Al Zamil is an electrical engineer. He _____[1] (work) for a telecommunications company. When he was a child, he _____[2] (go) to school in Tabuk, his hometown. At school, he _____[3] (become) very interested in maths. After he _____[4] (finish) school, he _____[5] (study) engineering in Riyadh. Now he _____[6] (live) in Medina. These days, he _____[7] (travel) a lot with his work. Every month, he _____[8] (have) a trip to the UAE.

6 Make notes about your past and present.

Write about

- when you first became interested in engineering
- things you do as a student now (take English classes, go the library every evening, etc.).

7 Work in pairs. Talk about your past and present.

» Go to **Grammar reference** p.118

» Go to **Irregular verbs** p.116

Listening

Choosing a career in engineering

1 🎧 Listen to five young engineers explain why they chose engineering as a career. Match each person with the correct field.

1 Joanne	a mechanical
2 Marcos	b civil
3 Mosaad	c aerospace
4 Anders	d electronics
5 Terry	e materials

2 🎧 Listen again. Tick (✓) the correct box.

	Joanne	Marcos	Mosaad	Anders	Terry
wants to improve the world.					
sees engineering is all around us.					
has worked as a technician.					
loves vehicles.					
is interested in how things work.					

3 What subjects have you studied in your engineering studies (see p.5 for names of classes)?

4 Work in small groups. Explain why you chose engineering as a course of study.

prototype (n) the first design of something

Reading

Scanning

1 Complete the flow chart which shows the main steps in producing an invention. Use these words.

brainstorm identify improve plan produce test use

_____ [1] a need, a want, or a problem

↓

_____ [2] and find a solution

↓

Do research and _____ [3] a product

↓

Design, build, and _____ [4] the product

↓

Make a **prototype** and then _____ [5] the product

↓

_____ [6] the product or sell the product to users

↓

_____ [7] the product

2 Look at the picture. What problem does it show? Can you think of a solution?

3 Before you read the text, look at the table. Then quickly scan the text to find the information to complete the table. Don't read the whole text. Just focus on the information you need.

The problem
The solution
Research and planning activities
Producer and seller of the product
Improvements

One day in the early 2000s, Howard Stapleton's seventeen-year-old daughter went to the shop near their home for some milk. However, she soon returned – without the milk. The problem? There was a gang of boys in front of the shop. She was afraid to go inside.

Stapleton, a security consultant, wanted to solve this problem. Then he had an idea. As a child, he visited a factory with his father. Workers in the factory used ultrasonic welding equipment. The noise from the equipment hurt Howard's ears, so he left the room. But he noticed that none of the adults could hear it. He later learned that when we're in our 20s, we lose our ability to hear very high sounds. It's a natural part of ageing.

Stapleton began to experiment with equipment that could produce very high-pitched sounds. He asked his children to listen to different sounds. At first, some of the sounds he used were painfully loud to the kids. They helped him choose ones that were annoying, but not painful.

He called his invention the Mosquito. He tested the product at a shop in Wales in 2005, then made improvements, for example adding an 'age switch' so the user can choose to produce a sound that only teenagers will hear, or that anyone can hear.

Now Stapleton's own company, Compound Security Systems, produces, markets, and sells the unit – which is an international success.

4 Think of another invention. Complete the table. If you don't know about research and planning activities, use your imagination.

Invention
The problem
The solution
Research and planning activities
Producer and seller of the product
Improvements

Writing

A class enrolment form

1 You are enrolling in an engineering foundation course. Complete the form.

CLASS ENROLMENT FORM

First name _____

Family name _____

Date of birth _____

Address _____

_____

_____

Qualifications _____

_____

Work experience _____

_____

What branch of engineering are you interested in?

_____

_____

What do you expect to learn on this course?

_____

_____

2 Work in pairs. Compare your answers.

Checklist

Assess your progress in this unit. Tick (✓) the statements which are true.

- I can talk about subjects for engineering
- I can understand and use the Present Simple and the Past Simple
- I can listen for specific information
- I can scan a text for information
- I can write basic personal information on a form

Key words

Engineering fields
architectural
chemical
civil
electrical
electronic
materials
mechanical

Adjectives
artificial
numerical
practical

Verbs
create
identify
improve
produce
test

2 Design and modelling

Kick off

1 Look at the picture. What things can you see that were probably designed and created by engineers?

2 Design engineers think carefully about design considerations. Choose three items from the picture in **1**. For each item, say what design considerations are the most important. Use words from the list or think of your own ideas.

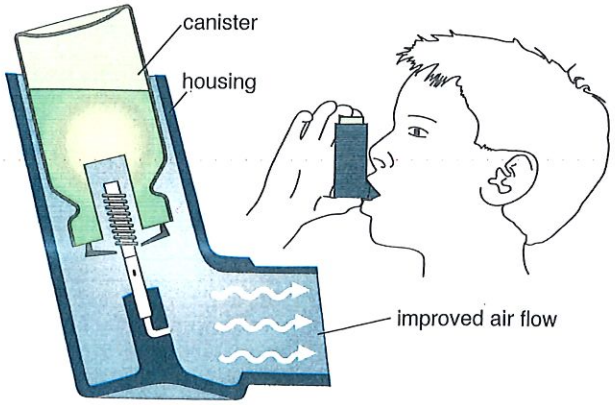
Design considerations – the features and uses of a product that are very important

performance	safety
price / cost to the buyer	size
energy economy	weight

Listening

Discussing a prototype

1 Look at the pictures. What is the product? What are some of the design considerations (see the definition of Design considerations in *Kick off*)?



2 🎧 Listen and check your answers.

3 Complete the notes from the meeting. Use these words.

analysis cost design improvements manufacturing marketing review

Benefits of Concept 5
- Lower overall _____[1] – disposable housing eliminated (also environmentally friendly)
- Improved air flow (result of Computational Fluid Dynamics _____[2])

Product design work
- ergonomic _____[3] complete
- _____[4] and modifications: must fit in hand; needs to be easy to operate

Next steps
- _____[5] has to recommend materials
- _____[6] must suggest colours
- product _____[7] team will create new prototype

4 🎧 Listen again and check your answers.

5 Look at the notes again. Find words that match these meanings.

1 (adj) designed to be comfortable to use
2 (n) the first design of something
3 (n) a change
4 (n) the way air moves through or across something
5 (adj) made to be thrown away

In this unit
- discussing a prototype
- calculations
- permission and necessity
- talking about design considerations

6 Listen again. Tick (✓) the steps that have been completed.

1 concept selected ☐
2 detailed design done ☐
3 CFD analysis done ☐
4 first prototype made ☐
5 ergonomic review completed ☐
6 materials selected ☐
7 colours selected ☐
8 stage 3 approval ☐

Vocabulary

Nouns ending in *-tion*

Words ending in *-ion*, *-ation*, or *-tion* are usually nouns that are related to verbs.

1 All of the nouns in the table appear in this unit. Complete the table.

Verb	Noun
calculate	calculation
compute	1
2	consideration
3	construction
equate	4
modify	5
oblige	6
solve	solution
specify	7

2 Complete the sentences with a noun or verb from **1**.

1 The drawings _____ the exact materials and dimensions of the piece.
2 People who work in the _____ industry usually have a practical understanding of engineering.
3 The original design didn't work, so we made a(n) _____ to improve it.
4 I've been working for months to _____ a difficult design problem, and I think I've finally done it.
5 When we design a car, we have a(n) _____ to make it as safe as possible.
6 Designers have to _____ a huge number of factors: the purpose, the design, the cost of the materials, the manufacturing process, etc.

Number talk

Calculations

1 Match the words and symbols.

1 plus / add	a x^3
2 minus / subtract	b .
3 times / multiplied by	c ÷
4 over / divided by	d π
5 equals	e ×
6 *x* squared	f =
7 *x* cubed	g −
8 pi	h +
9 point	i x^2

2 We can do simple calculations in our heads. Listen and write the calculations.

EXAMPLE
A What's three point two five times two?
B That's six point five.
You write: 3.25 × 2 = 6.5

1 _____ 4 _____
2 _____ 5 _____
3 _____ 6 _____

3 Check the calculations. Are they correct?

4 Work in pairs. Student A, go to p.106. Student B, see below.

1 Listen to Student A. Write the equations.
2 Say these equations. Student A will write them.
   a $441 \div 8 = 55.125$
   b $x^2 - y^2 = z^2$
   c $\pi^3 = 30.96$
   d $55 \times 2.73 = 150.15$
   e $5.24 + 5.88 = 11.12$
3 Check your answers with Student A.

Visual impact is the effect of a structure on the surrounding landscape. What is the visual impact of these structures?

Language spot

Permission and necessity

1 Look at the sentences. Complete the rules with the words in the list.

*The inhaler **has to** fit properly in the hand.*
*It **needs to** be easy to operate.*
*We **must** complete the next prototype in three weeks.*
*I **don't have to** talk to the workers.*
*You **mustn't** visit the site without a helmet.*

don't have to have to must mustn't need to

1 We use _____, _____, and _____ to talk about what's necessary.
2 We use _____ to talk about what isn't necessary.
3 We use _____ to talk about what isn't permitted.

2 For each sentence, write N (necessary), NN (not necessary), or NP (not permitted).

1 I have to wear a helmet when I visit the site.
2 You need to include the calculations with your drawings.
3 Yusuf doesn't have to do the maths because the computer does them.
4 You mustn't start construction without government approval.
5 We must choose the colour today.
6 Matteus has to attend a design meeting tomorrow.
7 All projects have to follow strict government safety rules.
8 The guidelines say we mustn't have fewer than four fire exits.

3 Complete the sentences with *must, mustn't, doesn't have to,* or *don't have to.*

1 We _____ choose a material that is both strong and light.
2 You _____ use a computer for the calculations, but it's a lot quicker.
3 The workers _____ begin building before the engineer arrives.
4 Simon _____ visit the site today, so he can attend the planning meeting in the office.
5 The designer _____ supply the drawings today or we won't finish the job on time.
6 In refrigerator interiors, you _____ use materials that aren't approved for use with food.
7 I _____ do the calculations for the windows because Alicia has done them already.
8 We _____ consider the visual impact of the new bridge.

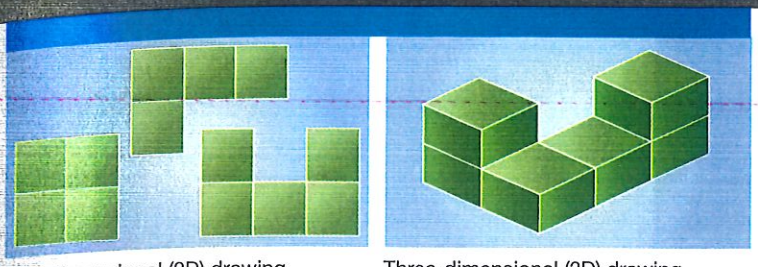
4 Look at Sara's list. Complete the sentences about her day. Use the words in brackets.

TODAY
1) Do calculations for prototype
2) Site visit cancelled
3) Phone Miguel
4) Remember: Don't use company car – no insurance!
5) Organize the ergonomic review

1 (needs to) _____
2 (doesn't have to) _____
3 (has to) _____
4 (mustn't) _____
5 (must) _____

5 Make a list about yourself. Say what you need to do, don't have to do, mustn't do, and must do.

» Go to **Grammar reference** p.119



Two-dimensional (2D) drawing

Three-dimensional (3D) drawing

Reading

Computers in design and modelling

1 Look at the picture and read the title of the article. What do you think the article is about?

2 Read the text and check your answers.

3 Read the text again and answer the questions.

1 What important tool did designers use before design software was available?
2 What is the main use of CAD?
3 What design problems does CAD help find?
4 What does FEA help designers deal with?
5 What does the use of CFD help ensure?

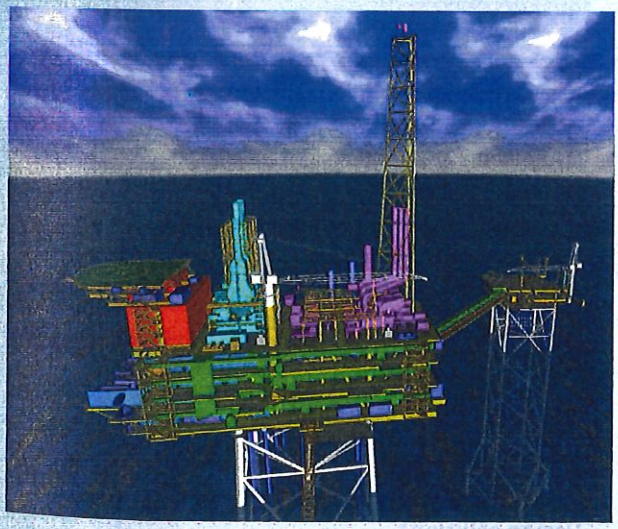
4 For each design task, choose the best computer technology – CAD, FEA, or CFD.

1 Designing a bicycle helmet so air flows over it easily
2 Calculating wind loading (the effect of wind) on a skyscraper
3 Designing the layout of equipment on an oil platform
4 Producing design drawings for an aircraft door
5 Planning the order of construction of a rail bridge
6 Predicting the effect of an earthquake on an oil storage tank

5 For each type of computer design tool, think of two more examples of how designers could use it.

Computers in design and modelling – oil platform design

Thirty years ago, design engineers didn't have powerful office computers. They had to use plastic models of oil platforms to visualize, coordinate, and check the complicated design process. Now design and construction is faster, cheaper, and better using advanced computer techniques.



CAD (computer-aided design)

CAD is used to produce drawings and design documentation. The drawings are detailed pictures that explain a design. They can be two-dimensional, like a plan showing the arrangement of a room, or three-dimensional, like the picture on the left showing pipes and structural details. Documentation includes lists of structural drawings, materials, etc. CAD checks for design clashes – for example, places where parts don't fit together – and produces walk-through videos to check ergonomic features such as access for maintenance.

FEA (finite element analysis)

Today's oil platforms are designed for difficult environments with natural forces such as seismic activity (earthquakes), waves, wind, and ice. FEA is an essential tool in making the design work. FEA divides the structure into a network of elements and solves many complicated equations. It shows how the whole structure will work together to stand against high winds, strong waves, or big earthquakes.

CFD (computational fluid dynamics)

CFD uses complex equations to model the interaction of fluids (liquids and gases) with surfaces. In oil platform design, engineers need to know the effect the wind has on the structure, including parts such as cranes and helicopter decks. This helps engineers to create a safe design. In the past, engineers used wind tunnel tests on a physical model, but now CFD allows engineers to try different designs to get the best result.