72 I can **use technical English**

Skyscrapers: design and construction

Every skyscraper is designed within physical **constraints** such as climate and geology, and then has to **comply with** the most **stringent** safety regulations. It also has to **meet the needs of** its **occupants**, and satisfy the aesthetic objectives of both owner and architect.

Design engineers translate the architect's vision into a detailed plan that is structurally sound. As each skyscraper is unique, models of the building must undergo **rigorous** tests in wind tunnels to **determine** whether they can **withstand** the effects of high winds. If tests show the building will **sway** excessively, designers may add mechanical devices to **counteract** or restrict **motion**.

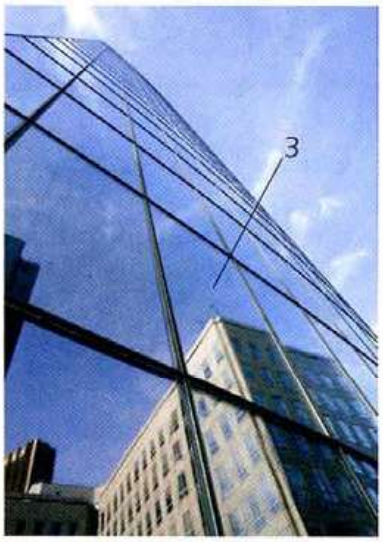
In the construction, engineers dig a massive hole in the rock and then establish the **footings**[1], which form the base that **anchors** the building. Steel or **reinforced concrete** columns are inserted in the footings, and concrete is poured on top.

Vertical supports are put in place by **cranes**[2]; these support the vertical **load**. Horizontal **beams** and steel **girders** are then placed at a 90 degree **angle** to the vertical columns; these hold the building together. Exterior walls merely enclose the structure, and are constructed by attaching **panels**[3] of material such as glass or metal to the building's framework. This is often done by **bolting** them to **brackets** secured to the floors or support columns. ■

Glossary

constraint	a thing which limits your freedom to do sth (**physical/financial/political constraints**). SYN **restriction**. **constrain** V.
comply with sth	obey a rule, order, law, etc. **compliance** N.
stringent	(of a law, rule, etc.) very strict.
meet the needs of sb/sth	satisfy the needs of sb/sth.
occupant	a person who lives or works in a particular room or building (**residents** live or stay in a building, but don't work in a building).
rigorous	done carefully and with great attention to detail. SYN **thorough**.
determine sth	calculate sth exactly. SYN **establish sth**.
withstand sth	be strong enough to be unharmed by great heat, cold, pressure, etc. SYNS **resist sth**, **stand up to sth**.
sway	move slowly from side to side.
counteract sth	do sth to reduce or prevent the bad effects of sth.
motion	the act or process of moving (sth can be **in motion**).
anchor sth	fix sth firmly in position so that it cannot move.
reinforced	made stronger, especially by the addition of another material.
concrete	a mixture of sand, cement, small stones, and water, which forms a hard building material.
vertical	going straight up or down from a surface.
load	the amount of weight pressing down on sth (a **vertical load**).
beam	a long piece of wood or metal, used to support a weight above.
girder	a strong metal beam in large buildings.
angle	the space between two lines or surfaces that join (**angle sth** V move or position sth so it is not straight; it is **at an angle**).
bolt sth to sth	fasten sth to sth with a **bolt** (= a long piece of metal).
bracket	a piece of metal or wood fixed to a wall to support sth.

Remember to test yourself



1 Circle the odd one out.

1	a) restriction	b) compliance	c) constraint
2	a) stringent	b) rigorous	c) thorough
3	a) beam	b) girder	c) bracket
4	a) motion	b) anchor	c) sway
5	a) counteract	b) determine	c) establish
6	a) withstand	b) resist	c) comply
7	a) angle	b) concrete	c) steel
8	a) occupant	b) constraint	c) resident
9	a) panels	b) crane	c) footings
10	a) bracket	b) bolt	c) load

2 Replace the underlined word(s) with a single word of similar meaning.

1 We haven't managed to <u>determine</u> the extent of the damage. _____
2 The building is <u>moving from side to side</u>. _____
3 You can't do anything once it is <u>in motion</u>. _____
4 We hope the structure will be able to <u>stand up to</u> the pressure. _____
5 They hope this will <u>satisfy</u> the needs of the planners. _____
6 Most architects have to operate with various financial <u>restrictions</u>. _____
7 Basically, the fence comprises six <u>rectangular pieces of wood</u>. _____
8 We need to <u>firmly fix</u> it to the ground. _____
9 High-rise buildings have to comply with <u>very strict</u> fire regulations. _____
10 They have very <u>thorough</u> tests before they are given the go-ahead. _____

3 Complete the texts with suitable words.

With a skyscraper, the effects of the wind are a greater problem than the weight of the structure, so designers have to ensure that the building can (1)_____ strong winds, and will not (2)_____ enough to cause the (3)_____ physical or emotional discomfort.

In the design, engineers will have to (4)_____ whether the steel (5)_____ are strong enough to support the vertical (6)_____. If not, engineers will have to (7)_____ the pressure of the weight, and one common method is to add more (8)_____ concrete around the supports in order to stiffen the central core of the building.

Remember to test yourself