Министерство образования Республики Беларусь
БЕЛОРУССКИЙ НАЦИОНАЛЬНЫЙ ТЕХНИЧЕСКИЙ
УНИВЕРСИТЕТ

Кафедра английского языка № 2

Н.Г. Качановская
Л.М. Морозова
О.А. Шалай

ENGINEERING THE FUTURE

СТРОИМ БУДУЩЕЕ

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Пособие по английскому языку для студентов специальности
1-70 02 01 «Промышленное и гражданское строительство»

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Пособие написано в соответствии с типовой программой по иностранным языкам для неязыковых вузов.

Материалом для пособия явились оригинальные технические тексты по важнейшим проблемам в сфере строительства.

Структура уроков предусматривает как работу над новым материалом в аудитории под руководством преподавателя, так и самостоятельную работу студентов при подготовке к занятиям. Упражнения направлены на расширение словарного запаса по специальности, развитие умений и навыков полного понимания читаемого и адекватного его воспроизведения при говорении и аннотировании.

Пособие предназначено для студентов строительных специальностей, а также для магистрантов, аспирантов, нуждающихся в возобновлении своих базовых знаний по английскому языку при подготовке к сдаче кандидатского экзамена.

Пособие включает в себя цитатный и иллюстративный материал.

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INTRODUCTION (ПРЕДИСЛОВИЕ)

Пособие предназначено для студентов строительных специальностей. Пособие подготовлено в соответствии с требованиями типовой программы по иностранным языкам для высших учебных заведений. Цель пособия – сформировать необходимый объем профессиональной лексики для чтения литературы по специальности, для ведения дискуссии и выступления с докладами на конгрессах, симпозиумах по проблемам строительства, а также создать мотивацию к дальнейшему изучению практики и теории проектирования и строительства.

Пособие состоит из трех разделов: «Устойчивое развитие и экологически чистое строительство», «Возобновляемые источники энергии и строительство» и «От пирамид до небоскребов». Каждый раздел состоит из четырех текстов. Уроки строятся по следующей схеме: предтекстовые задания, упражнения, направленные на понимание текста, на представление и освоение языковых моделей, дополнительные задания для творческой деятельности, темы для дискуссий и докладов.

В приложении пособия представлены материалы для дополнительного чтения, содержащие информацию по истории строительства с древних времен до наших дней.

Тексты заимствованы из специализированной литературы и предназначены для развития всех видов речевой деятельности. Пособие включает в себя иллюстративный материал. Авторы выражают благодарность всем специалистам, которые оказали помощь в подготовке и издании этого пособия.

UNIT I

SUSTAINABILITY AND "GREEN" BUILDING

Warming up

1. Read the following information about sustainability, matching questions with the answers.

1) What is sustainability from an ecological point of view?

2) What is the definition of sustainability in the broad sense?

"What use is a sawmill without a forest?"

The dimensions of sustainability are often taken to be: environmental, social and economic, known as the "three pillars".

3) What is important for humans to live sustainably?

4) What is necessary to avoid depleting of natural resources?

Sustainability is the ability to maintain a certain process or state. It is now most frequently used in connection with biological and human systems.

"to meet the needs of the present without compromising the ability of future generations to meet their own needs."

5) Since when has the idea of sustainability been reconsidered?

6) What is a widely accepted definition of sustainability?

Since the 1980s, the idea of human sustainability has become increasingly associated with the integration of economic, social and environmental spheres.

Sustainability can be defined as the ability of an ecosystem to maintain ecological processes, functions, biodiversity and productivity into the future.

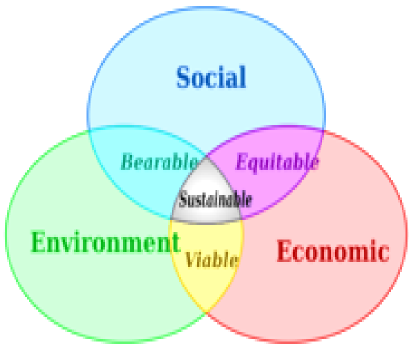
7) What are the three pillars of sustainability?

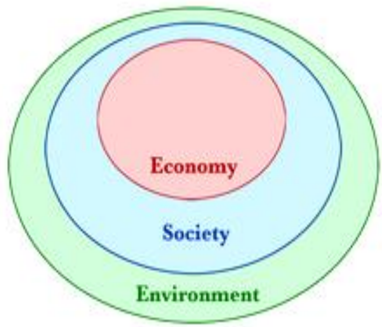
For humans to live sustainably, the Earth's resources must be used at a rate at which they can be replenished.

An unprecedented collective effort is needed to return human use of natural resources to within sustainable limits

8) What question illustrates the main idea of sustainability?

2. Now look at the two diagrams and try to explain their meaning.





1. Which diagram represents the three pillars of sustainable development?

2. Which of them shows economy and society bounded by the environment?

3. Read the following explanation and decide which of the two diagrams it describes:

The economy is, in the first instance, a subsystem of human society which is itself, in the second instance, a subsystem of the totality of life on Earth. And no subsystem can expand beyond the capacity of the total system of which it is a part.

4. Which diagram do you think expresses the idea of sustainability better?

Reading task A

1. Read the construction credo of eco-architects engaged in sustainable construction and comment on it. Do you share it? Which part has impressed you most?

2. Now read the text trying to grasp the idea of sustainability. Make sure you know these words:

Sensitive	outline
Trigger	halt
Imply	holistic
Flexibility	life span
Impact	concern
Augment	commitment
Spirits	precious
Convention	distinguish
Challenge	anticipate
Witness	evolve

Sustainability

"Our work embraces infrastructure, architecture and product design.

We design by challenging – by asking the right questions.

We believe the quality of our surroundings can lift the quality of our lives.

Our work ranges from new buildings to intervention within old structures.

We work from the scale of the airport down to the detail of a door handle.

We are guided by sensitivity to the culture and climate of place."

Norman Foster

While architects cannot solve all the world's ecological problems, they can design energy efficient, socially responsible buildings and they can influence transport patterns through urban planning. Importantly, sustainability also implies a way of building that is sensitive to its location and the culture that has shaped it. Although architects work on a scale unimaginable 40 years ago, sustainability is an issue that has driven the work of the practice since the early days and continues to inform what we do today. It is a thread that runs through from the very beginning to the present and on into the future.

Sustainability is a word that has become fashionable over the last decade. However, sustainability is not a matter of fashion, but survival. The United Nations, in its latest Global Environmental Outlook, outlined a series of possible environmental scenarios for the next thirty years. At worst, it foresaw crises triggered by increasing water shortages, global warming and pollution. It suggested that these trends might be slowed, but only if nations work together to address radically the global consumption of natural resources and energy, and to halt man's degradation of the environment.

Sustainability requires us to think holistically. The location and function of a building; its flexibility and life span; its orientation, form and structure; its heating and ventilation systems and the materials used; together impact upon the amount of energy required to build and maintain it, and travel to and from it. Only by finding new solutions to these problems can we create sustainable forms of building for the future.

The best architecture comes from a synthesis of all the elements that separately comprise and inform the character of a building: the structure that holds it up; the services that allow it to function; its ecology; the quality of natural light; the symbolism of the form; the relationship of the building to the skyline or the streetscape; the way you move through or around it; and last but not least its ability to lift the spirits. This holistic approach is augmented by a strong commitment to the clients and also to the public domain and the many users involved. A high degree of personal service, coupled with respect for the precious resources of cost and time, therefore characterizes the client relationships.

Eco-architects work in the spirit of enquiry, challenging preconceptions and testing conventions. The process of 'reinvention' distinguishes all of their work – past and present – and rests on a duty to design well and to design responsibly – whether that is at the scale of an airport or a door handle. The last decades have witnessed key shifts in public attitudes to ecology and energy consumption. Architects have always anticipated these trends, pioneering design solutions that use totally renewable sources of energy and offer dramatic reductions in CO_2 emissions. Environmental awareness is an integral part of the practice's culture as it evolves to meet the challenges of the next years.

3. Answer the following questions:

1. How do you understand the way of building "sensitive to its location and the culture that has shaped it"?
2. What is the linking element of the past, present and future in building?
3. Can you explain what it means "to think holistically"?
4. What process distinguishes the work of an eco-architect?
5. What is the essence of this process?
6. What changes took place in our society in the last decades?
7. Why is environmental awareness called "an integral part of the practice's culture"?

4. According to the text what are the constituent parts of the best architecture? Discuss each of them in pairs. Put them into the order of importance from your point of view. Make use of the following conversational formulas:

To my mind…
In my opinion…
As for me…
If you ask me…
As I see it…
I'd like to point out that…
I can't but mention …

Reading task B

1. Read the following news and try to guess what ideas they have in common and what problems they deal with.

Eco-terraces: Urban jungle

Eco-terraces are the next big thing in rooftop developments, says Stephen Kennett. It pays to have green fingers.

Arup Associates' design for Ropemaker includes four eco-terraces cascading down one side of the building. Gary Alden, a senior landscape architect, says: "Standard green roofs have become popular and clients and architects see the potential to make them into useable terraces. It becomes a unique selling point for these buildings."

Lee Hosking, an architect with Arup Associates, says the decision to incorporate useable roof is often dictated by the type of building. "If it's a tall, slim tower, you don't have much of a chance. But if you have a low-rise building or one that is a series of steps, you consider it straightaway."

Minister welcomes new green building code

Planning minister Margaret Beckett gave a cautious welcome last week to the UK Green Building Council's proposed Code for Sustainable Buildings. The minister said: "I am very willing to listen to people coming forward with ideas to reduce carbon emissions.

"The code should ensure consistency of approach between all policies, tools, guidance and initiatives. It should set the standards, metrics and targets that all sustainability tools should be aligned to and compliant with."

"At the moment the practical delivery and management of sustainable buildings is being held up by a confusing myriad of different policies, regulations, tools and standards.

Councillor Graham Wilkes at the "secret garden"

Walsall's bus station provoked mixed reactions for its modern architecture when it opened last year.

But one part of the building remained unseen until Tuesday - a secret garden above the heads of the passengers.

Thousands of tiny rock plants have been planted on the roof in an attempt to reduce pollution from the buses and protect the roof at the same time. It is believed to be the first scheme of its kind.

Councillor Graham Wilkes, of Walsall Council, said: "This garden was put down to protect the membrane underneath and stops wet penetrating the concrete. It also takes in ultra-violet light and infra-red light and is very environmentally friendly."

Mr Wilkes added: "In another 12 months the garden will be really green. This has never been tried anywhere else and if successful, I can see it going to other places."

Britain's new, greener neighbourhoods

A developer in Shropshire is building one of the greenest and most neighbourly housing schemes in the country.

It looks like it has come straight out of a children's story-book. Each house is a different shade of fruit pastel: raspberry red, custard yellow, lime green.

This is the Wintles, a new development of 40 houses on the edge of the town of Bishop's Castle. The buildings are actually designed with some sobering realities in mind: the fact that the planet is getting warmer. The fact that our homes make up around 27% of the UK's carbon emissions; and the target set by the government of reducing our carbon output by 60% by the year 2050. The designer Bob Tomlinson insists the Wintles is a modern development: "We set out to build houses appropriate for the time in which we live. We felt most builders now are using designs from the 1970s and so we looked at what was happening in North America and Scandinavia and came up with a very light and environmentally efficient house."

Reading task **C**

Sustainable Architecture Questions and Answers

1. Read some information about Kelly Hart – a green building professional. Then think of some questions you would like to ask him.

Kelly Hart has been involved with sustainable building concepts for much of his life. Kelly spent many years as a professional remodeler, during which time he became acquainted with many of the pitfalls of conventional construction. One of the more recent video programs that he produced is A Sampler of Alternative Homes: Approaching Sustainable Architecture, which explores a whole range of building concepts that are earth friendly. Kelly is knowledgeable about both simple design concepts and more complex technological aspects of home building that enhance sustainable living. Kelly, and his wife Rosana, live in the earthbag home. He is available, at a modest fee, for consulting about sustainable building design, either for remodeling existing structures to more fully embrace these concepts, or for new architectural designs.

2. Now read the interview itself. Have any of your questions been answered in it?

Q: What does the term "green architecture" mean?

A: Green architecture might mean different things to different people. I use the term to include all aspects of architectural design and construction that enhance sustainable, healthy living. This might simply relate to choosing materials that do not offgas toxic chemicals, or it might relate to significant building designs that capture and reuse all of the water and energy that is required for comfortable living within.

Q: I want to do my masters in architecture, and before starting I just want to know what sustainability means to architecture? What areas does it include and how?

A: Sustainable architecture means designing buildings that enhance our environment over a long period of time rather than detract through energy consumption or resource depletion. It includes the creation of structures that are non-toxic, that contribute to a healthy life-style, and that perform their functions well.

Q: I'm trying to trace the evolution of sustainable building from the 1970s. How difficult was it to procure sustainable building materials in the '70s? And were green building projects normally limited to such things as solar collectors and water recycling systems?

A: The main thing that has changed since the 1970s is a focus on, or awareness of, sustainable issues. Sustainable buildings were certainly being built, but people weren't thinking of them as "sustainable;" they were just traditional adobe or stone buildings. So most of the natural building blocks were available then, but perhaps some of the modern "green" industrial products were not. The concepts of passive solar design have evolved over a very long time.

Q: What are the benefits of using natural materials and where does technology fit in?

A: From an ecological standpoint, natural materials have the advantage that they generally don't require much energy to manufacture or even transport them. This savings in energy will likely diminish the amount of greenhouse gas (CO_2) that is emitted and also the amount of fossil fuel consumed. From an aesthetic or emotional standpoint, natural materials feel much more, well, natural. Technology is always behind the scenes in our modern world, and I am not one to spurn its use when appropriate. I just feel that one should look to the simpler, natural solutions first, before employing more technological ones.

Q: In your opinion is the public aware of the benefits of natural building, and is there a demand on this type of architecture?

A: I would say that there is greater awareness of the issues and the solutions all the time. I have noticed that many more architects are offering sustainable design options, the media is more likely to report on this trend.

Q: I would like to build a natural, environmentally-friendly and beautiful home. How should I go about choosing what to build with? When should I go with cob, adobe, strawbale, earthbags, rammed earth?

A: There are several criteria that can help you make these choices. The first thing to focus on is actually not the material, but the design and function and that will be guiding you. Once you know what and where you want to build then you can look at how and with what materials. Often people will say that they want to build a cob house, for instance, when in fact cob would not be a wise choice for a house in their particular climate.

Q: How long, if at all, do you think it will take for sustainable ideas to become the norm in construction?

A: With the pressures on society from global warming and peak oil we will inevitably be moving in this direction...probably sooner than most would expect.

Q: I found there are many people that believe building according to the principles of sustainability is too expensive and too complex. What is the cost difference in building a sustainable house versus a traditional house?

A: There are so many different ways of sustainable building that no generalizations should be made. Some are simpler and less expensive, while some are more complex and more expensive than conventional construction. Anyway, once the house is built, it will save energy and money for the owner through its efficiency.

Q: What do you think about modern architecture, i.e. the façade and the employment of synthetic material in it?

A: Modern architecture generally leaves me feeling rather cold. The stark rectangular forms made from industrial materials do not relate to the natural world, and in this departure it attempts to isolate man from our Mother Earth. I am much more interested in being a part of the natural world.

Q: Have you considered employing traditional architecture since it is based on the use of natural materials?

A: I am a strong supporter of the use of vernacular architecture, and promote it at my website. The older ways of building usually employ the use of natural materials in appropriate ways. The wisdom of the past should be utilized today.

3. Answer the following questions:

1. What problems relating to the topic of sustainable architecture have been touched upon?
2. What does Kelly Hart think of "green building"?
3. What is Kelly Hart's opinion on sustainability?
4. What is said about the history of this concept?
5. Can you name some advantages of using natural materials?
6. What should the first step be when you have made up your mind to build an environmentally-friendly house?
7. What is said about the cost of green building?
8. Can you compare it with building a conventional house?
9. What is Hart's opinion on the traditional architecture?
10. What is his point of view upon modern architecture?
11. Is public aware of the pressing environmental issues?
12. Are people ready to build green from Hart's point of view?

4. What ecologically friendly building materials are mentioned in the interview? Do you know all of them? Are they widely used in our country? Choose one material and find additional information about its properties. Then make a presentation in class.

Reading task D

1. Read what green building is and then discuss why it is one of the most topical environmental issues nowadays. Make use of the information given after the text.

The built environment has a vast impact on the natural environment, human health, and the economy. Green building is an approach to design and construction that respects the environment and conserves resources. It is a common sense approach that is available to all home owners. It is a set of informed decisions that considers the site and materials to reduce the cost, maintenance, and energy usage of the home. Green building techniques create a more cost effective, enjoyable and sustainable home to live in. Green construction methods can be integrated into buildings at any stage, from design and construction, to renovation and deconstruction.

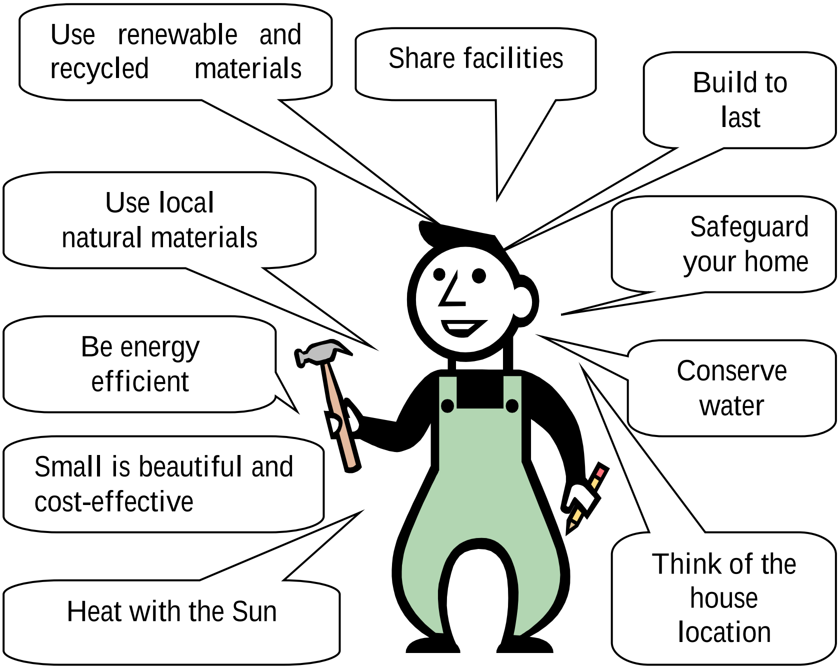
By adopting green building strategies, we can maximize both economic and environmental performance.

Environmental benefits	Economic benefits	Social benefits
Enhance and protect biodiversity and ecosystems	Reduce operating costs	Enhance occupant comfort and health
Improve air and water quality	Create, expand, and shape markets for green product and services	Heighten aesthetic qualities
Reduce waste streams	Improve occupant productivity	Minimize strain on local infrastructure
Conserve and restore natural resources	Optimize life-cycle economic performance	Improve overall quality of life

Facts and figures:

In the USA buildings account for:
39 % of total energy use
12 % of the total water consumption
68 % of total electricity consumption
38 % of the carbon dioxide emissions
90 % of their time people spend indoors.
2 to 5 times worse air quality inside than outside.

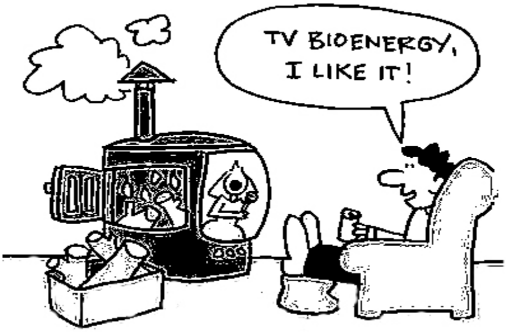
2. Here are 10 principles of green building. Look through them and try to predict what each of them is about. Then read the extracts below and match them with the corresponding principles.



1. The trend lately has been toward huge mansion-style houses. While these might fit the egos of those who purchase them, they don't fit with a sustainable life style. Large houses generally use a tremendous amount of energy to heat and cool. This energy usually comes from the combustion of fossil fuels, depleting these resources and emitting greenhouse gases and pollutants into the air. Also, the larger the house, the more materials go into its construction; materials which may have their own environmental consequences. A home should be just the right size for its occupants and their activities. Create multipurpose spaces. To save on construction costs, consider building more floors instead of a sprawling one-story home. Going up is usually cheaper than spreading out. A multistory home also reduces the impact on the landscape.

2. Use the sun to heat and cool the building. Passive solar heating, day lighting (using natural sunlight to light a room), and natural cooling can be incorporated cost-effectively into most buildings. As energy costs rise, it is critical to use building orientation, window placements, stone floors, roof overhangs, reflective barriers and other techniques to control natural solar energy. In colder climates, solar heat can be absorbed and stored by the surrounding thermal mass (usually masonry materials such as concrete or stone), so that the heat will be given back into the room when the sun goes down. A well designed solar house is both warm when you want it, and cool when you want it; that is to say, the temperature tends to stay fairly even.

3. There are many ways to conserve the use of fossil fuel. Using the sun, wind, or water to produce electricity is one. If you choose to do this, you will be forced to be careful in the way you use your electricity because it is limited. Whether you get your electricity from alternative sources or from the grid, it pays to choose energy efficient appliances. Making an energy-efficient building is the easiest thing you can do to save energy. Use high levels of insulation, high-performance windows, and tight construction. You may think of the way your house will use renewable energy, consider solar water heating and photovoltaics or design the roof for future solar panel installation.



4. The average person in the U.S. uses between 100 and 250 gallons (378-945 liters) of water a day. It is possible to get by just fine on one tenth that amount. The use of low water capacity toilets, flow restrictors at shower heads and faucet aerators are fairly common now. More radical conservation approaches include diverting gray water from bathing, clothes washing and bathroom sinks to watering plants or flushing toilets, catching rain water from roofs and paved areas for domestic use or irrigating your lawn.

5. There are several benefits to using local, indigenous materials. For one, they naturally fit into the "feeling" of the place. For another, they don't burn as much fossil fuel to transport them, and they are likely to be less processed by industry. Naturally occurring materials often "feel" better to live with. A major reason for choosing natural materials over industrial ones is that the pollution often associated with their manufacture is minimized. For every ton of Portland cement that is manufactured, an equal amount of carbon dioxide is released into the air. And then there is the matter of your health; natural materials are much less likely to adversely affect your health.

6. While wood is ostensibly a renewable resource, we have gone way beyond sustainable harvesting and have ruined enormous ecosystems. Use wood as decoration. Cull dead trees for structural supports. Design for alternative construction techniques. Use masonry, straw bales, cob, adobe, rocks, bags of volcanic rock, etc., instead of wood. Make the structure adaptable to other uses, and choose materials and components that can be reused or recycled. Consider an addition to your existing home instead of building new. Remodeling your home is a form of recycling. Before assuming you need to build something new, consider putting an addition on your home instead. Take the money you save and put it into more important things, like solar panels.

7. It`s just a common sense to choose healthy and non-toxic materials. At the beginning of your design, commit to using only healthy materials in your new home. Avoid products that contain dyes, ozone depleting chemicals, heavy metals, formaldehyde, or known carcinogens. Reducing the size of your lawn is a good idea as lawns require a great deal of maintenance, pesticides, and mowing. Avoid this high impact with native and natural landscaping. Make sure construction waste is properly disposed of, especially paints and solvents. Do not allow them to be buried on the site.

8. There is an attitude in this throw-away society that an old house might as well be replaced by a new one. Unfortunately this is often true, because of low-quality construction or poor choice of materials, or lack of maintenance. A well made house can last for centuries, and it should.

9. A basic principle of sustainability is to share what you have with others. Doing this can diminish the need for unnecessary duplication of facilities. In this way a group of people can not only have fewer tools or appliances or functional areas, but at the same time they can have available a greater variety of these facilities. This benefits both the environment (through less industrial activity) and the individual (by providing more options for living).

10. Locate your new home close to public transportation or bicycle paths, or within walking distance of shops and basic services so as to minimize dependence on your car. Include a home office in your design to reduce commuting; you'll reduce your stress and save on fuel costs. Locate the house to minimize environmental impact. Design the home to preserve open space and wildlife habitats. Try to keep as many of the existing trees, plants and birds as possible.

3. Answer the questions:

1. What is the main idea of green building?
2. What is your opinion on this construction approach?
3. Which of these principles would you like to follow if you decided to build green?
4. Are they followed in a typical construction process?
5. Do you think we can apply all of them to our country?
6. Do you know anything about the governmental support of green building in other countries? What about our country?

4. Divide into two groups and collect the arguments for and against the green building approach. Then discuss them in class.

5. Find the information about the application of this approach in our country.

Reading task E

Earth Cycle

1. Go over the vocabulary list. Consult a dictionary if you need:

Landscape	hearth	rugged
Awareness	align	ingrained
Response	rectangle	acquire
Shift	hunker	summarily
Punctuate	swoop	low-key
Commonality	luminaire	glitzy
Relevance	grid	verdant
Refuge	framing member	scar
Affinity	fin	rectilinear
Forage	operable	meander
Prospect	rustic	watchword
Sod	interim	subdued
Foil	berm	butt
Cantilever	rugged	buttress
Flank	ebb	overhang

2. Read the first part of the text and answer the questions after it.

Spanning 25 years in the work of Jim Olson of Olson Sundberg Architects, these houses illustrate the evolution of a sustainable design sensibility rooted in the 1960s.

The relationship of architecture to the land – and to the water and the sun and the wind – has been a constant concern in the work of Jim Olson of the Seattle firm, Olson Sundberg Architects. Olson grew up in the powerful landscape of the Pacific Northwest, where environmental awareness is less a response to crisis than a matter of respect for forces of nature larger than ourselves and our buildings. "Our culture is at a turning point as we begin to shift our roles from consumers of limited resources to stewards of the planet," the architect says, in explaining the credo that guides his firm's efforts at sustainable design.

Shown here are three houses that punctuate Olson's career: one a quarter-century old, from his architectural beginnings, one recently completed, and a third that is about to be built. They are interesting both for their commonalities and their differences; seen together, they illustrate the evolution of sensible strategies of energy conservation and sensitive responses to the landscape.

One thing the houses have in common is relevance to the theory of refuge and prospect, developed by the British geographer Jay Appleton, which analyzes the innate affinity humans have for particular physical settings. As summarized by architectural historian Grant Hildebrand, the theory holds that from the earliest time humans have needed "a place of secure hiding, closed to weather and to attack from predators, a relatively dark place from which, looking out, we are not seen". This is the refuge. At the same time, "we must have a place of hunting and foraging, a place of open views over long distances in bright light to illuminate and cast shadows". This Appleton named the prospect.

The beginnings.

The first of the three Olson houses, designed in the late 1960s, is on a steep, densely wooded cliff (near a beach where Olson played as a youth) overlooking south Puget Sound and, in the distance, mighty Mount Rainier. The house is a weathered cedar object inserted into the landscape. Grass and wild flowers continue from the hill behind onto the roof. The sod is penetrated by a large sculptural concrete chimney intended as a vertical foil to the horizontality of the house.

Cantilevered over the hillside, the house is pointed directly at the mountain and is flanked by a pool. The master bedroom is against the bermed rear of the house, clearly a place of refuge. At the same level, a small parlor with a large hearth is a refuge with view. A few steps down is a second living room, its glass walls on all sides bringing in the dramatic prospect of water, woods, and mountain. In all, the house has an elemental quality, a power reflecting that of the setting. It has weathered well until it is virtually a part of the landscape.

The Next Generation

The second house, built in 1992 in the suburb of Kirkland east of Seattle, bursts cheerfully from the landscape instead of hunkering into it. Yet the principle of prospect and refuge is at work here too. The clients, a family with small children, wanted the house to seem like a pavilion in the meadow, and that is exactly its feel. It is a house that, in project architect Tom Kundig's words, "celebrates light": major rooms are aligned in a rectangle with along glazed south wall; the roof swoops upward, reaching its high point at the south façade. The rooms in this wing are suffused with light reflected from the white slope of the ceiling high overhead, which acts as a luminaire. The prospect of meadow and water is seen through the south wall's grid of wood framing members, horizontal metal fins, and round concrete columns. (The grid looks mechanical enough to be operable but is not.)

The rear wing of the house is more refugelike in character, set into the sloping meadow and bermed, the planting continuing over the garage and the children's bedrooms.

The differences between the first, rather rustic house, and the second, more "mechanic" building, reflect how time, tastes, and Olson's ideas changed in the interim: demand for rugged simplicity had ebbed and, by the time the second house appeared, the residential work of the office had grown larger, more complex and, in some instances, more formal.

3. Answer the following questions to part I:

1. What is the constant concern of Jim Olson?
2. What is the credo of his work?
3. What do three of his houses illustrate?
4. What do these houses have in common?
5. Can you explain the theory of refuge and prospect?
6. Where is the first of Olson's houses situated?

7. Can we say that the house is the integral part of the landscape? Can you prove it?
8. Does this house have a place of refuge?
9. What views can you enjoy from the house?
10. What can you say about the general character of the house?
11. Where is the second house situated?
12. Will this house attract your attention as soon as you arrive to the place?
13. What were the clients' requirements to their future house?
14. Can you describe the character of this house?
15. What can be seen from the grid of the south wall?
16. Can you prove that the rear wing of the house is more refugelike in character?
17. What is the reason for the differences between the first and the second house?

4. Read the second part of the text and answer the questions after it.

The 1960s Revisited.

Yet the third house discussed here returns to many of the themes of the first – a "return to roots" brought about in not a small part by the client's close collaboration in its design.

Like Olson, the client is a Northwest native with an ingrained respect for nature. She acquired the site for her house largely because of its fine views of one of the region's most beautiful urban lakes. Once densely wooded, it was cleared for development that never occurred.

On the advice of an interior decorator she at first turned to a Los Angeles architect, who produced a scheme that had the house rising imposingly from the very center of the site. This the client summarily rejected and turned to Olson through acquaintance with some of his clients. She told him that she was more interested in a garden than a house, and that the house should be low-key, natural, and anything but glitzy.

When Olson saw the site he termed it “a scar” of brown earth in the otherwise verdant landscape. He determined not just to respect the site but to heal it.

Olson has a technique of getting clients to join in making collages out of architectural images they like. The one made with this client was revealing: the images she responded to were of simple, rectilinear houses blending with nature, melding indoor and outdoor space, often partially covered by vines and other landscaping; their forms were straightforward, colors subdued; several had glass butting into walls and all had huge fireplaces. Interestingly, one of the images she chose for the collage was taken from the first of the three houses.

Olson tries to make “private worlds”, using perimeter walls as buttresses and creating a quiet interior space, sometimes enclosed and sometimes open. He quickly produced a sketch applying this approach to the sloping lakeside site and it was immediately accepted.

The sketch divided the body of the house into two parallel wings, with the garage, kitchen, dining and family rooms on one side, bedrooms, exercise room, library, and indoor pool on the other. The wings began as beams at the rear of the site, and were bridged by an entry and a living room overlooking the lake. The client said that she would like to enter the house from a garden path so the “valley” between wings would be a garden. Other plantings would cover the roofs of the wings.

Once the basic scheme was established, Olson and associate Kundig began to elaborate on it. A cross axis through the two wings and the bridging element was twisted and deliberately interrupted so that it became a meandering lateral path though the house; the wings were to be largely illuminated by clerestories. They would be deep refuges with a strong sense of enclosure. The living room, the architects reasoned, should be pure prospect, a seemingly open pavilion facing the lake view. Not only would it be glazed on three sides, but the sheets of glass would have planting at their bases both inside and out so that they virtually disappeared. The roof was to be raised high overhead so that it seemed to float above the walls. Weightlessness and illusion were the watchwords.

The room began to take on the look of a temple; various roof forms, including a dome and a pyramid, were studied.

Keeping it Simple

The client would have none of it – no illusions, no architectural tricks. She wanted simplicity; the living room roof would be flat, its windows perceptible as such. The cross axis would be straight and uninterrupted.

The architects were devastated to have their favourite devices rejected. "It was as though she were the artist working through us," Olson recalls. But he came around. What the client had done, he realized, "was to take us back to our roots" and, specifically, to the first house. Once on track together architects and client undertook to make the house ever more naturalistic. With perimeter gardens and trees and grasses on the lake side, the entire site will read as a garden with a house embedded in it.

The house is emerging as one of Olson's favourites, as was the first. He hoped that it will be "timeless, like a Mayan ruin disappearing back into the landscape."

Olson Sundberg has a loosely organized "eco-committee," comprising a changing group of interested employees who research and advise on diverse aspects of sustainability in the firm's designs. The committee was partially responsible for such conserving elements as the stone floors, wide overhangs, zoned heating and air conditioning, and the use of recycled and recyclable materials that will be employed in the house.

But Olson sees the most basic kind of conservation as building to last. "These houses should only get better with time", he says, and time already has proven him right about the first one.

5. Answer the questions to part II:

1. Did the owner of the third house help to develop its design?
2. What were her requirements for the design of the house?
3. Why did Olson call the site "a scar"?
4. What types of houses did the client respond to when making collages?
5. What idea did Olson try to realize in this house?
6. Can you describe the basic scheme of the house?

7. Will the vegetation be preserved on site according to the architects' scheme?
8. What were the watchwords of the house design?
9. What techniques were to help them be realized?
10. Did the client support the project of her future house?
11. On what points did the opinions about the character of the house differ?
12. What was the final scheme of the house?
13. Did Olson himself like it?
14. What was the "eco-committee" responsible for?
15. What is Olson opinion of conservation?
16. Does he have grounds to think so?

Comprehension check

6. Decide whether the following statements are true or false according to the text.

1. These three houses are interesting both for their commonalities and their differences.
2. One thing the houses have in common is relevance to the theory of energy conservation and sustainability, developed by the British geographer Jay Appleton.
3. The first of the three Olson houses was designed in the early 1960s.
4. It bursts cheerfully from the landscape instead of hunkering into it.
5. Cantilevered over the hillside, the house is pointed directly at the mountain and is flanked by a lake.
6. The second house in project architect Tom Kundig's words "celebrates light".
7. The differences between the first, rather "mechanic" house, and the second, more rustic building, reflect how time, tastes, and Olson's ideas changed in the interim.
8. The third and the second houses are very much alike in character.
9. Once densely wooded, the site of the third house was cleared for development that never occurred.
10. When Olson saw the site he liked it at once.

11. The images the client responded to when making collages were of imposing houses attracting everyone's attention immediately.

12. The living room, from the architects' point of view, should be a seemingly open pavilion facing the lake view.

13. The client wanted simplicity.

14. The architects were surprised to have their favourite devices rejected.

15. The architects and the client collaborated to make the house still more naturalistic.

16. Olson sees the most basic kind of conservation as the use of recycled and recyclable materials.

7. What is not mentioned in the text?

1. The theory of refuge and prospect.
2. The necessity to be environmentally aware.
3. The idea of returning to our roots.
4. The idea of sustainability.
5. The economic benefits of building to last.

8. What do you think:

1. Which of the three houses described in the article do you like most? Can you explain your choice?
2. Do you prefer simplicity and blending with nature or an imposing style striking the people's eye?
3. What is your opinion on Jim Olson's architectural ideas and his credo?
4. Can you work out your own credo that will guide you in your future professional work?
5. Do you know any examples of houses with some interesting building techniques in our country?
6. Can you explain the title of the text?
7. Which principles of sustainable architecture have been implemented by Jim Olson in building his houses?

9. Make up the plan of the text.

10. Make a summary according to your plan using the following expressions:

The title of the text is…. The point under discussion is…. The text can be divided into …. The first part dwells upon…. The second part describes…. The third part reports on…. The main idea of the text is….

Language focus

11. Match the words with their synonyms.

1) environment	6) buttress	a) support	f) method
2) ebb	7) fin	b) background	g) interrupt
3) punctuate	8) technique	c) fade away	h) simple
4) intend	9) rustic	d) setting	i) fill
5) foil	10) suffuse	e) design	j) rib

12. Match the words with their antonyms.

1) commonality	6) verdant	a) front	f) low-key
2) rear	7) reject	b) strict	g) twisted
3) enclosed	8) loose	c) forget	h) accept
4) awareness	9) recall	d) difference	i) leafless
5) glitzy	10) rectilinear	e) open	j) ignorance

13. Match the words with their definitions.

1. cantilever	a) a narrow path or ledge at the edge of a slope, road, or canal
2. affinity	b) a living room, especially one kept tidy for the reception of visitors
3. clerestory	c) a rapid drawing or painting, often a study for subsequent elaboration
4. buttress	d) a natural liking, taste, or inclination towards a person or thing

5. berm	e) a view or scene, especially offering an extended outlook
6. refuge	f) a construction, usually of brick or stone, built to support a wall
7. parlour	g) a row of windows in the upper part of the wall
8. prospect	h) the floor of a fireplace, especially one that extends outwards into the room
9. hearth	i) shelter or protection, as from the weather or danger
10. sketch	j) to construct a building member, beam, etc. so that it is fixed at one end only

Language development

14. Fill in the gaps with the words below:

a) inserted	b) refuge
c) elaborate	d) low-key
e) ingrained	f) watchwords
g) a scar	h) in the interim
i) in common	j) conservation
k) feel	l) framing members
m) devastated	n) buttresses

1. One thing the houses have ____ is relevance to the theory of refuge and prospect, developed by the British geographer Jay Appleton.
2. The house is a weathered cedar object _____ into the landscape.
3. At the same level, a small parlor with a large hearth is a ______ with view.
4. The clients, a family with small children, wanted the house to seem like a pavilion in the meadow, and that is exactly its_____.
5. The prospect of meadow and water is seen through the south wall's grid of wood _________, horizontal metal fins, and round concrete columns.
6. The differences between the first, rather rustic house, and the second, more "mechanic" building, reflect how time, tastes, and Olson's ideas changed _______.

7. Like Olson, the client is a Northwest native with an ______ respect for nature.
8. She told him that she was more interested in a garden than a house, and that the house should be _____, natural, and anything but glitzy.
9. When Olson saw the site he termed it "___" of brown earth in the otherwise verdant landscape.
10. Olson tries to make "private worlds", using perimeter walls as _______ and creating a quiet interior space, sometimes enclosed and sometimes open.
11. Once the basic scheme was established, Olson and associate Kundig began to _____ on it.
12. Weightlessness and illusion were the_______.
13. The architects were _______to have their favourite devices rejected.
14. But Olson sees the most basic kind of ____as building to last.

15. Think of not less than 5 sentences of your own using the words and word-combinations from the previous exercise.

16. Complete the sentences with the suitable preposition, if necessary.

1. respond … the images
2. affinity … a place
3. to be interesting … their commonalities
4. to burst … the landscape
5. suffused … light
6. refugelike … character
7. to act … a luminaire
8. a demand … simplicity
9. to elaborate … the project
10. to clear … development
11. … the advice of a decorator
12. a respect … nature
13. to make collages … … architectural images
14. to blend … nature
15. to butt … the walls

16. to apply this approach … the site
17. to divide the house … two wings
18. to take … the look of a temple
19. to take us … to our roots
20. to advise … diverse aspects
21. to be responsible …
22. to face … the lake view

17. Translate the following sentences from Russian into English:

1. Уважение к природе, забота об окружающей среде и отказ от потребительского отношения к природным ресурсам являются принципами жизни разумного человека.
2. Из окна гостиной открывается потрясающая панорама лугов и лесов у подножия холма.
3. Дом нависает над склоном холма и составляет неотъемлемую часть окружающего пейзажа.
4. Клиент склонялся к строительству простого дома из прямых линий и отклонил проект вычурного бросающегося в глаза особняка.
5. В результате был построен небольшой дом, находящийся в гармонии с природой и как бы притаившийся среди окружающего пейзажа.
6. Изгибающаяся тропинка проходит через основную часть дома и делит дом на два крыла.
7. Крыша была поднята настолько высоко, что, казалось, плыла над стенами.
8. Полностью застекленная сторона дома создавала иллюзию невесомости.
9. Тем временем угас спрос на яркие броские дома и возрос интерес к простому сельскому стилю строительства.
10. Группа архитекторов давала консультации по различным аспектам экологически устойчивого строительства.

Follow-up

18. Look through some information about underground construction and answer the following questions:

1. Is it possible to build underground wherever you like?
2. In what way is underground construction connected to green building approach?
3. Do you think it is a widespread construction technique? If so, give some examples of it.
4. What are the main advantages of subterranean homes
5. Can you think of any disadvantages of building such houses?
6. Would you like to live in such a house or would you prefer a conventional one?

Underground housing (sometimes called earth sheltered housing) refers specifically to homes that have been built underground, either partially or completely. These subterranean homes have grown increasingly popular over the last thirty years and are an important sector in the green building movement.

Factors determining the design of an underground home:

1. soil type
2. topography
3. precipitation
4. ground water levels
5. load-bearing properties
6. slope stability.
7. availability of waterproof, durable construction materials strong enough to withstand underground pressure (concrete is frequently used).

Several methods of building for subterranean living:

- Constructed Caves – made by tunnelling into the earth. Although popular around the world, this can be an expensive and dangerous procedure.
- Cut and Cover – also called culvert homes, these are made by assembling precast concrete pipes and containers into the required design of the living space, and then burying them in the ground.
- Earth Berm – house is first built on flat land or a small hill, and then buried, leaving a wall or roof open for light.
- Elevational – house is built into the side of a hill with the front of the home left open.
- Atrium – also called courtyard homes, the rooms are built below the ground around a sunken garden or courtyard that lets light in.
- PSP – stands for post, shoring and polyethylene. House is built by excavating the ground, sinking in posts, placing shoring (boards) between the posts and the earth, and placing polyethylene plastic sheets (for waterproofing) behind the shoring.
- Shaft – an ambitious project in Japan called Alice City plans the construction of a wide and deep cylindrical shaft sunk into the earth with a domed skylight covering, and different levels for business and domestic use built around the shaft.

Advantages of building underground

Houses can be built on steep surfaces and can maximize space in small areas by going below the ground. In addition the materials excavated in construction can be used in the building process.

Underground houses have less surface area so fewer building materials are used, and maintenance costs are lower. They are also wind, fire and earthquake resistant, providing a secure and safe environment in extreme weather.

One of the greatest benefits of underground living is energy efficiency. The earth's subsurface temperature remains stable, so underground dwellings benefit from geothermal mass and heat exchange, staying cool in the summer and warm in the winter. This saves around 80% in energy costs. By incorporating solar design this energy bill can be reduced to zero, providing hot water and heat to the home all year round. An additional benefit of the surrounding earth is noise insulation. Underground homes are exceptionally quiet places to live.

Finally, underground houses blend with the natural landscape, and have minimum impact on the local ecology. This is not only aesthetically pleasing but ensures that the maximum habitat is left alone for wildlife.

19. Look through the unit again and make notes under the following headings. Then use your notes to talk about sustainability and green building.

1. Sustainability and its application in architecture.
2. The main principles of green building.
3. Sustainable building design and materials.
4. Examples of an interesting building design.
5. Possible benefits of living in such houses.
6. Underground construction.

Extra activities

1. Do this questionnaire to find out how green you are. Make use of the list of unknown words at the end of it. Then discuss the results in class.

? Eco-pinions

How do you feel about the green movement?

"Going green" has become as mainstream as baseball and apple pie, and Earth Day has morphed from an also-ran government holiday to a full-fledged international celebration of all things eco-friendly. Are you on the green bandwagon, or still wondering how to take part? Who do you think is making a difference, and whose lifestyle annoys you?

1. Which celebrity is doing the most to save the world?
a) Brad Pitt - The King of Abs and Eco-Building
b) Leonardo DiCaprio - The King of Environmental Movie Stars
c) Angelina Jolie – a mother for every child
d) Heather Mills – go vegan or go home!
e) Oprah – the Expert of Everything

2. Who is the least green celebrity?
a) Chris Brown – he'll buy new clothes before he'll do laundry
b) John Travolta – responsible for 800 tons of carbon emissions per year just from his private jet trips
c) Jennifer Aniston – does yoga, but shills SmartWater in plastic bottles
d) Mariah Carey – flies her trainer to NYC from St. Barts every day
e) Madonna – voted PETA's most evil fur wearer

3. What's the easiest thing to do in going green?
a) Recycle and compost
b) Bring reuseable shopping bags to the store
c) Switch to CFL bulbs
d) Unplug electronics when you're not using them
e) Go vegetarian one day a week

4. What's the hardest part about going green?
a) Walking or biking instead of using the car
b) Spending more money for organic food

c) Giving up bottled water
d) Using recycled toilet paper
e) Avoiding wearing fur-coats

5. On a scale of 1 to 5, how green are you?
a) 1 – Not at all
b) 2 – I do a little when a can
c) 3 – It's important to me
d) 4 – Being green is a huge part of my life
e) 5 – I consider the planet's health in every decision I make

6. What's your number one green priority?
a) Wildlife conservation
b) Reducing pollution
c) Managing over-population
d) Developing alternative energy
f) Ending world hunger

7. What's at the top of your eco-wishlist?
a) Hybrid car
b) Energy efficient appliances
c) Bamboo flooring and recycled carpeting
d) Solar panels
e) Organic clothing

8. What do you think is the most pressing environmental issue?
a) Climate Change
b) Preserving the rainforests
c) Protecting endangered animals
d) Running out of oil
e) Saving the honeybees

PETA – People for the Ethical Treatment of Animals
to shill – to advertise something by actively using it
vegan – a person who refrains from using any animal product whatever for food, clothing, or any other purpose
also-ran - an unsuccessful person; a loser
fledged – grown up

to morph – to transform

mainstream – the main current, the majority

to be on the bandwagon - to join or give support to a party or movement that seems to be assured of success

Time for fun

Read the following jokes.

Builder in Hell

A builder dies and reports to the pearly gates. St. Peter checks his dossier and says, "Ah sorry, you're in the wrong place." So the builder reports to the gates of hell and is let in. Pretty soon, the builder gets dissatisfied with the level of comfort in hell, and starts making improvements. After a while, they've got air conditioning and flush toilets and escalators, and the builder is a pretty popular guy. One day God calls Satan up on the telephone and says, "So, how's it going down there in hell?" Satan replies, "Hey, things are going great. We've got air conditioning and flush toilets and escalators, and there's no telling what this builder is going to come up with next." God replies, "What??? You've got a builder? That's a mistake! He should never have gotten down there; send him up here." Satan says, "No way. I like having a builder on the staff, and I'm keeping him." God says, "Send him back up here or I'll sue." Satan laughs uproariously and answers, "Yeah, right. And just where are YOU going to get a lawyer?"

Construction Engineers and Lawyers

There are two big conferences in NY, one for construction engineers and one for lawyers. They are both being held in the same building downtown.

On the first day of the conference, two groups run into each other at the train station and chat while waiting in line to buy tickets into the city. When they reach the counter, the three lawyers each buy tickets and watch as the three Engineers buy only a single ticket. "How are three people going to travel on only one ticket?" asks a lawyer. "Watch and you'll see," answers an Engineer.

They all board the train. The lawyers take their respective seats, but all three Engineers cram into a restroom and close the door behind them. Shortly after the train has departed, the conductor comes around collecting tickets. He knocks on the restroom door and says, "Ticket, please." The door opens just a crack and a single arm emerges with a ticket in hand. The conductor takes it and moves on. The lawyers see this and agree it is quite a clever idea.

After the conference, the lawyers (recognizing the engineers' superior intellect) decide to copy the construction engineers on the return trip and save some money. When they get to the station, they buy a single ticket for the return trip.

To their astonishment, the construction engineers don't buy a ticket at all. "How are you going to travel without a ticket?" says one perplexed lawyer. "Watch and you'll see," answers an engineer. When they board the train the three lawyers cram into a restroom and the three construction engineers cram into another one nearby. The train departs.

Shortly afterward, one of the construction engineers leaves his restroom and walks over to the restroom where the lawyers are hiding. He knocks on the door and says, "Ticket, please."

The Guilliotine

In some foreign country a priest, a lawyer and a construction engineer are about to be guillotined. The priest puts his head on the block, they pull the rope and nothing happens – he declares that he's been saved by divine intervention – so he's let go. The lawyer is put on the block, and again the rope doesn't release the blade, he claims he can't be executed twice for the same crime and he is set free too. They grab the construction engineer and shove his head into the guillotine, he looks up at the release mechanism and says, "Wait a minute, I see your problem......"

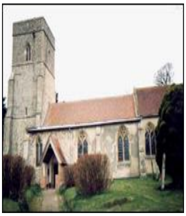
UNIT II

RENEWABLE ENERGY AND CONSTRUCTION

Warming up

1. Read the following news and try to guess what ideas they have in common and what problems they deal with.

A 13th Century village church is aiming to install solar panels as part of an environmentally friendly fund-raising scheme.



Parish officials hope the panels will produce more than enough power to light St Mary's in Lidgate, Suffolk.

They plan to sell the excess electricity back to the National Grid.

St Mary's is thought to be one of the first churches in the country to try to generate power and extra money in such a fashion.

Church warden Michael McEvoy said the scheme, which will cost £12,000, will not spoil the church's architecture.

Cost of solar power could fall 40% by2015

Technological advances are driving down photovoltaic panel prices by as much as 10% each year.

The cost of photovoltaic panels could fall around 40% in the next five to six years, according to Dutch sustainable energy provider Econcern.

The company claimed that system prices are decreasing by 7% to 10% a year as a result of technological innovation and increased production capacity.

The development of solar power in the Middle East looks set to exceed growth of solar power globally.Solar energy will be one of the most important sources of energy within 10 years.

Medieval architecture

Library of the Free University, Berlin

Berlin's Free University has made a self-assured mark with its new library designed by Britain's most famous architect Lord Norman Foster. The new FU humanities library has been nicknamed "The Berlin Brain". And true to its name, the building's curved galleries and stairways actually resemble the winding convolutions of a brain. The fascinating building which opened in September 2005 now unites the 700,000 books that were previously housed in 11 different libraries. From the outside the building resembles a scaled, spherical igloo, while the inside offers an airy, inspiring atmosphere for concentrated study.

From the inside an inner membrane of glass fibre gives the impression of looking through a soft-focus lens at the outer bubble-like enclosure of steel, glass and aluminium. "The Brain" is also ecologically friendly: computer regulated vents and a heating system that utilizes the heat-reflecting elements of the structure enable natural ventilation and heating almost all year round.

inspires zero-carbon home

Innovative energy-efficient home based on historic technique of arched overlapping thin clay bricks will star in TV's Grand Designs

The four-bedroom Crossway house in Staplehurst uses a large vault constructed out of clay tiles spanning 20m to create a structure with a low embodied energy and high thermal mass. The basic design is adapted from a historic Mediterranean technique called "timbrel vaulting", which uses thin bricks to create lightweight and durable buildings.

Any necessary heating comes from solar energy through the UK's first example of a combination photovoltaic and thermal heating system.

While more expensive than some conventional homes, the designers of Crossway believe that its design and technology could ultimately be a prototype for cheaper energy-efficient homes. The building demonstrates how contemporary design can celebrate local materials and integrate new technologies to produce a highly sustainable building that sits lightly on the Earth.

Reading task A

Renewable Energy

1. Before reading the text try to answer the following questions:

What is renewable energy?

What renewable sources of energy are used nowadays?

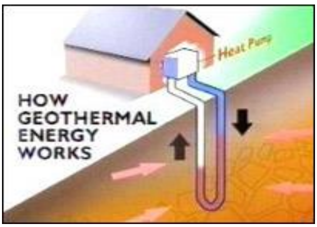
2. Read the text and check your answers.

Renewable energy is energy generated from natural resources — such as sunlight, wind, rain, tides and geothermal heat — which are renewable (naturally replenished).

In 2006, about 18% of global final energy consumption came from renewables, with 13% coming from traditional biomass, such as wood-burning.

Hydroelectricity was the next largest renewable source, providing 3% (15% of global electricity generation), followed by solar hot water/heating, which contributed 1.3%.

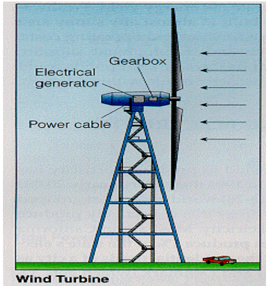
Modern technologies, such as geothermal energy, wind power, solar power, and ocean energy together provided some 0.8% of final energy consumption.



Geothermal energy is energy obtained by tapping the heat of the earth itself, usually from kilometers deep into the Earth's crust. Where hot underground steam or water can be tapped and brought to the surface it may be used to generate electricity. Such geothermal power sources exist in certain geologically unstable parts of the world such as Chile, Iceland, New

Zealand, United States, the Philippines and Italy. The world's largest geothermal power installation is The Geysers in California.

Wind power is the conversion of wind energy into a useful form, such as electricity, using wind turbines. It is growing at the rate of 30 percent annually and is widely used in several European countries and the United States. It is renewable and produces no greenhouse gases during operation, such as carbon dioxide and methane.



Wind Turbine

Solar energy refers to energy that is collected from sunlight. Solar thermal power stations operate in the USA and Spain.

Solar energy can be applied in many ways, including to:

- generate electricity using photovoltaic solar cells.
- generate electricity using concentrated solar power.
- generate electricity by heating trapped air which rotates turbines in a Solar updraft tower.
- generate electricity in geosynchronous orbit using solar power satellites.
- generate hydrogen using photoelectrochemical cells.

"In one hour more sunlight falls on the earth than what is used by the entire population in one year."

- heat and cool air through use of solar chimneys.
- heat buildings, directly, through passive solar building design.
- heat foodstuffs, through solar ovens.
- heat water or air for domestic hot water and space heating needs using solar-thermal panels.
- solar air conditioning

Energy in water (in the form of kinetic energy, temperature differences or salinity gradients) can be harnessed and used.

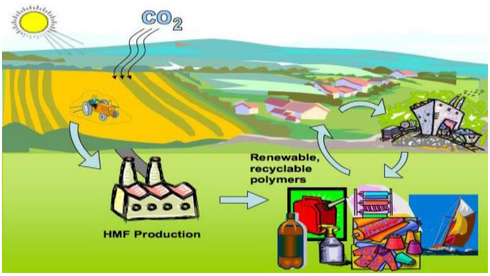
Forms of water energy:

- Hydroelectric energy is a term usually reserved for large-scale hydroelectric dams. Examples are the Grand Coulee Dam in Washington State and the Akosombo Dam in Ghana.
- Micro hydro systems are hydroelectric power installations that typically produce up to 100 kW of power. There are many of these installations around the world, including several delivering around 50 kW in the Solomon Islands.

- Damless hydro systems derive kinetic energy from rivers and oceans without using a dam.
- Ocean energy describes all the technologies to harness energy from the ocean and the sea.

Biofuel is defined as solid, liquid or gaseous fuel obtained from relatively recently lifeless or living biological material and is different from fossil fuels, which are derived from long dead biological material. Also, various plants and plant-derived materials are used for biofuel manufacturing. Globally, biofuels are most commonly used to power vehicles, heat homes, and for cooking.

"Fossil fuels are depleted at a rate that is 100,000 times faster **than they are formed."**



Biofuel industries are expanding in Europe, Asia and the Americas. Recent technology developed at Los Alamos National Lab even allows for the conversion of pollution into renewable bio fuel. Agrofuels are biofuels which are produced from specific crops, rather than from waste processes such as landfill off-gassing or recycled vegetable oil.

Brazil has one of the largest renewable energy programs in the world, involving production of ethanol fuel from sugar cane, and ethanol now provides 18 percent of the country's automotive fuel. Ethanol fuel is also widely available in the USA.

3. Fill in the table.

Types of energy	Advantages	Countries
1. Geothermal energy		
2. Hydroelectricity		
3. Solar energy		
4. Wind power		
5. Biofuel		

4. Read the text again and make questions. Answer them.

How many…?
Where can…applied?
What is…?
When…?
How much…?
What forms of…?

5. Choose any source of energy and make a short presentation. Try to use additional information.

Reading task B

1. Read the text and answer the questions after it.

What is a passive house?

"Maximising the use of solar energy and minimising heat loss is our credo."
Rolph Disch

A passive house is a building in which a comfortable interior climate can be maintained without active heating and cooling systems. The house heats and cools itself, hence "passive".

Passive solar building design uses the structure's windows, walls, and floors to collect, store, and distribute the sun's heat in winter and reject solar heat in summer. It can also maximize the use of sunlight for interior illumination.

The technology is called passive solar design, or climatic design. Unlike active solar heating systems, it doesn't involve the use of mechanical and electrical devices — such as pumps, fans, or electrical controls — to circulate the solar heat. Buildings thus designed incorporate large south-facing windows and construction materials that absorb and slowly release the sun's heat. The longest walls run from east to west. In most climates, passive solar designs also must block intense summer solar heat. They typically incorporate natural ventilation and roof overhangs to block the sun's strongest rays during that season.

"Day lighting" takes advantage of natural sunlight, through well-placed windows and specialized floor plans, to brighten up a building's interior.

Passive solar design can be used in most parts of the world.

In the United Kingdom, an average new house built to the passive house standard would use 77% less energy for space heating, compared to the Building Regulations.

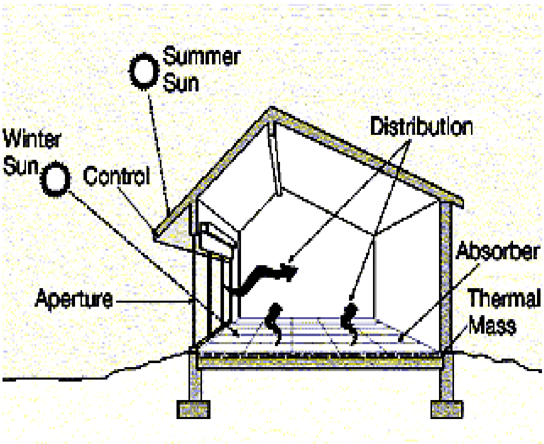
In Ireland, it is calculated that a typical house built to the passive house standard instead of the 2002 Building Regulations would consume 85% less energy for space heating and cut space-heating related carbon emissions by 94%.

The first passive house buildings were built in Darmstadt, Germany, in 1990, and occupied the following year. In September 1996 the Passive House Institute was founded in Darmstadt to promote and control the standard. More than 6,000 passive house buildings have been constructed in Europe, most of them in Germany and Austria, with others in various countries worldwide. In North America the first passive house was built in Urbana, Illinois in 2003, and the first to be certified was built at Waldsee, Minnesota, in 2006.

In the United States, a house built to the passive house standard results in a building that requires between 75 and 95% less energy for space heating and cooling than current new buildings that meet today's US energy efficiency codes. The passive house in the German Language Village, Waldsee, in Minnesota uses 85% less energy than a normal house of its size.

Elements of passive solar design

Every passive solar building includes five distinct design elements:



Elements of passive solar design, shown in a direct gain application.

1. An aperture or collector — the large glass area through which sunlight enters the building.
2. An absorber — the dark surface of the storage element that absorbs the solar heat.
3. A thermal mass — the material that stores the absorbed heat. This can be masonry materials such as concrete, stone, and brick; or a water tank.
4. A distribution method — the natural tendency of heat to move from warmer materials to cooler ones (through conduction, convection, and radiation) until there is no longer a temperature difference between the two.
5. A control mechanism — to regulate the amount of sunlight entering the aperture. This can be as simple as roof overhang designed to allow more sunlight to enter in the winter, less in the summer.

Main features of passive houses design

- the air is fresh and very clean but dry (especially during winter).
- Due to the high resistance to heat flow (high R-value insulation), there are no "outside walls" which are colder than other walls.
- as there are no radiators, there is more space on the rooms' walls.
- inside temperature is homogeneous; it is impossible to have single rooms (e.g. the sleeping rooms) at a different temperature from the rest of the house.
- the temperature changes only very slowly - with ventilation and heating systems switched off, a passive house typically loses less than 0.5 °C per day (in winter), stabilizing at around 15 °C in the central European climate.
- opening windows for a short time only has a very limited effect - after the windows are closed, the air very quickly returns to the "normal" temperature.

Peculiarities of passive solar construction

1. Space heating

Passive house buildings make extensive use of their intrinsic heat from internal sources – such as waste heat from lighting, white goods (major appliances) and other electrical devices (but not dedicated heaters) – as well as body heat from the people and animals inside the building. Together with the comprehensive energy conservation measures taken, this means that a conventional central heating system is not necessary, although they are sometimes installed due to client skepticism.

2. Superinsulation

Passive house buildings employ super insulation to significantly reduce the heat transfer through the walls, roof and floor compared to conventional buildings.

3. Air tightness

Building envelopes under the passive house standard are required to be extremely airtight compared to conventional construction. Air tightness minimizes the amount of warm (or cool) air that can pass through the structure.

4. Ventilation

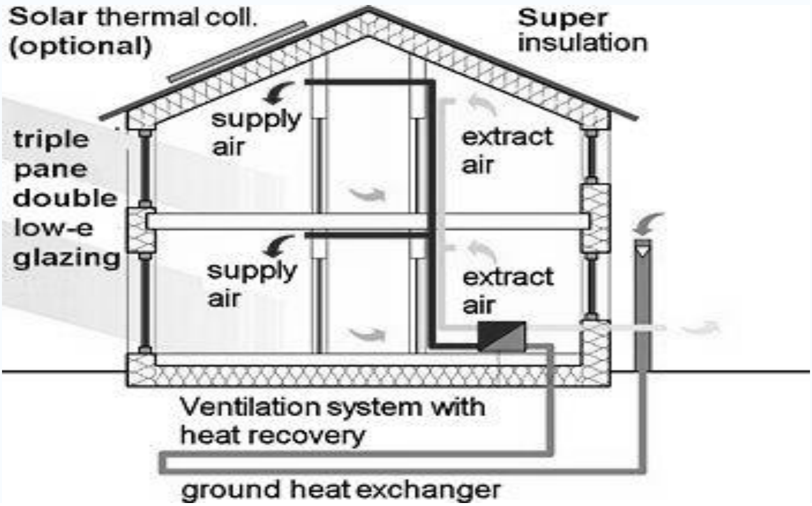
Mechanical heat recovery ventilation systems are employed to maintain air quality, and to recover sufficient heat to dispense with a conventional central heating system All ventilation ducts are insulated and sealed against leakage.

5. Typical passive house windows

Windows normally combine triple-pane insulated glazing with air-seals and specially developed thermally-broken window frames.

6. Lighting and electrical appliances

To minimize the total primary energy consumption, low-energy lighting (such as compact fluorescent lamps), and high-efficiency electrical appliances are normally used.



2. Answer the following questions:

1. What points about passive houses have been touched upon in the text?
2. Can you give a definition of the term "passive house"?
3. What countries have already followed the passive house standard?
4. What does a typical passive house consist of?
5. Can you think of some advantages and disadvantages of passive solar design?

6. What are the differences of a passive house in comparison with a conventional house?

7. What factors should be taken into account when building a passive house?

8. What are the peculiarities of a passive solar design?

9. What are the main reasons of choosing to build a house according to the passive house standard?

3. Read the following information and try to guess what type of house is described in each paragraph.

The term passive house refers to the rigorous, voluntary, passive house standard for energy efficiency in buildings. This can be achieved by a mixture of energy conservation technologies and the use of renewable energy sources. However, in the absence of recognized standards, the mix between these - and consequently the energy-use profile and environmental impact of the building - can vary significantly. It results in many new types of buildings.

a) ultra-low energy buildings
b) a near-zero energy building
c) energy-plus buildings
e) an autonomous building
f) zero energy buildings
g) a low-energy house

1. Such buildings require little energy for space heating or cooling.

2. It is a general term applied to buildings with no net energy consumption and no carbon emissions annually. They are autonomous from the energy grid supply - energy is produced on-site.

3. It is a building approaching zero energy use.

4. Buildings that produce a surplus of energy during a portion of the year.

5. It is any type of house that uses less energy than a regular house.

6. It is a building designed to be operated independently from infrastructural support services such as the electric power grid, municipal water systems, sewage treatment systems, storm drains, communication services, and in some cases, public roads.

Reading task C

1. Go over the vocabulary list. Consult a dictionary if you need.

assembly (n)	emission (n)
proprietor (n)	advocate (v)
rubble (n)	blinds (n)
recyclable (adj)	perspire (v)
conventional (adj)	wavelength (n)
unanimous (adj)	glazed (part)
heat squandering (part)	surplus (n)
sustainable (adj)	grid (n)
fungal (adj)	self-sufficient (adj)
capacity (n)	recoup (v)
lay off (v)	yardstick (n)
boom (v)	breakthrough (n)
shingle (n)	settlement (n)

2. Notice the pronunciation of the proper and geographical names from the text.

Hubert Fritz	Scandinavia
Arbeits-gemeinschaft Holz	Arnim Seidel
Erkheim	Rolf Disch
Bavaria	Heliotrop
Baufritz	Hans Erhorn
Darmstadt	Stuttgart

Freiburg Fraunhofer Institute	Freiburg
North America	Germany

3. Look at the title trying to predict the contents of the text. Then read the introduction to the text. Were your answers correct?

4. Read part I and answer the questions after it.

Building for the future

Houses without heating? Long considered only a subject for research projects, this idea has now become a practical reality. Zero-energy houses obtain electricity and heat from the sun free of charge. Yet this still doesn't go far enough for architects and builders like Hubert Fritz who are working on houses that are also power plants.

Part I. Hubert Fritz's best ideas always come to him in bed. Between four and six o'clock in the morning, he contemplates new ways of sealing joints, intelligent assembly techniques, and innovative marketing approaches. And if, a few hours later, at around eight o'clock, he arrives at work in Erkheim, Bavaria, with a pile of paper under his arm, his employees know: "The boss has just had another night of inspiration. And we now have a strenuous day ahead of us".

The proprietor of the Baufritz construction business feels: "We ought to use our brains more when we build." He considers the vast majority of buildings "ridiculous, energy-wasting rubble." In contrast, the houses of the future, believes the 59-year-old, will be intelligent and recyclable, and not use any energy. This is what Fritz works on both night and day, and a growing number of architects, engineers, and clients are following his lead. In many German towns, what are known as "low energy houses", "ultra houses" or "passive houses" are gaining ground – buildings that need only a small fraction of the heating energy and electricity required by conventional structures. The apex of this building philosophy is represented by so-called "plus-energy houses", small power plants that feed more electricity into the grid over a year than they take out. All these houses have good wall insulation and use the sun as a source of energy. That's the only way to consume less than 40% of primary energy needs on heating, cooling, and lighting.

A generation of ecologically inspired architects and construction businesses have made it their credo: "Save Fossil Fuel, Use Solar Energy." They believe that energy needs can be met entirely by using the sun, wind, water, and biomass – provided that current energy consumption levels can be reduced by roughly half. This has not only been achieved by the first "passive house", which was built in Darmstadt in 1991. By 1995 it was estimated that some 5% of new houses in Germany already fulfilled low-energy standards. According to an optimistic scenario presented by the Freiburg-based Öko-Institut, all new houses will be low-energy buildings by the year 2015. It is quite possible that 10% of new buildings will then achieve the energy-saving standards of "passive houses" and only require emergency heating systems.

Although the planners and construction firms are unanimous about the need to strike electricity and heat squandering bungalows and housing blocks from their order books, they also differ on the materials that will enable them to achieve this. While some put their faith in stone, concrete or plastic, Hubert Fritz is a firm believer in the virtues of wood. Some 90% of each house he builds is made of the renewable material: walls, ceilings, roof shingles – if client wishes, even drainpipes – are made of spruce and fir from sustainably managed forests. The moustached entrepreneur is particularly proud of the insulation material he developed in conjunction with researchers at the college in Rosenheim, Bavaria. To improve fire safety characteristics, Fritz mixes wood chips, produced by the ton in his factory, with whey, a by-product of cheese production. With a portion of soda added to prevent fungal attack, the special material provides good insulation.

Not all wood construction firms employ the ecological building material as extensively as Hubert Fritz. Yet most are working at near full capacity. While other construction firms are laying off employees, the wood sector has began to boom. More and more clients can not only imagine living in a wooden house, but are actually having them built. Germany is still not a centre of wooden house building like North America or Scandinavia. But Armin Seidel of Arbeitsgemeinshaft Holz, a working group that promotes the use of wood, estimates that 14% of new buildings in Germany will be made of wood by the turn of the millennium – twice as many as at present.

Wood has a number of advantages. The production of the material itself causes low levels of emissions and requires low energy input, it is a renewable and carbon-storing material, and has excellent building characteristics. This is why Hubert Fritz calls his products “Voll-Wert-

Häuser" (whole-value products). In German the term brings to mind images of health food, but Fritz is not 'a muesli manager' advocating a return to nature. "Houses ought to be oases where people can relax without chemicals," says the skilled carpenter. "And relaxation also involves technology that makes life easier."

5. Answer the questions to part I:

What kind of person do you think is Hubert Fritz?

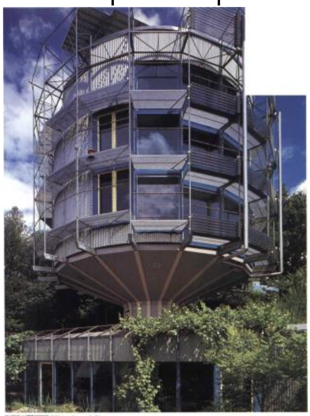
1. What is his opinion about conventional buildings?
2. What is the apex of his building philosophy?
3. Are his ideas popular in Germany?
4. Can you explain the difference between "zero-energy houses", "low-energy houses" and "plus-energy houses"?
5. What can satisfy energy needs according to eco-architects?
6. Is a "passive house" still a dream?
7. When and where was the first passive house built?
8. Can you describe the optimistic scenario of the eco-construction sector development?
10. What building materials are mentioned in this part?
11. Is there the one and only material accepted by all construction managers?
12. What is Hubert Fritz's favourite building material and why?
13. What material did he develop?
14. What sector in German construction industry has begun to boom and why?
15. What countries are the centres of wooden house building?
16. Can you prove that wood has a number of advantages?
17. What is Hubert Fritz's opinion of what houses should be?

6. Read part II and answer the questions after it.

Part II

In conjunction with the local college and other businesses, Fritz is attempting to combine high-technology and ecology in an "intelligent house" in Rosenheim. The windows close when the air conditioning comes on, and the blinds quietly roll down before the sun makes the occupants perspire. The house technology can be controlled via monitors or the telephone. "We need houses that demand less looking after, that gives us more time for our children, that are more fun," says the father of two children. "Where are the self-cleaning windows? What about electronic systems that let us in, but keep burglars out? Where is the exchangeable installation core?" At least Fritz has been able to realize the latter in his houses.

The eco-manager has worked with the wood technologists in Rosenheim for many years in order to gain a scientific foundation for his ideas. Since 1996 he has enjoyed inviting his partners to "Germany's largest wooden head." From time to time Fritz brings together managers, engineers and politicians inside the 15-metere-tall sculpture to plan an environmentally friendly building future. He appeals for ideas and thinking based on natural cycles and oriented toward the sun.



On this point, Hubert Fritz is on exactly the same wavelength as Rolf Disch, the Freiburg-based solar pioneer. In contrast to Fritz, however, Disch does not limit himself to using only one building material. Wherever possible the architect uses wood, but if necessary his houses are also made of stone with polystyrene insulating material. Disch always gives priority to the economical use of electricity and heat. "That's the most important thing," says 54-year-old looking down over the vineyards onto the city of Freiburg. Disch has an unobstructed view from the fully glazed side of his house. What is more, Heliotrop, his solar tree house, can turn in all directions, towards and away from the sun as needed. The architect lets the sunshine in during the winter, but on hot summer days he gives it the cold shoulder – turning the almost completely closed metal side of the house toward the sun. The solar panel on the roof, on the other hand, always directly faces the sun and busily supplies electricity – more than the house and its energy-saving devices can use. During the summer Disch feeds the surplus energy into the local electricity grid. Overall, the Heliotrop produces five times as much electrical energy as it uses each year.

The solar architect plans soon to put his concept of the "plus-energy house" into practice in a housing area in Freiburg. And he intends to do this at affordable prices. "It's still maintained that solar, energy-saving construction doesn't pay. Yet we want to show that it's possible – through intelligent planning – not only to save money, but even to make a profit." Disch points to the tubular solar collectors that not only provide safety as balcony railings but also heat the shower water.

A few kilometers away, a hydrogen-based system is meeting the year-round energy needs of a family of three. The occupants of this energy-self-sufficient solar house, a research project by the Freiburg Fraunhofer Institute for Solar Energy Systems, burn solar-generated hydrogen for cooking and heating. Their electricity is supplied by photovoltaic units and a fuel cell.

What has been achieved here, namely "disconnecting" a house from the electricity and gas networks, is clearly too expensive for the "man in the street". The higher investment costs for a passive house are recouped within a few years as a result of the lower energy costs. But if you want to reach the plus-energy standard, and decide to mount a photovoltaic installation on your roof, you won't be able to reduce your building costs below 2,000 marks a square metre of living space, even taking into account federal and state subsides. This figure is considered the yardstick for cheap building. Accordingly, Hans Erhorn of the Fraunhofer Institute for Construction Physics in Stuttgart considers it realistic – as in the car industry – to aim for a "three-litre house," a building which only requires a maximum of three litres of heating oil a year per square metre, compared with the figure of 30 litres achieved by houses built in the 1970s. “If we succeed in making the low-energy house the norm, we’ll have accomplished a great deal,” says Hans Erhorn, who believes that ecological building will only really make a breakthrough when it pays for the majority of house buyers.

Hubert Fritz is also working towards this goal. New settlement concepts, small building plots, and jointly used technology are intended to make sustainable construction affordable – without any concessions on quality. Nevertheless, we still have a long way to go until we can build cheap, intelligent, recyclable houses that need no energy input. Hubert Fritz will have to spend a few more nights thinking up new ideas.

7. Answer the questions to part II:

1. Was Hubert Fritz successful in making an “intelligent house” in Rosenheim? Give ground to your answer.
2. What does he appeal for?
3. Does Rolf Disch share all the ideas of Hubert Fritz?
4. Has Rolf Disch succeeded in building a solar house according to his construction philosophy?
5. Can you describe Heliotrop?
6. Is it a “zero-energy house”, a “low-energy house” or a “plus-energy house”? Explain why.
7. What project is Disch planning to realize in the near future?
8. Does Disch think that “plus-energy houses” can make a profit?
9. Do you believe he will manage to realize his project?
10. What is another example of an energy-self-sufficient solar house described in the text?
11. What supplies electricity there?

12. What is faster to recoup: the higher investment costs for a "passive house" or for a "plus-energy house"?
13. What figure is considered to be the yardstick in cheap building?
14. What is more realistic to aim for according to Hans Erhorn?
15. What will help to make sustainable construction affordable?

Comprehension check

8. Decide whether the following statements are true or false according to the text:

1. Hubert Fritz is a famous German economist.
2. "Plus-energy houses" are small power plants that feed more electricity into the grid over a year than they take out.
3. The planners and construction firms are unanimous about the materials that will enable them to achieve low-energy consumption levels.
4. For Hubert Fritz the best construction material is wood.
5. Germany is a centre of wooden house building.
6. The windows open when the air conditioning goes off in an "intelligent house".
7. Rolf Disch is on the same wavelength as Hubert Fritz on the point of using only one building material.
8. The Heliotrop produces 3 times as much electrical energy as it uses each year.
9. Rolf Disch is a designer of a hydrogen-based system meeting the year-round needs of a family of three.
10. Energy-self-sufficient solar houses are affordable for the "man in the street."
11. Architects and construction firms have already succeeded in making the low-energy houses the norm.

9. What is not mentioned in the text?

1. plus-energy houses concept
2. the usage of renewable materials in construction
3. making sustainable construction affordable

4. sustainable development of the German economy
5. the necessity to be ecologically oriented

10. Make sure you can explain the following word combinations:

Recyclable houses
Renewable materials
Sustainable construction
Environmentally friendly building future
Ecologically inspired architects
Energy-wasting rubble
Intelligent house
Energy-saving construction
Energy-self-sufficient house
Sustainably managed forests

11. What do you think:

1. Do new types of houses have any chances to get ground in Germany and other countries?
2. What do you know about such trends in the construction industry in our country? Does it follow the lead of Hubert Fritz and his supporters?
3. Can you imagine living in such a house? Would you like to have such an experience?

12. Make up the plan of the text.

13. Make a summary according to your plan. The following word-combinations will help you:

The title of the text is…
Such problems as… are touched upon in the text.
The first part is devoted to…

The second part enumerates/ illustrates/ gives examples of/emphasizes…

The final part draws our attention to/ proves that/ stresses the necessity of…

The main idea of the text is …

From my point of view the text is rather helpful/ useful/ informative/ interesting.

The article is provided with pictures/ drawings.

Language focus

14. Match the words with their synonyms:

1) proprietor	6) breakthrough	a) overlook	f) support
2) estimate	7) squander	b) stable	g) evaluate
3) conventional	8) consumption	c) compensate	h) use
4) face	9) advocate	d) traditional	i) waste
5) recoup	10) sustainable	e) owner	j) advance

15. Match the words with their antonyms:

1) roughly	6) affordable	a) hire	f) relaxed
2) lay off	7) strenuous	b) expensive	g) shortcoming
3) surplus	8) skilled	c) shortage	h) exactly
4) unobstructed	9) boom	d) incompetent	i) dependant
5) self-sufficient	10) virtue	e) slump	j) blocked

16. Match the words with their definitions:

1. store	a) to pass through a system again for further treatment or use or to reclaim for further use
2. by-product	b) to close tightly so as to render airtight or watertight

3. assembly	c) capable of being maintained at a steady level without exhausting natural resources or causing severe ecological damage
4. insulate	d) a one-storey house, sometimes with an attic
5. seal	e) a junction of two or more parts or objects
6. bungalow	f) to prevent or reduce the transmission of electricity, heat, or sound by surrounding with a non-conducting material
7. shingle	g) the process of putting together a number of parts to make a machine or other product
8. joint	h) to keep, set aside, or accumulate for future use
9. sustainable	i) a thin rectangular tile, esp. one made of wood, that is laid with others in overlapping rows to cover a roof or a wall
10. recycle	j) a secondary or incidental product of a manufacturing process

Language development

17. Fill in the gaps with the words below making all necessary changes to them:

a) fulfilled low-energy standards	b) are laying off
c) are gaining ground	d) put their faith in
e) strenuous	f) a number of
g) brings to mind	h) to gain a scientific foundation
i) on exactly the same wavelength	j) limit himself to
k) gives priority to	l) gives it a cold shoulder
m) to make a profit	n) to put his concept into practice
o) are following his lead	p) apex

1. The _____ of this building philosophy is represented by so-called "plus-energy houses", small power plants that feed more electricity into the grid over a year than they take out.
2. While some _______ stone, concrete or plastic, Hubert Fritz is a firm believer in the virtues of wood.

3. The architect lets the sunshine in during the winter, but on hot summer days he _______ – turning the almost completely closed metal side of the house toward the sun.

4. Disch always _______ the economical use of electricity and heat.

5. Yet we want to show that it's possible – through intelligent planning – not only to save money, but even ______.

6. The eco-manager has worked with the wood technologists in Rosenheim for many years in order ________ for his ideas.

7. Wood has _________ advantages.

8. In many German towns, what are known as "low energy houses", "ultra houses" or "passive houses"_______.

9. On this point, Hubert Fritz is _______ as Rolf Disch, the Freiburg-based solar pioneer.

10. In German the term ______ images of health food, but Fritz is not a muesli manager" advocating a return to nature.

11. In contrast to Fritz, however, Disch does not ______ using only one building materials.

12. This is what Fritz works on both night and day, and a growing number of architects, engineers, and clients ________.

13. By 1995 it was estimated that some 5% of new houses in Germany already ________.

14. While other construction firms _______ employees, the wood sector has began to boom.

15. "And we now have a _______ day ahead of us".

16. The solar architect plans soon ________ of the "plus-energy house" _____ in a housing area in Freiburg.

18. Think of not less than 5 sentences of your own using the words and word-combinations from the previous exercise.

19. Complete the sentences with a suitable preposition. You can choose from the following ones: up, with, of, at, by, in, out, for, via. Some of them can be used more than once.

1. The engineers are especially proud ___ improving this construction material.

2. The cost of maintaining these new low-energy houses will be reduced ___ roughly half.

3. It will be possible to control the operation of all the technological units installed into this house ___ monitors or the telephone.

4. The houses in this new residential area will be sold ____ affordable prices.

5. The team of ecologically-inspired architects spent a strenuous day thinking ___ new ideas and concepts for their research project.

6. This insulating material is made ___ wood chips mixed ___ whey.

7. Wood chips are produced ___ the ton in sawmills.

8. The houses are equipped ___ electronic systems letting the residents ___, but keeping the burglars ___.

9. Hubert Fritz appeals ___ environmentally friendly construction.

10. The new power plant is working ___ full capacity to satisfy the energy needs of the city.

20. Read the following quotations and try to guess people from which spheres of life and of what professions they could belong to:

1. "Right from the beginning, I considered light and sun to be essential elements in housing construction, initially as a source of brightness and well-being, then increasingly as an energy factor — until I moved over to solar architecture altogether."

2. "Today the task of architecture is to give people living spaces that have a future in both ecological and economic terms."

3. "People who live in surplus energy housing are not affected by oil crises and rising energy costs."

4. "I was fascinated by the idea of being an energy producer in my own home."

5. "Most of people still believe that the sun does not shine enough in Germany and that therefore it doesn't make economic sense to use solar energy."

6. "And perhaps one day I will be able to fulfill a special dream of mine: a fitness studio of the future in which people create their own energy, as they work out on exercise bikes and treadmills."

7. “But the architect does not just put his faith in modern technology. He also exploits the skills of solar architects that have been passed down through the centuries.”

21. Translate the following sentences from Russian into English:

1. Древесина – это натуральный экологически чистый возобновляемый материал с превосходными строительными характеристиками.
2. Не все строительные фирмы единодушны в вопросе использования каких-либо одних строительных материалов.
3. Экологическое строительство только тогда закрепит свои позиции, когда оно будет выгодно большинству покупателей.
4. Энергетические потребности «пассивных домов» можно полностью удовлетворить, используя энергию солнца, ветра, воды и энергетического сырья.
5. Более низкие расходы на отопление компенсируют более высокие затраты на строительство «пассивных домов».
6. Гелиотроп, солнечный дом Рольфа Диша, производит в 5 раз больше электроэнергии, чем ему необходимо за счет установки солнечной панели на крыше и способности всегда поворачиваться к солнцу.

Follow-up

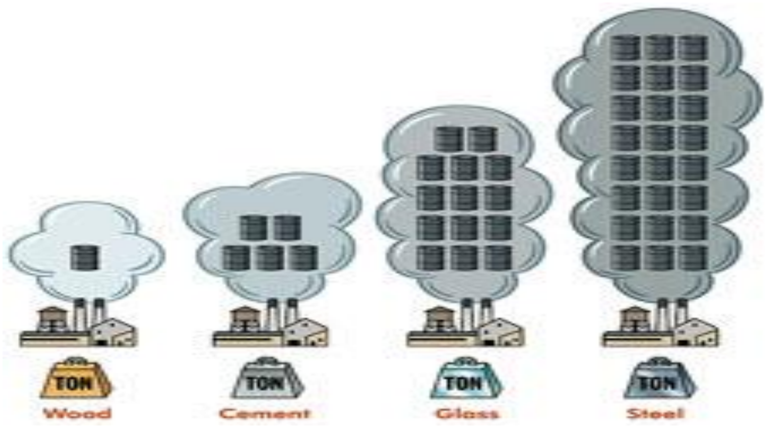
22. Read the news dating May, 2000 and check whether Rolph **Disch's ideas have been realized. Were your predi**ctions about the chances of the new type of houses to get ground correct?

One of the most modern housing estates in Europe is being built in Freiburg which was named Environmental Capital of Germany in 1992.

The so-called surplus energy houses on the estate produce more energy than they consume. In his design for the houses, the renowned solar architect Rolf Disch has united modern energy-saving technology with centuries-old solar construction skills.

The houses are positioned with architectural precision, each strictly lined up with the sun. Their terrace-like south-facing facades are designed to soak up the heat, especially in the winter when the sun is low in the sky. Their northern facades, which are three or four storeys high, are closed off, shutting out wind and inclement weather. A refined ventilation system keeps the houses cool in the summer and warm in the winter. "We've used 460 kilowatt hours since May," says the architect, gesturing towards the mouse-grey interior of the meter box. "And we've produced more than 4,000 kilowatt hours" — without gas or oil. These days, it's not only journalists who take one of Disch's guided tours through the first finished row of terraced housing in Europe's most modern solar construction project, at the foot of the Schlierberg in Freiburg. Fellow architects, engineers, house-builders and whole bus-loads full of tourists travel to Germany's solar capital to see this first financially feasible housing project that produces more energy on average than it consumes.

23. Study the information below and then try to give a reasoned explanation to the fact that wood is a favourite building material of Hubert Fritz and his followers.



Simply put, manufacturing wood is energy efficient. Compare the amount of energy it takes to produce one ton of cement, glass, steel, or aluminum to one ton of wood:

- 5 times more energy for one ton of cement
- 14 times more energy for one ton of glass
- 24 times more energy for one ton of steel
- 126 times more energy for one ton of aluminum

Wood products make up 47% of all industrial raw materials manufactured in the United States, yet consume only 4% of the total energy needed to manufacture all industrial raw materials. Wood's manufacturing process alone makes it the environmentally friendly choice in building materials.

24. What is the best summary of the previous extract?

1. Wood is the most ecologically friendly material.
2. Wood is the lightest material.
3. Wood offers more product for less energy.
4. Wood is the cheapest material in production.
5. Wood is the most energy efficient in production.

25. Look through the unit again and make notes under the following headings. Then use your notes to talk about ecologically-friendly architecture and construction.

1. Alternative sources of energy and their application in construction industry.
2. Passive solar design and its benefits.
3. The appearance of new types of houses in Germany.
4. Famous names in eco-friendly building.
5. Construction materials of the future.
6. New technologies employed in new types of houses.
7. The examples of such houses.

Reading task D

1. Look at the pictures of these six houses. Do you think they have anything in common? Read the descriptions below and match them with the corresponding houses.

1. Villa Girasole

The oldest rotating house we have found is Angelo Invernizzi's Villa Girasole (Villa Sunflower) near Verona, Italy. "The two storied and L shaped house rests on a circular base, which is over 44 meters in diameter. In the middle there is a 42 meters tall turret, a sort of conning tower or lighthouse, which the rotating movement hinges on. A diesel engine pushes the house over three circular tracks where 15 trolleys can slide the 5,000 cubic meters building at a speed of 4 millimeters per second (it takes 9 hours and 20 minutes to rotate fully).

2. Everingham Rotating House

This Australian house rotates around a central pivot point. “It also encapsulates many aspects of ecologically sound building principles, such as optimising on natural light and heat, while rotating 180o to take advantage of sunshine and shade at different times of the day and year.”

The Everingham model is a 24 m (79’) diameter octagon with a 3-metre (10’), 360-degree verandah. It weighs 50 tonnes, but can rotate a full 360-degrees, around a central core of plumbing and electricals. Within this core is also a geothermal piping system (120 metres long and 2.5 metres deep), supplying a constant 22ºC to the house.

3. Massau Rotating House

50 years ago François Massau built this rotating house so that his sickly wife could enjoy sunshine and warmth any time of the year. Massau was an eccentric builder who does not appear to have been very nice, and spent his last years fighting in court, dying alone and penniless at 97 in 2002. However his house survives, with its fixed roof and house that turns beneath it.

4. Maisons Labbe Turntable House

We now enter the realm of speculation, of proposals that are not yet built. In Nice, France, Frederic Plazar has designed a series of turntable houses ranging from 80m2 (861 SF) to 140m2 (1506 SF). The Maisons Labbé website calls it a "Bioclimactic house", that uses 60% less energy than a conventional house.

5. Glenn Howells' rotating "sustainable" Dubai Condo

Its hot in Dubai, and everyone wants water view- so Glenn Howells is building "an eco-friendly sustainable design, using solar power to revolve the cylindrical form and recycling water to irrigate the landscaped gardens. The concept for the façade design has evolved through the use of intricate layers and textures that also help to address the extreme heat conditions in Dubai, while providing the residents with energy efficient control of their internal environment.

The dual-skin breathing façade creates a dynamic appearance and adds depth to the building with interesting materials including high performance glass with neutral coating and gold screens." We like the line in the advertising: "Awake one day to see panoramic lake views and another day to see beautiful landscapes and the worlds biggest shopping mall .

6. David Fisher's Rotating Tower in Dubai

We have been dubious about Architect David Fisher's rotating tower for Dubai, with its wind turbines built in between each floor, and its claims that "the building will generate 10 times more energy than required to power it." We also wondered about how "The new tower is the first building of its size to produced in a factory. Each floor, made up of 12 individual units, complete with plumbing, electric connections, air conditioning, etc., will be fabricated in a factory. These modular units will be fitted on the concrete core or spine of the building at the central tower."

2. Answer the following questions:

1. What do these houses have in common?
2. Which of them correspond to the principles of ecologically friendly architecture and construction? Can you prove it?
3. Which of them are “plus-energy houses”?
4. Which of them are “low-energy houses”?
5. Which house do you like most of all?
6. Which house would you like to live in?
7. Can you think of any other examples of rotating houses?

Time for fun

Construction Worker and Engineer

An Engineer and a Construction Worker are sitting next to each other on a long flight across country.

The Engineer leans over to the Construction Worker and asks if he would like to play a fun game. The Construction Worker just wants to take a nap, so he politely declines and rolls over to the window to catch a few winks.

The Engineer persists and states that the game is real easy and a lot of fun. He explains "I ask you a question, and if you don't know the answer, you pay me $5. Then you ask me a question, and if I don't know the answer, I'll pay you $5." Again, the Construction Worker politely declines and tries to get to sleep.

The Engineer, now somewhat agitated, says, "OK, if you don't know the answer you pay me $5, and if I don't know the answer, I'll pay you $50!" This catches the Construction Worker's attention, and he sees no end to this idiotic torment unless he plays, so he agrees to the game. The Engineer asks the first question. "What's the distance from the earth to the moon?" The Construction Worker doesn't say a word, but reaches into his wallet, pulls out a five-dollar bill and hands it to the Engineer. Now, it's the Construction Worker's turn. He asks the Engineer "What goes up a hill with three legs, and comes down on four?" The Engineer looks up at him with a puzzled look. He takes out his laptop computer and searches all of his references. He taps into the Airphone with his modem and searches the net and the Library of Congress. Frustrated, he sends e-mail to his co-workers – all to no avail. After about an hour, he wakes the Construction Worker and hands him $50. The Construction Worker politely takes the $50 and turns away to try to get back to sleep.

The Engineer, more than a little miffed, shakes the ConstructionWorker and asks, "Well, so what's the answer?" Without a word, the Construction Worker reaches into his wallet, hands the Engineer $5, and turns away to get back to sleep.

Unit III

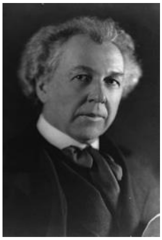
FROM PYRAMIDS TO SKYSCRAPERS

Warming up

1. Work with a partner. Which of these people have you heard of? Why are they famous?

2. Read their quotations. Which do you agree with?

Louis Sullivan
(1856 – 1924)



Frank Lloyd Wright
(1867 – 1959)

Cass Gilbert
(1859 – 1934)

1. “What is the chief characteristic of the tall office building? It is lofty. It must be tall. The force and power of altitude must be in it, the glory and pride of exaltation must be in it. It must be every inch a proud and soaring thing, rising in sheer exaltation that from bottom to top it is a unit without a single dissenting line.”

2. “The architect must be a prophet . . . a prophet in the true sense of the term . . . if he can't see at least ten years ahead don't call him an architect.”

3. “To become an Architect in the right sense of the word means that a man shall give his life to it and nothing else, and shall study the work he has to do with enthusiastic interest in every detail pertaining to it, and content himself with nothing less than complete success.”

3. Do you know any modern architects and constructors? What can you tell about them? Discuss with your partner, then the group.

Reading task A

1. Work in groups and answer the questions.

SKYSCRAPER QUIZ

1. What was the tallest building built in the 26th century BC?

a. the Lincoln Cathedral
b. the Great Pyramid of Giza
c. the Washington Monument
d. the Great Pyramid of Khufu

2. Which 16th-century city entirely consisted of high-rise houses?

a. Fustat
b. Chicago
c. Edinburgh
d. Shibam

3. Which building is considered to be the first skyscraper in the world?

a. the Grand Midland Hotel
b. Home Insurance Building
c. Wainwright Building
d. the Empire State Building

4. Which cities known as the "the big three" are recognized as having the most compelling skylines in the world?

a. Chicago, Hong Kong, New York
b. London, Manhattan, New York
c. Chicago, New York, Dubai
d. New York, Dallas, Dubai

2. Read the text and check your answers

The History of Skyscrapers

The word skyscraper often carries a connotation of pride and achievement. The skyscraper, in name and social function, is a modern expression of the age-old symbol of the world center or axis mundi: a pillar that connects earth to heaven and the four compass directions to one another.

Modern skyscrapers are built with materials such as steel, glass, reinforced concrete and granite, and routinely utilize mechanical equipment such as water pumps and elevators. Until the 19th century, buildings of over six stories were rare, as having great numbers of stairs to climb was impractical for inhabitants, and water pressure was usually insufficient to supply running water above 50 m (164 ft).

The tallest building in ancient times was the Great Pyramid of Giza in ancient Egypt, which was 146 metres (480 ft) tall and was built in the 26th century BC. Its height was not surpassed for thousands of years, possibly until the 14th century AD with the construction of the Lincoln Cathedral (though its height is disputed), which in turn was not surpassed in height until the Washington Monument in 1884. However, being uninhabited, none of these buildings actually complies with the definition of a skyscraper.

High-rise apartment buildings already flourished in antiquity: ancient Roman insulae in Rome and other imperial cities reached up to 10 and more stories, some with more than 200 stairs.

The skylines of many important medieval cities had large numbers of high-rise urban towers. Wealthy families built these towers for defensive purposes and as status symbols. The residential Towers of Bologna in the 12th century, for example, numbered between 80 to 100 at a time, the largest of which (known as the "Two Towers") rise to 97.2 metres (319 ft). In Florence, a law of 1251 decreed that all urban buildings should be reduced to a height of less than 26 m, the regulation immediately put into effect.

The medieval Egyptian city of Fustat housed many high-rise residential buildings. An early example of a city consisting entirely of high-rise housing is the 16th-century city of Shibam in Yemen. Shibam was made up of over 500 tower houses, each one rising 5 to 11 storeys high, with each floor being an apartment occupied by a single family. The city was built in this way in order to protect it from Bedouin attacks.

An early modern example of high-rise housing was in 17th-century Edinburgh, Scotland, where a defensive city wall defined the boundaries of the city. Due to the restricted land area available for development, the houses increased in height instead. Buildings of 11 stories were common, and there are records of buildings as high as 14 stories. Many of the stone-built structures can still be seen today in the old town of Edinburgh. The oldest iron framed building in the world is the Flaxmill (also locally known as the "Maltings"), in Shrewsbury, England. Built in 1797, it is seen as the "grandfather of skyscrapers" due to its fireproof combination of cast iron columns and cast iron beams developed into the modern steel frame that made modern skyscrapers possible.

Early skyscrapers

The first skyscraper was the ten-storey Home Insurance Building in Chicago, built in 1884–1885. In this building the architect Major William Le Baron Jenney created the first load-bearing structural frame – a steel frame which supported the entire weight of the walls, instead of load-bearing walls carrying the weight of the building, which was the usual method. This development led to the "Chicago skeleton" form of construction.

Sullivan's Wainwright Building in St. Louis, 1891, was the first steel-framed building with soaring vertical bands to emphasize the height of the building, and is, therefore, considered by some to be the first true skyscraper.

The United Kingdom also had its share of early skyscrapers. The first building to fit the engineering definition, meanwhile, was the largest hotel in the world, the Grand Midland Hotel, now known as St. Pancras Chambers in London, which opened in 1873 with a clock tower 82 metres (269 ft) in height. The 12-floor Shell Mex House in London, at 58 metres (190 ft), was completed a year after the Home Insurance Building and managed to beat it in both height and floor count. 1877 saw the opening of the Gothic revival style Manchester Town Hall by Alfred Waterhouse. Its 87-metre-high clock and bell tower dominated that city's skyline for almost a century.

Most early skyscrapers emerged in the land-strapped areas of Chicago, London, and New York toward the end of the 19th century. A land boom in Melbourne, Australia between 1888-1891 spurred the creation of a significant number of early skyscrapers, though none of these were steel reinforced and few remain today. Height limits and fire restrictions were later introduced. London builders soon found building heights limited due to a complaint from Queen Victoria, rules that continued to exist with few exceptions until the 1950s. Concerns about aesthetics and fire safety had likewise hampered the development of skyscrapers across continental Europe for the first half of the twentieth century (with the notable exceptions of the 26-storey Boerentoren in Antwerp, Belgium, built in 1932, and the 31-storey Torre Piacentini in Genoa, Italy, built in 1940). After an early competition between New York City and Chicago for the world's tallest building, New York took a firm lead by 1895 with the completion of the American Surety Building. Developers in Chicago also found themselves hampered by laws limiting height to about 40 stories, leaving New York with the title of tallest building for many years. New York City developers then competed among themselves, with successively taller buildings claiming the title of "world's tallest" in the 1920s and early 1930s, culminating with the completion of the Chrysler Building in 1930 and the Empire State Building in 1931, the world's tallest building for forty years.

Modern skyscrapers

From the 1930s onwards, skyscrapers also began to appear in Latin America and in Asia. Immediately after World War II, the Soviet Union planned eight massive skyscrapers dubbed "Stalin Towers" for Moscow; seven of these were eventually built. The rest of Europe also slowly began to permit skyscrapers, starting with Madrid, in Spain, during the 1950s. Finally, skyscrapers also began to appear in Africa, the Middle East and Oceania (mainly Australia) from the late 1950s and early 1960s.

To this day, no city in the world has more completed individual free-standing buildings over 492 ft (150 m) than New York City.

The number of skyscrapers in Hong Kong will continue to increase, due to a prolonged highrise building boom and high demand for office and housing space in the area.

Chicago is currently undergoing an epic construction boom that will greatly add to the city's skyline. Since 2000, at least 40 buildings at a minimum of 50 stories high have been built. The Chicago Spire, Trump International Hotel and Tower, Waterview Tower, Mandarin Oriental Tower, 29-39 South LaSalle, Park Michigan, and Aqua are some of the more notable projects.

Chicago, Hong Kong, and New York City, otherwise known as the "the big three," are recognized in most architectural circles as having the most compelling skylines in the world. Other large cities that are currently experiencing major building booms involving skyscrapers include Shanghai in China, Dubai in the United Arab Emirates, and Miami, which now is third in the United States.

Today, skyscrapers are an increasingly common sight where land is scarce, as in the centres of big cities, because they provide such a high ratio of rentable floor space per unit area of land. But they are built not just for economy of space. Like temples and palaces of the past, skyscrapers are considered symbols of a city's economic power. Not only do they define the skyline, they help to define the city's identity.

3. Match the building with the year of its creation:

The Chrysler Building	1932
Home Insurance Building	1940
The Flaxmill	1930
Manchester Town Hall	1895
Wainwright Building	1797
The Boerentoren	1931
The Empire State Building	1877
The Shell Mex House	1891
The Torre Piacentini	1884–1885
The American Surety Building	1886

4. Make questions for these answers:

a) Steel, glass, reinforced concrete and granite.
b) The Great Pyramid of Giza in ancient Egypt.
c) Due to the restricted land area available for development.
d) The architect Major William Le Baron Jenney.
e) The American Surety Building.
f) The Chrysler Building and the Empire State Building.
g) In Latin America and in Asia.
h) From the late 1950s and early 1960s.
i) Chicago, Hong Kong, and New York City.

j) Shanghai, Dubai, and Miami.

Follow-up

5. Look at the Top-5 of the tallest buildings in the world. Have you known all these names before? What other famous skyscrapers do you know? Choose any of them to describe. Use additional information.

Building	City	Height	Floors	Built
Burj Khalifa	Dubai, UAE	828 m	162	2010
Taipei 101	Taipei, Taiwan	508 m	101	2004
World Financial Center	Shanghai, China	492 m	101	2008
International Commerce Center	Hong Kong, China	484 m	118	2010
Petronas Twin Towers	Kuala Lumpur, Malaysia	452 m	88	1998

6. Look through some additional information about skyscrapers. Give the main points using the following phrases:

It is believed that…

It could be argued that…

It has been proved that…

It has been mentioned that…

On the one hand

On the other hand

Some people claim that…

But in spite of this…

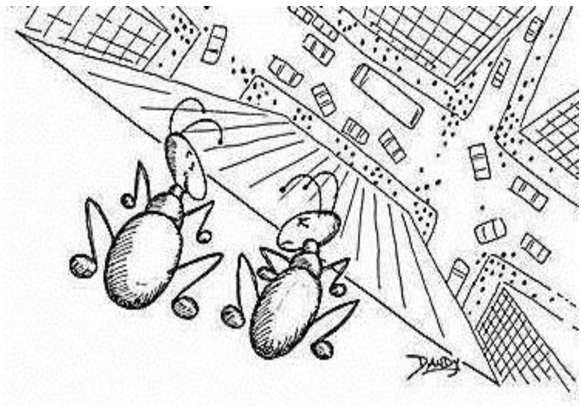
Sustainability

The skyscraper as a concept is a product of the industrialized age, made possible by cheap energy and raw materials. The amount of steel, concrete and glass needed to construct a skyscraper is vast, and these materials represent a great deal of embodied energy.

Tall skyscrapers are very heavy, which means that they must be built on a sturdier foundation than would be required for shorter, lighter buildings. Building materials must also be lifted to the top of a skyscraper during construction, requiring more energy than would be necessary at lower heights.

Furthermore, a skyscraper consumes a lot of electricity because potable and non-potable water must be pumped to the highest occupied floors, skyscrapers are usually designed to be mechanically ventilated, elevators are generally used instead of stairs, and natural lighting cannot be utilized in rooms far from the windows and the windowless spaces such as elevators, bathrooms and stairwells.

Despite these costs, the size of skyscrapers allows for high-density work and living spaces, reducing the amount of land given over to human development. Mass transit and commercial transport are economically and environmentally more efficient when serving high-density development than suburban or rural development.



"From up here they look like us."

Also, the total energy expended towards waste disposal and climate control is relatively lower for a given number of people occupying a skyscraper than that same number of people occupying modern housing.

Reading task B

1. Read the following news and try to guess what ideas they have in common and what problems they deal with.

Europe's Tallest Skyscraper Bid

A proposal for the tallest residential skyscraper in Europe to be built in Leeds has been submitted to planners. The planned £225m Lumiere Tower 1 will have 52 storeys and be 170.88m (560ft) high. If built, it would be two metres taller than the newly topped-out Beetham Tower in Manchester which is 168.87m (554ft).

Designed by the same architect, the building will house 650 apartments, office space and a dentist, as well as shops and cafes.

If approved, the building is hoped to be completed by 2010.

The building has been designed chiefly by architect Ian Simpson at Ian Simpson Architects.

Quake Risk to Chinese Skyscrapers

Growing number of ultra-high skyscrapers in China could be at risk from earthquakes. But the architects say their buildings are safe, and undergo rigorous testing to withstand earthquakes and typhoons.

A number of Chinese cities are racing to build the mainland's tallest skyscraper. The World Financial Centre will eventually rise to 492m (1614 feet), making it one of the tallest buildings in the world. In Guangdong they plan to go even higher with a TV tower that will rise to 600m (1970 feet).

Earthquakes are common in China. One of the worst quakes in the last century took place in Tangshan in the north of the country, killing almost 250,000 people.

Skyscraper fears for London views

Largest Skyscraper This Year Starts In

Views of some of London's most historic buildings could be threatened by new planning guidelines. Westminster and City of London planners have raised concerns about the mayor's draft London View Management Framework.

Guidelines currently favour wide unobstructed views of buildings like St Paul's Cathedral and Parliament. But a Westminster Council spokesman said views of key landmarks would be a lot narrower and skyscrapers could be built behind them, ruining the view. There are plans for several new skyscrapers – including the 1,016 ft (310m) Shard of Glass at London Bridge – said to be Europe's tallest tower block. But current rules mean skyscrapers are limited to certain areas where they will not obstruct views. Peter Rees, the City planning officer, said mayor Ken Livingstone wanted to narrow long-distance views of St Paul's from places like Hampstead Heath, Parliament Hill fields, Blackheath park.

Reading task C

Moscow

Despite the probable cancellation of the Russia Tower and a number of other major projects in Moscow not everything is affected as the Zvenigorodsky Multifunctional Complex proves.

With 252.82 metres of height and 62 floors, not to mention an enormous amount of internal space the project marks the largest to start in Moscow so far this year. In total it will contain 202,500 square metres of space for offices and a 160,000 square metre shopping mall in a huge sprawling low-rise wing that is longer than the tower is tall, plus underground parking for 3,400 cars.

The tower is composed of two distinct visual elements. The front of it is a circular part with a diagrid running up it, whilst intersecting with it is the length of the tower clad in glass with white render creating strong vertical lines. At the top are two levels of angled roofs in lieu of a crown.

1. Work in groups. Which world famous buildings do the pictures illustrate?

1 
2 
3 
4 
5 
6 

a) The Petronas Twin Towers (Kuala Lumpur, Malaysia)
b) The Empire State Building (New York City, USA)
c) The iconic World Trade Center twin towers (NYC, USA)
d) 30 St Mary Axe (London, Great Britain)
e) Taipei 101 (Taipei, Republic of China)
f) The Sears Tower (Chicago, USA)

2. Translate the following word-combinations from the text.

To rise majestically, to enjoy breathtaking views, to express concern, to whisk up, to come up with something, to lead the way in skyscraper building, downtown Chicago, a proud and soaring thing, to rise in sheer exultation, without a single dissenting line, a financial backer, to set back, a step-like look of buildings, to put an end to, a fresh start of skyscraper building, to take on bold new shapes, to stand out.

3. Read the text and put these phrases in the correct place:

a) working and living areas for many people
b) how strong a steel frame could be
c) to be only two feet long
d) before the dream of a skyscraper could become real
e) control over the height and floor plans of new buildings
f) the most talented and most famous
g) stand out as ugly objects in the city landscape
h) and business was doing well
i) wealth and success
j) about the changes they are creating

Buildings that Scrape the Sky

One of the wonders of the modern American city is that architectural marvel called the skyscraper. From New York to Miami from Chicago to Dallas, from Seattle to Los Angeles, these towers of stone and steel and glass rise majestically into the urban sky. From their upper floors, visitors can enjoy breathtaking views.

As skyscrapers transform the cities of America, some people are expressing concern (1) ___. Despite the problems, however, the tall buildings seem to be here to stay. Soon elevators will be able to reach 180 floors and more. Then people will build their modern pyramids higher and higher into the sky.

Every day visitors from all over the world lined up on the ground floor of the World Trade Center in New York City. They were waiting to get on elevators that would whisk them up to the enclosed observation deck on the 107th floor of one of the Center's twin silver towers.

On calm days, visitors could take elevators from the 107th floor up to the open walkway above the 110th floor. It is 1,377 feet (413 m) above the ground. From it, the Brooklyn Bridge seems (2) ___. Cars in the streets look like tiny toys. Visitors feel the excitement that people must have felt whenever they stood on high places and looked at the world around them. But only in the last 100 years or so have we had the ability to make buildings of 25, 50, or 100 and more stories — buildings called skyscrapers.

One invention that helped make tall buildings possible was the passenger elevator. Elisha Otis first demonstrated a steam-powered elevator in New York in 1853. Before then, few buildings were more than five or six stories tall. People could not comfortably climb stairs that went higher.

New ways of building also had to be perfected (3) ___. For centuries, most tall buildings were made of stone. The higher the building, the thicker the walls of the lower floors had to be to support the weight of the upper ones. Then, in the nineteenth century, builders began using an iron frame to support the floors of new buildings. Even with this frame, the lower walls still had to support the weight of the upper ones. Finally, engineers came up with a steel frame strong enough to support both floors and walls.

According to one story, it was Major William Le Baron Jenney, a Chicago engineer and architect, who first saw (4) ___. He found out when he got angry at the squawkings of the family parrot. He banged a heavy book down on the parrot's steel wire cage and was surprised when the wires neither bent nor cracked. Jenney was the first architect to use a steel frame in a tall building. He designed the 12-story Home Insurance Company Building in Chicago in 1884. Chicago really led the way in skyscraper building. Most of central Chicago was destroyed by the Great Fire in 1871. Business leaders wanted to rebuild the city in the most modern, attractive, and profitable way possible. In the 1880s and 1890s, one skyscraper after another went up in downtown Chicago.

Probably (5) ___ of the young architects during this time was Louis Sullivan. He thought a building should "be tall ... a proud and soaring thing, rising in sheer exultation from top to bottom without a single dissenting line."

Other architects disagreed with Sullivan. They believed that skyscrapers should borrow ideas from the Greeks, the Romans, and the Gothic cathedrals of Western Europe. Financial backers of the new skyscrapers seemed to agree with them. The more Greek columns or Gothic arches a skyscraper had, the more they thought it would impress people. The skyscraper had quickly become a sign of (6) ___ for the firms that built and owned them.

The 20-story Flatiron Building, built in 1902, was the first skyscraper in New York City. More soon followed! In 1913, the Woolworth Building reached the new height of 60 stories. With its strong vertical lines leading to a Gothic tower at the top, the Woolworth Building combined many of Louis Sullivan's ideas with past architectural styles.

Not everyone admired skyscrapers, though. City planners had already begun to criticize the tall buildings for creating sunless streets and traffic jams. In 1916, New York City passed the first Building Code Resolution. This resolution gave the city (7) ___. Other cities followed with laws of their own.

To provide enough light and air for buildings and streets, many of the new laws required that the outside walls of tall buildings be set back above certain heights. This led to the steplike look of many office buildings and apartment houses built during the 1920s and 1930s.

By 1929, American cities had 377 skyscrapers of more than 20 stories, and 188 were in New York City. The Great Depression that hit the United States in that year put an end to many new skyscrapers. But plans were too far along to stop construction for what would be for many years the tallest building in the world — the Empire State Building in New York City. Its 102 stories were completed in 1931.

There was a fresh start of skyscraper building in the late 1940s. The Depression and World War II were both over (8) ___. More office space was needed, and steel and other building materials were again easy to get.

Skyscrapers took on bold new shapes. Outer walls of tinted glass often replaced the concrete surfaces of earlier buildings. Sometimes the steel structure was exposed as part of the design. Rarely was a postwar building decorated with Gothic details like the skyscrapers of the past.

The Empire State Building remained the world's tallest until the twin towers of the World Trade Center opened in New York in 1972. But the Trade Center's triumph was short. Only two years later, the 110-story Sears Tower was completed in Chicago. It reached a height of 1,454 feet (436.2 m) — more than 100 feet (30 m) higher than the World Trade Center.

What of the future? Will skyscrapers go even higher? It's possible. Engineers are ready to build taller buildings made strong with walls that will not allow swaying in high winds. Elevator makers believe their cars can carry passengers up to at least 180 floors.

Meanwhile, some critics are against building more skyscrapers and point out serious problems with today's tall buildings. Skyscrapers provide (9) ___. These people mean more crowded streets, public transportation, and parking lots. Skyscrapers are big users of electric power. Also, skyscrapers may get in the way of television reception, block bird flyways, obstruct air traffic, and sometimes (10) ___.

Yet, throughout history, people have built tall structures — from the ancient pyramids, to the mighty bridges and towering skyscrapers of the last 100 years. In the future, despite the problems, skyscrapers will probably continue to go up higher and higher into the sky.

4. Answer the following questions:

1. What important invention helped make tall buildings possible?
2. Why did Chicago lead the way in skyscraper building?
3. Which disagreements existed between Louis Sullivan and other architects of his time?
4. How many skyscrapers had been built in American cities by 1929?
5. Why are tall buildings sometimes criticized?

5. Put these events in the chronological order:

1. The Woolworth Building reached the new height of 60 stories.
2. The 110-story Sears Tower was completed in Chicago.
3. Most of central Chicago was destroyed by the Great Fire.
4. Major William Le Baron Jenney designed the 12-story Home Insurance Company Building in Chicago.
5. The 20-story Flatiron Building was built in New York City.
6. The twin towers of the World Trade Center appeared in New York.
7. The Great Depression hit the United States and put an end to many new skyscrapers.
8. Elisha Otis first demonstrated a steam-powered elevator.
9. 102 stories of the Empire State Building were completed in New York.

6. Give your personal reactions to the text using these phrases.

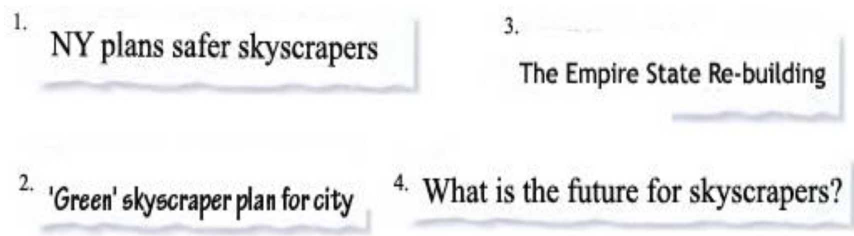
I didn't think/I already knew that…	It's hard to believe that…
What surprised me was…	I wonder what can be done to…

7. Louis Sullivan favored simple, straightforward buildings. Other architects preferred fancier buildings with details like Greek columns and Gothic arches. Which style do you prefer?

8. **Give the main points of the article "Buildings th**at scrape the **sky" in 6-**10 sentences. Use the follow**ing clichés:**

The text deals with … . The author points out that ... . Attention is drawn to the fact that … . It should be noted that … . The importance of … is stressed. There is no doubt that … . The author comes to the conclusion that … . I find the text rather / very … .

9. Look at these four newspaper headlines. What do you think the story is behind each one? Discuss your ideas with your partner, and then tell the group.


1. NY plans safer skyscrapers

2. 'Green' skyscraper plan for city

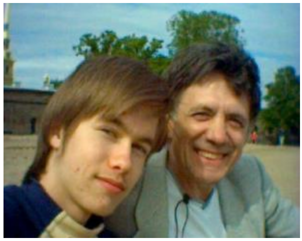
3. The Empire State Re-building

4. What is the future for skyscrapers?

Reading Task D

1. Read the dialogue and fill in the blanks using the words from the box below.

antenna	gargoyles	marshy	elevator	excavated	architecture
skyscrapers	decorated	observatory	tallest	population	



John: Hey, it's really nice of you to show me round New York like this, Uncle Harry.

Uncle Harry: It's my pleasure, John. I thought our next stop could be the Empire State Building.

J: But what's so special about it? It isn't even the highest in New York any more.

U.H.: Maybe not, but I think you'll be surprised to find out quite how interesting it is... Here we are!

J: O.K., then, let's go to the top!

U.H.: Right, here's the _____(1). We have to change at the 86th floor, and then we can go straight on up to the 102nd floor _____(2). The Empire State Building was finished in 1931. It was the highest building in the world then.

J.: Until 1972! That's when they built the World Trade Center.

U.H.: Hey, I didn't know you were an expert!

J.: Well actually, I've just done it in Civic Studies at school!

U.H.: Right then, let's see if we can find a few more facts to impress your teacher. Foundations, for example? They're only 20 meters deep, but nearly 400,000 tons of dirt and rock had to be _____(3). That's more than the weight of the whole building!

J.: Wow, we're here already. I didn't expect it to be so quick.

U.H.: Don't forget, there are 73 elevators in the building, and their speed can reach 360 meters a minute!

J.: Just look at the view! How high is the tower?

U.H.: Where we're standing, it's 381 meters, but right to the top of the TV _____(4) it's 443 meters from the ground.

J.: And look, there's the World Trade Center over there!

U.H.: Yes, you're looking to the south, and that tiny little dot in the distance is the Statue of Liberty. All the ages of American _____(5) are under your feet. Just down there is the Woolworth Building. It was the _____(6) in the world from when it was built in 1913 until the Chrysler Building was finished in 1930.

J.: Oh yeah, I can see it there to the east. Is it true that the top is _____(7) with the different symbols of Chrysler cars?

U.H.: Almost! In fact the _____(8) you can see up there reproduce the 1929 Chrysler radiator caps. And to its right you can see the United Nations Building.

J.: Oh yeah, Le Corbusier's building that they call "The Matchbox".

U.H.: Hey, you've been reading the guide books too!

J.: I can't get over how many _____(9) there are, and how close they are together.

U.H.: That's why the _____(10) of Manhattan is so dense: there are thousands of people to the square meter! But don't forget that New York isn't all skyscrapers. The buildings are much lower in the areas which were _____(11), like in Greenwich Village.

J.: And have a look over there, north to Central Park. Then you'll see a bit of green!

NEW YORK IN A FEW YEARS FROM NOW
(A prophecy of 1881)

Poets' Corner

Skyscraper

by Rachel Field

Do skyscrapers ever grow tired
Of holding themselves up high?
Do they ever shiver on frosty nights
With their tops against the sky?
Do they feel lonely sometimes
Because they have grown so tall?
Do they ever wish they could lie right down
And never get up at all?

Diagrams

by Thom Gunn

Downtown, an office tower is going up.
And from the mesa of unfinished top
Big cranes jut, spectral points of stiffened net:
Angled top-heavy artefacts, and yet
Diagrams from the sky, as if its air
Could drop lines, snip them off, and leave them there.
On girders round them, Indians pad like cats,
With wrenches in their pockets and hard hats.
They wear their yellow boots like moccasins,
Balanced where air ends and where steel begins,
Sky men, and through the sole's flesh, chewed and pliant,
They feel the studded bone-edge of the giant.
It grunts and sways through its whole metal length.
And giving to the air is sign of strength.

Skyscraper

by Paul Sutton

Shaft of steel and stone standing forbidding
Dark and dead pointing to a brilliant moon
Black and brooding so bleak and unbending
Peak of the island, a gigantic tomb.
That tip of the shaft, a column of fire
A flame between earth and the moons cold light
Below cement swaths the island entire
The catacombs of man in dead of night.
The rock sea swells, avenue and canyon
And wave crests of agitated neon,
Flesh-filled capsules crawl and beetles surge on
Remote from this pinnacle of cold stone.
What are you? Sign of that which will have gone
Or blade of shining steel, symbol of dawn?

Skyscraper

by Jerome Dehnert

A driver pounds a pile of steel down
Until the alloy strikes a rock below.
No farther does the steal alloy go,
Since bedrock checks the progress of Motown.
A Lattice-work of steel embraces dawn,
While heavy cables, winches, and men work
To lift up slabs of cement like clockwork,
As metal, stone, and glass give way to brawn.
Amid the blood and sweat and cheers goes up
A building raised by those who understand
That from the ravages of time and sand,
A race that takes a part builds up and up.
God bless America and keep her safe,
The skies above her free from sin vouchsafe.

Reading task E

1. Go over the vocabulary list. Consult a dictionary if you need.

Developer(s)	joint venture	step down
Walk-up(s)	affiliate	u-shaped pattern
Predecessor	partner	townhouses
Crowd-pleaser	neighborhood of impact	ring
Large-scale events	plaza	tenement
Range	outdoor sculpture	pedestrian
Demolish	skirt(v)	spandrels
Block	drive	set back(v)
Access	drop off point	shaft

2. Note the pronunciation of the construction companies, personal and geographic names in the article and try to present them in your native language:

Manhattan	Kumagai Gumi
Madison Square Garden	David Childs
Broadway	Zeckendorf
Skidmor, Owings & Merrill (SOM)	World Wide Plaza
Arthur G. Cohen	Rockefeller Centre
Communication Centre Associates	Childs
Frank Williams	Dominic Fonti
HRH Construction Corporation	Richard F. Row
Robert P. Sanna	Robert Halvorson
Garry R. Steficek	Mosher Steel Co.
Ontario	Isyumov
Peter Chorman	Werner Dahnz
Michael Sardina	

3. Note the abbreviations and symbols in the article:

Co. - company	lin. ft - linear foot
Co. Ltd - company limited	sq ft - square foot
Corp. - corporation	lb per ft (libra) - pounds per foot
ft. - foot (feet) - 30.5 cm	in. - inch - 2.5 cm
200x800 - two hundred by eight hundred	

4. Read the title/subtitle of the article and answer:

a. What the difference between a horizon and a skyline is?
b. Whether you can live in a commercial-residential complex?
c. Whether this complex is a multiuse building?
d. Where do you think you would see such a complex
(suburb / city centre / downtown / the country side)?
e. Where you should walk-up?

5. Turn to the title and try to explain the contents of the text. Find an adequate translation of the title.

6. Skim the article and answer how many parts it is divided into.

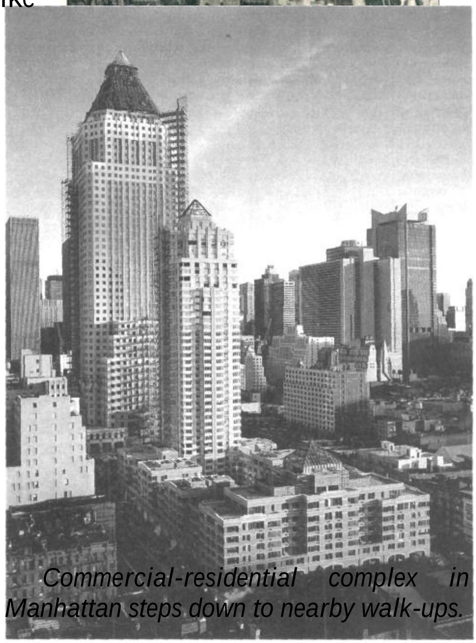
7. Read parts I and II and answer the questions after them. Make sure you can explain the following terms and word combinations from part I and II:

City skyline
Adding a notch
Commercial-residential complex
Walk-ups
Developers
To be a crowed-pleaser
Large-scale events
Range from
City block
To give a chance for a comeback
Joint venture
Affiliate
A partner in the office
Master plan for the site
To create a neighbourhood of impact
Mirror image
Mixed-use project
To step down on the site
Public plaza
Public seating
Outdoor sculpture
Narrow drive
Dropoff point
Massing of the project
U-shaped pattern
Townhouses ring (the edge of the site)
Tenement
Classically derived design
To set back the spandrels
In the glazed brick exterior
To define the verticality of the shaft
Clear glass
The tower is accessed
To promote pedestrian traffic
To share a private courtyard

Adding a Notch to a City Skyline

Part I. Introduction. The developers of a $545-million complex on the west side of Manhattan hope their project, like its predecessor on the site, is going to be a crowd-pleaser.

The 3.7-acre site was once a location of Madison Square Garden, where young and old enthusiasts watched large-scale events that ranged from circus performances to boxing matches. That structure was demolished and replaced with a new Garden at another site more than 20 years ago, and the block has been used for surface parking ever since.



Commercial-residential complex in Manhattan steps down to nearby walk-ups.

Commercial tower and residential tower are separated by a public plaza.

The new owner, New York Communication Center Associates, is giving the site, just one block from Broadway, a chance for a comeback. Communication Center Associates is a joint venture of four New York City companies – The Zeckendorf Co., World Wide Realty Corp., Arthur G. Gohen and KG Land New York Corp., an affiliate of Japan’s Kumagai Gumi Co. Ltd.

Architect David Childs, a partner in the New York City office of Skidmore, Owings and Merrill, designed the master plan fro the site. Acknowledging that he was in the unusual position of having a full city block to design. Childs says he wanted to create a neighborhood of impact. “The project, called World Wide Plaza, was “planned as a mirror image" to the initial grouping of buildings at Rockefeller Center, three blocks to the east. Although the initial Rockefeller Center was commercial and World Wide Plaza is a mixed-use project, both have separate lowers that step down on the site.

Between the towers on each site is a ` plaza with public seating and a large outdoor sculpture. Both plazas can be reached by the public from three directions and both are skirted by a narrow drive designed as a drop-off point for people entering the tallest tower.

At World Wide Plaza, the massing of the project steps down from the 53-story commercial tower to a 41-story residential tower and again to a U -shaped pattern of 7 to 10-story townhouses that ring the western edge of the site. The steps leading into the townhouses provide the same relationship to the street as the tenement walk-ups directly opposite.

Part II. Class tower. Childs, who designed the commercial tower as well as doing the master plan, says the tower's design is "classically derived. The spandrels in the glazed brick exterior are set back to define the verticality of the shaft, "like the pin stripes on a suit," he says. "It's clearly like New York in character, but a solid, geometric, modern office building." The four-story sections that intersect each of the tower's four corners are clad with granite. Windows are dear glass.

Architect Frank Williams and Associates, New York City, designed the residential tower and townhouses. The residential tower is accessed directly from the public plaza, which is designed to promote pedestrian traffic. Six theatres will be constructed beneath the plaza. For privacy, residents will share a private courtyard inside the ring of residential buildings.

8. Answer the questions to parts I and II:

1. What do the developers of the complex on the west side of Manhattan hope for?
2. What was located on the site before?
3. How has the site been used after Garden's demolition?
4. Who is the new owner of the site?
5. Who designed a master plan?
6. Why was Childs in an unusual position?
7. How was the project planned?
8. What do the WWP and Rockefeller Centre have in common?

9. How is the public plaza decorated?
10. Is there any drive for cars?
11. How many stories are the towers?
12. In what way is the relationship of the townhouses to the street provided?
13. What is the design of the commercial tower?
14. In what way is the verticality of the shaft defined?
15. Do you like the appearance and the character of the commercial tower?
16. Who designed the residential tower and townhouses?
17. How can people access the residential building?
18. What will be constructed beneath the plaza?
19. What is planned inside the ring of residential building?
20. Can you characterize the complex in one word?

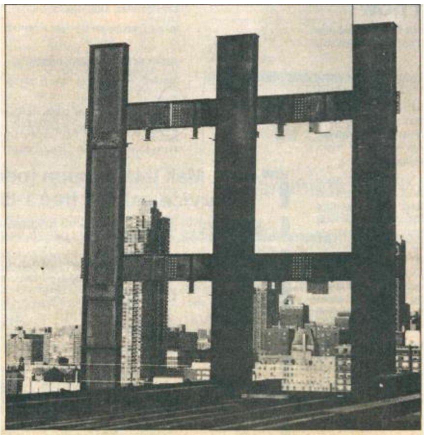
9. Read part III and answer the questions after it. Make sure you can explain the following terms and word combinations from part III.

Excavation of the rest of the site
Parking lot
Excavation and foundation contractor
To deal with a maze
Underground debris
To set the construction schedule back
Rebar
Cut with torches
Equipment housed in the basement
Oil tank
Rocky subsurface
Explosive charges
Close blasting
A close and more precise line
Spacing

Lobby
Grade level
Granite-clad columns
Prefabricated off the site
Option
Faced with granite
Dowels
Preset holes
Vaulted ceiling
Coffered sections
Fiberglass-reinforced gypsum
Joist framing system
To be within the footprint
Transferred loads
Structural engineer
Associate partner with
Mechanical mezzanine
Project manager

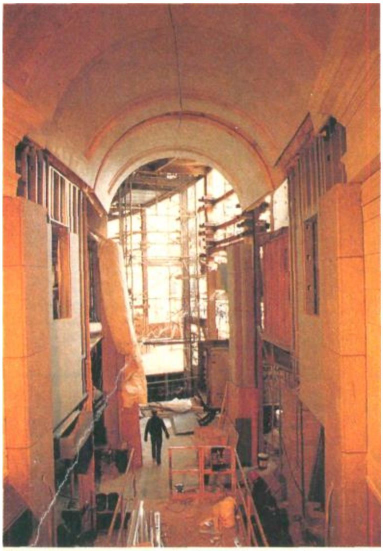
To chip away	Rigid frame
To turn to a backhoe	Bays
To renovate a subway entrance	Setback (n)
Token booth	Wind stresses
Superstructure	Braced core
Exterior tube	

Part III. Demolition. A three-story brick building in a corner of the site was quickly demolished in two days. But when excavation of the rest of the 200 x 800-ft site began, no one knew what was below the asphalt parking lot. Excavation and foundation contractor Delma Construction, New York City, discovered that the old Garden's reinforced concrete floor slab had simply been cut in half and dumped into the building's basement. Instead of a simple ex-cavation, Delma had to deal with a maze of underground debris. The process set the construction schedule back about a month, says Dominic Fonti, the commercial tower's project manager for HRH Construction Corp., New York City. Rebar had to be cut with torches before it could be removed by crane.



Columns had stubs welded in shop for easier moment connection.

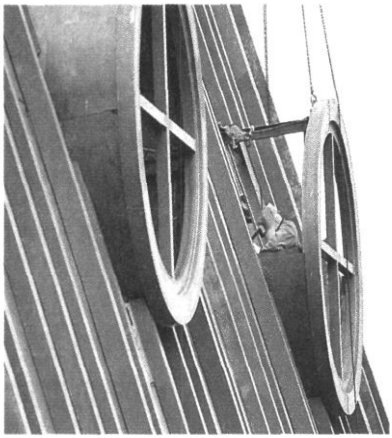
The excavation process also uncovered all of the mechanical equipment that had been housed in the basement of the old Garden. Obstacles included an oil tank full of oil that had to be emptied before it could be removed from the site, Fonti says.



Three-story arcade around office lobby is elliptical in plan.

To excavate the site's rocky subsurface, explosive charges had to be kept very small because blasting was so close to an active subway line. This slowed the construction schedule another three to four weeks, says Fonti. To get a close and more precise line for the charges, workers drilled holes that were about 6 in. on center. This spacing meant that the rock wall was just chipped away. When workers were as close as 20 to 25 ft to the subway, they turned to a backhoe fitted with a hydraulic hammer.

Zeckendorf had agreed to renovate and expand a subway entrance that will be part of the commercial tower. The entrance had been sealed 22 years ago when the old Garden was demolished. When workers opened it, they found lots of dust and an old token booth that was later removed—but no graffiti. It is "probably the only subway entrance [in New York City] untouched by graffiti," adds Fonti. During the tion, the only part of the old Garden structure that was retained was its north foundation wall. Nearly 100 lin ft o f it was integrated into the foundation wall system for the commercial tower. The superstructure of the 778-ft-high commercial tower consists of an exterior tube



Roof panels and dormers are installed from inside.

with a braced frame at the core. The tube resists most of the overturning moment and the braced core resists most of the shear forces.

An arcade, elliptical in plan, surrounds the lobby at grade level. The arcade's 25-ft-high granite-clad columns were prefabricated off the site. Fonti says this option was faster and saved money on labor. The 4-ft-high sections are 6 in. thick and consist of a concrete layer faced with granite. The sections are connected on the site with dowels inserted into preset holes. The 35-ft-high vaulted ceiling in the arcade is also made of prefabricated sections. Its coffered sections, with ornamental borders, are made of fiberglass-reinforced gypsum. They are hung from a metal joist framing system.

Rooftop pyramid is a space frame clad with glass that will be illuminated.

Although the arcade is open to the exterior, it is still within the footprint of the structural tube. To get the tube's loads around the three-story arcade, they are transferred to the corners of the building through heavy diagonal W14 sections.

Structural engineer Richard F. Rowe, an associate partner with SOM, explains that transferring the loads "over a couple of stories is more elegant, so the load is gradually distributed to the places that you want it." He adds that it is important to recognize that the transfers take place so you can't see them from the exterior." A network of transfers is located between the second and fourth floors. Transfers also take place in a 4 to 5-ft-high space below the second level, used as a mechanical mezzanine, says Robert P. Sanna, one of HRH's project managers on the job. Above the fifth floor, wide tube columns are used as structural members instead of W14s. Structural engineer Robert A. Halvorson, a partner with SOM, adds that the rigid frame is interrupted between the 41st and 43rd floors. The columns stay in the same location, but a 2-ft recess of the beams between the 19-ft-bays provides a setback for exterior lighting equipment to be installed. Halvorsons explains that the wind stresses are low enough at that height that the rigid frame can be interrupted without problem.

10. Answer the questions to part III:

1. Was excavation of the site simple?
2. What was below the asphalt parking lot?
3. Why was the construction schedule set back about a month?
4. Who was excavation and foundation constructor?
5. What obstacles were in the basement of the Old Garden?
6. Why were explosive charges small?
7. How were the holes for the charges drilled?
8. What was just chipped away?
9. What did the workers use when they were as close as 20 ft to the subway?
10. Why was the subway entrance different from others?
11. What part of the old Garden structure was retained?
12. What is the function of the exterior tube?
13. What is the shape of the arcade?
14. What materials are used for the arcade?
15. How are the sections connected?
16. What materials are used for the arcade's vaulted ceiling?
17. How are the tube's loads transferred?
18. What is Richard F. Rowe?
19. Where is the rigid frame interrupted?
20. What provides a setback for exterior lighting equipment?

11. Read part IV and answer the questions after it. Make sure you can explain the following terms and word combinations from part IV.

Project engineer	Core bracing
Tight bay spacing	Chamfered corner
To splice on at midspan	To form Ts
Field-welded	Wedding cake pattern
Shop-welded (on to one side) beam stubs	Gravity load
Curved masonry	

Part IV. Bracing. Gary R. Steficek, SOM's project engineer for the commercial tower, adds that not all of the core bracing continues to the top of the building, either. Some of the bracing stops at the 16th floor, some stops at the 40th and the rest continues to the 50th floor. Tight bay spacing was needed at the corners to help transfer the wind loads around the corners of the building. There are four 11-ft-wide bays at each end and alternating 19-ft and 11-ft bays in the center. Each end bay has a chamfered corner. Columns that had beam stubs spiced on at midspan to form Ts were used between the 11-ft-wide bays. "The [horizontal] stubs were welded on in the shop where it is a lot easier to make a moment connection," says Steficek. Mosher Steel Co., Houston, fabricated the structural steel for the theaters and commercial tower. Steficek adds that the stubs could not exceed 5-ft because they had to be transported through tunnels into New York City. That meant that for the 19-ft-wide bays, stubs could only be shop-welded onto one side of the columns and additional beams for the frame had to be field-welded.

The steel framing that surrounds the tube in a wedding cake pattern at the building's base does not add to its stability. Steficek explains that the 18 floors of framing around the base of the tube carry only their own gravity load. The curved masonry on the exterior that is designed to mirror the arcade inside is six stories high. Steficek adds that the floor area varies from about 45,000 sq ft at the base to about 25,000 sq ft on the upper floors.

12. Answer the questions to part IV:

1. Who is the project engineer for the commercial tower?
2. Does all of the core bracing continue to the top of the building?
3. What was needed to transfer the wind loads around the corners of the building?
4. What columns were used between the 11-ft-wide bays?
5. What welding was used for the horizontal stubs?
6. What company fabricated the structural steel?
7. What needed field welding?
8. What is the steel framing compared to?
9. What load do the 18 floors of the framing carry?
10. How high is the curved masonry?

11. How does the floor area vary?

13. Read part V and answer the questions after it. Make sure you can explain the following terms and word combinations from part V.

Impermeable envelope
Wind forces
Research director
Wind tunnel
Boundary layer
Round dormers
Roof space
A four-store-high plenum
Air intake
Exhausted air
Water intake
Wind loads
Built-up patches
Sheltering effect
Penthouse
Panelized roof
Curtain wall
Scaffolding
Crane
Derrick
Assistant project manager
Subcontractor

Mullions
To span between the girts
To specify
Loosened up copper
The bolt spacing
Copper stiffeners
Gasket
Translucent glass
Tight midtown site
Staging area
Plaza’s landscaping
Vehicular drive
Tree wells
Principal designer
Landscape architect
To frame parts of the structure
Substantial amount of seating
Pavilion(s)
Retail space
To wash with lights
Lit from within

Part V. Wind forces. Most skyscrapers have an impermeable envelope. This building project is unusual because both the arcade at grade level and the copper-clad roof are open to wind forces on the interior walls, says Nicholas Isyumov, research director at the University of Western Ontario's Boundary Layer Wind Tunnel Laboratory, in London, Ontario.


Dormers will have grilles to intake and exhaust air.

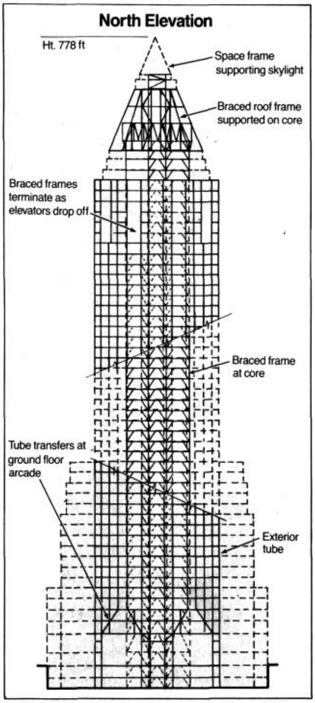
Round dormers that let air in and out through copper grilles are located at the top and the bottom of the 150-ft-high roof space, creating a four-story-high plenum. Bottom dormers at the 50th floor level have an air intake through cooling towers located at the 708-ft to 731-ft levels. The air is exhausted through the dormers at the top of the roof. All of the dormers are in a vertical position to reduce the chance of water intake. Mechanical-electrical design is by Cosentini Associates, New York City.

The actual wind loads on the building will be higher than they are on some nearby skyscrapers because it is "away from the built-up patches of Manhattan. It does not have the sheltering effect of surrounding buildings and the biggest, strongest winds in Manhattan tend to come from the west," says Isyumov. To the west of the project, most of the surrounding buildings are five-story walk-up tenements.

The roof structure, used as a penthouse for the mechanical equipment, is made of prefabricated copper panels. HRH suggested that the roof be panelized so it could be installed like a curtain wall and scaffolding would not be needed for its erection. As results, the roof was built from the interior "with as few pieces as possible," says SOM's Rowe. The 2 x 26-ft-long copper sheets were lifted by crane and derrick, adds Peter M. Chorman.

SOM's assistant project manager for the roof and arcade. They were stored on the 47th floor and on the two floors inside the roof. Subcontractor Werner Dahnz, Toronto, designed and fabricated the copper roof panels. They are made of girts with ribs "similar to curtain wall mullions that span between the girts, " says Rowe. The girts are being bolted in the field to sloping columns. The copper roof panels had to be equipped with doors to provide access to the lighting equipment that will be used to illuminate the roof.

Rowe adds that SOM typically specifies that a portion of a window wall be tested for wind loads air infiltration. Here, in addition to a section of a wall, a section of the roof with dormers also was built and tested. "The first time it failed miserably. The copper loosened up in the first test," explains Rowe. The problem was corrected by increasing the bolt size and reducing the bolt spacing from 18 to about 12 in. on center. The copper panels, with copper stiffeners on 8-in. centers, are held between aluminum glazing stops that are bolted to aluminum mullions. A gasket separates the two dissimilar metals. At the top of the copper-clad roof is a pyramid space frame clad with translucent glass.



Perimeter tube and cross-braced core give lateral stability.

The grade-level plaza, located between the residential and commercial towers, is reached directly from the arcade. Its construction was a priority because its open area was needed for the storage of construction materials on the tight midtown site. The plaza also is being used as a staging area for the fabrication of reinforced concrete sections for the residential tower and the townhouses. But before the structure supporting the plaza's landscaping, fountain and vehicular drive could be built, the project's six theaters had to be constructed.

The roof of the theaters is at the bottom of the tree wells, says Michael Sardina, principal designer for the landscape architecture, The SWA Group, Boston. Loading is high on the plaza because of the 10-ft-wide vehicular drive that is adjacent to the commercial tower.

To support the plaza weight and get the necessary clear spans for the theaters, four 7 ½ -ft-deep girders frame parts of the underground structure. Two of the deep girders are 80ft long and two are 60ft long. The heaviest of them weigh 784 Ib per ft.

The plaza will have trees, shrubs and "a substantial amount of seating," says Sardina. Two 30-ft-high pavilions, one on either side of the plaza, will provide entrances to the underground theaters as well as retail space on the plaza. To attract pedestrians and keep the public spaces active at night, the commercial tower will be washed with lights. The rooftop pyramid, lit from within, will become a beacon on the city's skyline.

14. Answer the questions to part V:

1. What envelope do most skyscrapers have?
2. Why is this project unusual?
3. What is creating a four-story plenum?
4. Where is the air intake at the 50th floor?
5. How is the air exhausted?
6. Why are all the dormers in a vertical position?
7. Why are the actual wind loads on the building higher than on nearby skyscrapers?
8. Where do the biggest winds in Manhattan tend to come from?
9. Is the roof structure used as a penthouse for residents?
10. Why wasn't scaffolding used for the roof construction?
11. What mechanisms were used to lift copper sheets?
12. Who designed and fabricated the copper roof panels?
13. How is the access to the lighting equipment provided?
14. What was tested for wind loads and air filtration?
15. How are the copper panels held?

16. What is reached directly from the arcade?
17. What was another function of the plaza?
18. What was necessary to construct before the fountain and vehicular drive?
19. Where is the roof of the theatres?
20. What frame parts of the underground structure?
21. What will the plaza have?
22. What do the 30-ft-high pavilions provide?
23. Why will the commercial tower be washed with lights?
24. What will the roof-top pyramid become?

Comprehension check

15. Decide whether the following statements are true or false according to the text:

1. The commercial-residential complex in Manhattan is an added notch to a city skyline.
2. The structure was demolished and replaced with a surface parking.
3. Rockefeller Center and World Wide Plaza differ in functions.
4. Both plazas can be reached from two directions.
5. Excavation and foundation contractor had many obstacles in the excavation process.
6. The subway entrance was covered with graffiti.
7. The superstructure consists of an exterior tube with a braced frame at the core.
8. The arcade's granite-clad prefabricated columns saved money on labour and time.
9. Transferring the loads over a couple of stories can be seen from the exterior.
10. The rigid frame couldn't be interrupted because of wind stresses.
11. It is a lot easier to make a moment connection by welding in the shop.
12. The steel framing that surrounds the tube in a wedding cake pattern at the building's base does not add to it's stability.
13. This building has an impermeable envelope.

14. The air is exhausted through the dormers at the top of the roof.

15. The actual wind loads on the commercial tower will be lower than they are on nearby skyscrapers.

16. The roof was panelized to be installed like a curtain wall from the interior.

17. The copper roof panels had to be equipped with doors to provide access to the lighting equipment to illuminate the roof.

18. The project's six theatres construction was a priority.

19. To support the plaza weight four heavy girders framed parts of the underground structure.

20. The commercial tower will be washed with lights to be protected from flying aircrafts.

16. What do you think:

1. Do skyscrapers have any chance to get ground in Belarus?
2. What do you know about construction industry in this country?
3. Does it follow the high-tech designs of Skidmore, Owings and Merril and other construction companies and businesses?
4. Can you imagine living in a penthouse or on the 41st floor of a skyscraper?
5. Would you like to live there or just enjoy a breathtaking view from a sky deck or working in the office on the 100th floor?

17. Make up the plan of the text.

18. Make a summary according to your plan. The following word-combinations will help you:

The title of the article is… .The article touches upon … . The article consists of … parts. The first part deals with such problems as… . The second/third part reports on … . Such designs as…are described. The advantage of this design is… . The article is provided (illustrated) with (photos, diagrams, tables). The final part of the article gives the information about… .

Language focus

19. Match the words with their synonyms:

1) walk-up	6) surround	a) access	f) tenement
2) design	7) adjacent	b) beam	g) reflect
3) construct	8) mirror	c) design	h) nearby
4) girder	9) reach	d) light	i) skirt
5) develop	10) illuminate	e) build	j) project

20. Match the words with their antonyms:

1) increase	6) install	a) walk-up	f) exterior
2) let (air) in	7) top	b) reduce	g) remove
3) tower	8) load	c) demolish	h) exhaust
4) construct	9) intake	d) let out	i) weight
5) interior	10) underground	e) bottom	j) subway

21. Match the words with their definitions:

1. expand	a) to remove the building from the site
2. interrupt	b) the top part of a building
3. slab	c) finished with granite, glass or other material
4. impermeable	d) the underground part of a building
5. walk-up	e) a town house without elevators
6. excavate	f) the company making part of the project
7. residential	g) the unit between storeys of a building
8. plaza	h) a part between two streets of any town
9. subcontractor	i) to make wider
10. foundation	j) the building equipment used on a tight construction site
11. demolish	k) to make a break n a process
12. blasting	l) not letting air n or out
13. roof	m) the room with arches as a ceiling
14. backhoe	n) to dig the ground for a foundation
15. clad	o) making explosion
16. arcade	p) a place for public activities or entertainment
17. block	q) meant for people to live in

22. What do we call: (use the words from the list below)

(bracing , contractor , hydraulic, aluminium, exterior,
load, fabricate ,scaffolding, design, core, demolition, charge ,
commercial building, brick, depth, surface, crane,
basement, derrick, superstructure).

1. the person or organization signatory to a contract to do certain work within a specified time for payment.
2. a silvery grey metallic element with good corrosion resistance used in many light alloys.
3. structure members to stiffen it or to resist wind forces.
4. hydraulically powered tool on the jib of an excavator.
5. something outer or external.
6. an action applied to a structure, artifact or its surroundings.
7. construct or manufacture by a fabricator.
8. a broad class of mechanical devices for lifting and moving heavy loads.
9. a crane with a vertical mast.
10. the process of knocking down or pulling a building.
11. the distance from a surface innards.
12. a small rectangular block of fired clay used in building.
13. the part of a building or other structure above the foundation.
14. the outside part or uppermost layer of something.
15. having most of the space used for commerce; often including stores, offices, libraries, churches, museums, warehouses, government buildings etc.
16. a temporary structure to provide access or protection to temporary works; may be in timber or made of tubular steel poles.
17. to formulate an idea and turn it into a practical reality as a structure.
18. central or most important part of something.
19. a quantity of explosive inserted in a drill hole in a blasting operation.
20. the underground storey of a building.

23. Arrange the following words into groups according to the part of speech. Pay attention to their suffixes and prefixes.

Verb	Noun	Adjective	Adverb

Construction, miserably, loosen, infiltration, residential, equipment, subcontractor, stability, electrical, developer, predecessor, commercial, relationship, replace, parking, provide, acknowledge, unusual, separate, outdoor, derive, geometric, intersect, directly, define, walk-up, verticality, western, pedestrian, privacy, excavate, basement, courtyard, private, uncover, contractor, hydraulic, renovate, spacing, subsurface, explosive, precise, impermeable, charges, locate, stiffness, dissimilar, translucent, arcade, vehicular, fabrication, panelize, chip away, blasting, retain, superstructure, overturning, prefabricate, preset, fiberglass, structural, transfer, elegant, gradually, rigid, bracing.

Language development

24. Complete the sentences with a suitable preposition. You can choose from the following ones: *from, as, to, with, about, of, for*. Some of them can be used more than once.

1. The skyscraper steps down … nearby walk-ups.
2. The operations ranged … blasting … fieldwelding.
3. The site is used … surface parking.
4. The project was designed … a mirror image … the buildings in downtown.
5. The walls were clad … granite.
6. The theatre can be accessed directly … the public plaza.
7. The workers had to deal … a maze of underground debris.
8. The tests set the construction schedule back… a month.
9. The blasting will be too close … a railway.
10. The Central Park has a substantial amount …seating.

25. Translate the following combinations of noun groups and colloquial expressions. Then choose any 10 items and make up your sentences or find the similar ones in the article.

a) city skyline,
large- scale events
pin stripes on a suit
joint venture
parking lot
reinforced concrete floor slab
token booth
exterior tube
concrete layer
tube columns
core bracing
wedding cake pattern
research director
copper grilled
air intake
nearby skyscrapers
curtain wall
air infiltration
tree wells
crowd- pleaser
tenement walk- ups
mirror image
neighborhood of impact
excavation contractor
building`s basement
foundation wall system
shear forces
fiberglass- reinforced gypsum
wind stresses
beam stubs
gravity load
wind tunnel
bottom dormers
water intake
built- up patches
copper roof panels
aluminium glazing stops

b) be going to be
acknowledging
plan as a mirror image to
be reached from
be accessed directly from
cut with torches
be emptied
during the excavation
elliptical in plan
save money on labour
insert into holes
transfer loads around the arcade
interrupt the rigid frame
at midspan
weld on in the shop
be open to wind forces
have the sheltering effect of
give a chance for a comeback
be in the unusual position
step down on the site
be skirted by
deal with
be housed in the basement
be chipped away
resist an overturning moment
be prefabricated off the site
face with granite
be within the footprint of the tube
use as a mechanical mezzanine
provide a setback
form Ts
have an impermeable envelope
be exhausted
use as a penthouse

as a result	be lifted by crane and derrick
be bolted	be tested for wind loads
fail miserably	be clad with translucent glass
located between	use as a staging area
support the plaza`s landscaping	be at the bottom of the tree wells
adjacent to	substantial amount of seating
attract pedestrians	be washed with lights
become a beacon on the city`s skyline.	

26. Fill in the correct words from the list below and translate the following sentences into your native language:

Location, site, drive, drop off point, reached, plazas, ranged, mixed-use project, block, surface, city block, joint venture, derived, explosive charges, sealed, spandrels, set back, accessed, townhouses, ring, demolished, backhoe, hydraulic hammer, dumped, basement, excavation, uncovered, arcade`s, prefabricated off, untouched, curved masonry superstructure, core, Transferring, couple of stories, vaulted, sections, curved masonry, rigid frame, interrupted, core bracing, actual wind loads, structural steel

1. The events ... from circus performances to boxing matches.
2. The ... was used for... parking.
3. The associates is a... of four New York companies.
4. The architect had a full ... ... to design.
5. The Complex is a … … .
6. Both … can be …from three directions.
7. A narrow… is designed as a… for people entering the tallest tower.
8. The 10- storey … ... the western edge of the site.
9. The commercial tower`s design is classically ….
10. The … are … … to define the verticality of the shaft.
11. The residential tower is … directly from the public plaza.
12. The brick building was quickly … in 2 days.
13. The floor slab was … into building`s ….
14. The … process… the mechanical equipment.

15. ... ... had to be kept very small.
16. The workers turned to a … fitted with a …
17. The entrance was … by graffiti.
18. The … consists of an exterior tube with a braces frame at the ….
19. The … columns were… the site.
20. The … ceiling in the arcade is made of prefabricated ….
21. ... the loads over a … is more elegant: you can`t see they from the exterior.
22. The … … is … between 41tst and 43rd floors.
23. Not all of the … … continues to the top of the building.
24. Mosher steel Company fabricated the… … for the commercial tower.
25. The … … on the exterior is six stories height.
26. The… … … on the building will be high.
27. The entrance was … 22 years ago.
28. The 3.7-acre...was once the ... of Madison Square Garden.

27. Translate the following sentences from Russian into English:

1. Разработчики нового комплекса в Минске надеются, что их объект привлечет много людей.

2. Эту башню снесли более 60 лет назад.

3. Площадь использовалась в качестве парковки для автомобилей.

4. Генплан всего квартала был разработан сотрудником нью-йоркского офиса компании СОМ.

5. Это архитектор Лангбард разработал проект Дома Правительства.

6. Под площадью были построены 5 театров и 2 кафе.

7.Именно внутри кольца из жилых зданий будет частный дворик для внутреннего пользования жильцами.

8. Подрядчику на строительство фундамента, пришлось столкнуться с подземными завалами.

9.Также препятствием была и цистерна, заполненная мазутом.

10. Взрывные работы сдвинули график строительства еще на 3-4 недели.

11. Скважины для взрывных зарядов бурили с шагом 6 дюймов (между центрами).

12. Вход в метро является частью торгово-общественной башни.

13. Труба и будет противостоять опрокидывающему моменту.

14. Кессонные секции свода будут выполнены из гипса, армированного стекловолокном.

15. Передача нагрузок осуществляется настолько элегантно, что вы не ощущаете этого, глядя снаружи.

16. Для установки наружного осветительного оборудования обеспечивается ниша.

17. Связи каркаса прерываются на 19- м этаже.

18. Только дополнительные балки для каркаса пришлось приваривать на стройплощадке.

19. Действующие ветровые нагрузки на жилую башню были выше, чем на соседние небоскребы.

20. Конструкция крыши выполнена из сборных медных панелей, которые устанавливались изнутри, и леса не потребовались.

21. Медные листы складированы на 57 этаже.

22. Часть стены была испытана в аэродинамической трубе.

23. На самом верху медной кровли размещается каркас в форме пирамиды, крытый прозрачным стеклом.

24. Прямо из аркады можно попасть на площадь, расположенную между башнями.

25. Прежде чем возводить опорную конструкцию под зеленой зоной площади, фонтаном и проездом для автомобилей, построили 5 подземных театров.

26. Длина прогонов варьируется от 60 до 80 футов.

27. Пирамида на крыше, залитая светом изнутри, выглядит как маяк на городском небосклоне .

Follow-up

28. Look through the article again and make notes under the following headings:

1. Commercial - residential complex in Manhattan.
2. Demolition of the old Garden`s structures.
3. Excavation and foundation construction.
4. Superstructure of the commercial tower.
5. Transferring the loads.
6. Core bracing.
7. Wind stresses.
8. The roof structure.
9. The grade- level plaza construction.

29. Now talk on the subjects:

1. Choosing a site for a mixed- use project in a built- up district of a city.
2. Problems in designing a master plan.
3. Demolition and excavation on the tight site.
4. Operations on and off the site.
5. Building materials used in the World Wide Plaza construction.
6. Problems with wind forces to solve in skyscrapers construction.
7. The underground structures make an additional area for public events and entertainment.

30. Read and learn the poem. Say, whether 26 storeys is enough to qualify a building as a skyscraper?

Questions Regarding Skyscrapers

The dictionary says (and I trust it's no lie),
a SKYSCRAPER's a VERY TALL BUILDING. Why,
how tall, then, is VERY TALL? What rule to apply?
Would twenty-six storeys qualify?
And besides, skyscrapers should scrape the sky.

But I've never seen one doing it. Why?
Perhaps it's because the sky's too high
even for skyscrapers. My oh my!
But how high, tell me then, is the sky?
At what height does it begin? and why?
Is it just where the jackdaws cry:
or farther up where the aeroplanes fly?
or where the satellites orbit by?
or where the stars are rich in supply?
or where the angels sing lullaby?
And, anyway, what on earth is the sky,
that it can be scraped? Is it soft as pie
(sometimes they say there's a pie in the sky),
or is it hard like a wooden ply,
or simply a giant butterfly?
I wish I could fly up and try,
but the flight, I'm afraid, may go awry.
Perhaps I'll only find out when I die,
unless you can tell me, but please don't lie.
If you tell me, I'll give you a chunk of my pie.

Dietrich Hucke

31. Answer the following questions:

1. Why do people wish to build tall structures?
2. How do they manage in high-rise construction?
3. Can you recollect the examples of tall structures from the ancient times and at present?
4. What is the main purpose of building skyscrapers?
5. Can we manage without them?
6. What risks can ultra-high skyscrapers be at?

32. There exist several problems associated with the skyscrapers:

1. Designs should be tested in earthquakes.
2. Skyscrapers should be protected from terrorists' attacks.
3. Skyscrapers threaten wide views of historic buildings and city skyline.

4. Skyscrapers are big users of electric power.

Try to find possible solutions to these problems. What other problems can you mention? Work in pairs.

TIME FOR FUN

The Barometer Problem

The following concerns a question in a physics degree exam at the University of Copenhagen:
"Describe how to determine the height of a skyscraper with a barometer."

One student replied: "You tie a long piece of string to the neck of the barometer, then lower the barometer from the roof of the skyscraper to the ground. The length of the string plus the length of the barometer will equal the height of the building."

This highly original answer so incensed the examiner that the student was failed immediately. The student appealed on the grounds that his answer was indisputably correct, and the university appointed an independent arbiter to decide the case.

The arbiter judged that the answer was indeed correct, but did not display any noticeable knowledge of physics. To resolve the problem it was decided to call the student in and allow him six minutes in which to provide a verbal answer that showed at least a minimal familiarity with the basic principles of physics.

For five minutes the student sat in silence, forehead creased in thought. The arbiter reminded him that time was running out, to which the student replied that he had several extremely relevant answers, but couldn't make up his mind which to use. On being advised to hurry up the student replied as follows:

"Firstly, you could take the barometer up to the roof of the skyscraper, drop it over the edge, and measure the time it takes to reach the ground. The height of the building can then be worked out from the formula H = 0.5g x t squared. But bad luck on the barometer."

"Or if the sun is shining you could measure the height of the barometer, then set it on end and measure the length of its shadow. Then you measure the length of the skyscraper's shadow, and thereafter it is a simple matter of proportional arithmetic to work out the height of the skyscraper."

"But if you wanted to be highly scientific about it, you could tie a short piece of string to the barometer and swing it like a pendulum, first at ground level and then on the roof of the skyscraper. The height is worked out by the difference in the gravitational restoring force T =2 pi sqr root (l /g)."

"Or if the skyscraper has an outside emergency staircase, it would be easier to walk up it and mark off the height of the skyscraper in barometer lengths, then add them up."

"If you merely wanted to be boring and orthodox about it, of course, you could use the barometer to measure the air pressure on the roof of the skyscraper and on the ground, and convert the difference in millibars into feet to give the height of the building."

"But since we are constantly being exhorted to exercise independence of mind and apply scientific methods, undoubtedly the best way would be to knock on the janitor's door and say to him 'If you would like a nice new barometer, I will give you this one if you tell me the height of this skyscraper'."

The student was Niels Bohr, the only Dane to win the Nobel Prize for physics.

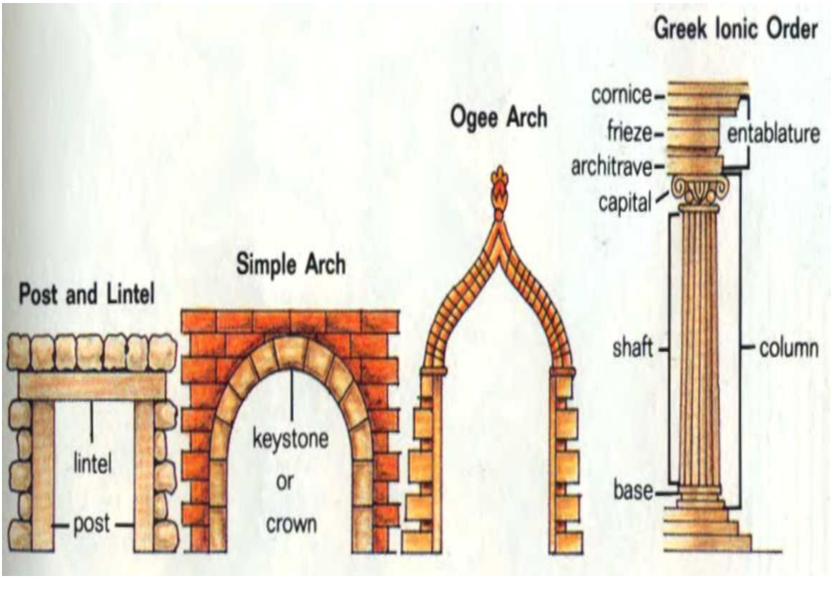
Texts for supplementary reading

Text 1

Technical Terms

Our language is expanding all the time. Whenever new inventions, styles, or ideas are created, old words take on new meanings or new words are added. For example, the word computer took on a new meaning with the invention of the high-speed electronic machine that stores information and performs mathematical and logical calculations. The technical terms software and hardware entered our language.

All fields of science and applied arts use technical terms that have particular meanings. The diagrams below will help you understand some technical terms used in architecture.



Use the diagrams to answer these questions:

1. What does the term post mean in architecture?
2. What other meanings does the word have?
3. What does the term keystone refer to?

4. What meaning does capital have in architecture?
5. What other meanings does the word have?
6. What parts make up a column?
7. What parts make up an entablature?

Text 2

The Seven Wonders of the Ancient World

The ancient Greeks were probably the first to make up a list of the Seven Wonders – those marvelous structures that no traveler would want to miss. Through the ages, others added to or subtracted from the list, based on their opinions. Today, however, the following wonderworks are most often referred to as the Seven Wonders of the Ancient World.

- The Pyramids, tombs for the Egyptian pharaohs, are the oldest and best preserved of all the ancient wonders. The three most famous pyramids were built at Giza ('gēzə) about 2600 B.C. The largest of the three, the Great Pyramid, stands about 450 feet (137 m) high. Its base occupies about 13 acres (5 hectares).
- The Hanging Gardens of Babylon were built by King Nebuchadnezzar (nebjəkəd'nezə) who ruled Babylonia from 605 to 562 B.C. Babylon, the capital of Babylonia, was located near the city of Baghdad (bæg'dæd) in Iraq. The walls are in ruins today, but accounts describe beautiful gardens of flowers, fruit trees, and fountains. The gardens were laid out on brick terraces about 400 feet (120 m) square and 75 feet (23 m) above the ground.
- The Temple of Artemis (ɑːtɪmɪs) was built about 550 B.C. in the Greek city of Ephesus (efəsəs) on the west coast of what is now Turkey. Artemis was the Greek goddess of hunting. The temple was made entirely of white marble except for its tile-covered wooden roof. It was 377 feet (115 m) in length and 180 feet (55 m) in width. More than one hundred enormous stone columns, in a double row around the building, supported its huge roof.
- The Statue of Zeus at Olympia, Greece, was perhaps the most famous statue of the ancient world. It was made in about 435 B.C. and dedicated to the king of the Greek gods. The statue was made of ivory,

40 feet (12 m) high, and showed Zeus sitting on a huge golden throne set with precious stones.

- A The Mausoleum at Halicarnassus (halə'kärnəsəs) was located in what is now southwestern Turkey. It was a huge, white marble tomb for a king named Mausolus (môsô'ləs). Its size and gold decoration made it so famous that large tombs are called mausoleums even today.
- The Colossus of Rhodes was a huge bronzed statue that stood near the harbor of Rhodes, an island in the Aegean (i je' an) Sea. The statue honored the Greek god of the sun, Helios (hēlēäs). It stood about 120 feet (37 m) tail-about as high as our Statue of Liberty.
- The Lighthouse of Alexandria stood on the island of Pharos in the harbor of Alexandria, Egypt. The lighthouse rose from a stone platform in three sections: the bottom was square, the middle eight-sided, and the top circular. Light was provided by a bonfire burning continuously at the top of the tower.
- Except for the pyramids at Giza, none of the ancient wonders is standing today. They were destroyed by humans or nature. We can still play this game of listing wonders though, just as the Greeks did. What do you think the seven wonders of the modern world are?

Text 3

Italy's green primary school

Rossiglione's school has been rebuilt from the ground up

The first thing you notice about the new primary school in Rossiglione, northern Italy, is the smell. Despite the fact that it is brand new, there is no eye-stinging stench from chemicals, glues and fresh paint. Instead it has a warm woody odour that is more afternoon walk than building site.

Set deep in the Ligurian hills, about 30 winding minutes from Genoa, Rossiglione is home to a project that the European Union hopes will provide a blueprint for future constructions.

Partly-funded by Brussels, partly by the local council, the sleepy village is home to one of Italy's first environmentally friendly schools.

Demonstrative

"It is a project that aims to illustrate how things can be done," explains Luciana Zuaro, an architect working on the project.

"People say that bio-architecture is either something for the rich or for private companies, but we need to get it out into the mainstream, the public sector."

"That way, it is no longer a product of privilege but something that benefits us all," said Ms Zuaro, kicking up a cloud of dust as she heads into the unfinished secondary school that is being built next door.

Despite her ready laugh and wild hair, Ms Zuaro is not an isolated player on the lunatic fringe of her industry.

The issue of environmental, or sustainable, building is moving through the UK construction industry "like a hurricane", according to Ed Badke, director for construction and the built environment at the Royal Institution of Chartered Surveyors.

"You have a push-pull scenario," he explains. "The push comes from the government saying you have to do this. The pull comes from the consumers becoming more environmentally conscious."

Cheek by jowl

The changing construction landscape also plays its part.

With less land to build on, people are living closer together, increasing the need for better sound proofing, fewer emissions and greener living.

Britain has set out a target of cutting carbon emissions by 60% by 2050, and there is talk of requiring all new buildings to include some form renewable energy, such as solar panels.

"The issue is very much on the agenda," said Gary Clark, a project manager for Hopkins Architects in London.

"There has been a change of mindset as an industry and more architects are taking it seriously. The profession as a whole is fairly keen to push things along."

The total value of new construction projects in 2003 was £49.6bn (71bn euros; $91bn), according to RICS figures.

Sustainable building accounts for a small part of that total at present, but that is expected to increase with time.

"It's something that happens gradually," said RICS's Mr Badke. "But there is a definite trend from suppliers in the industry to respond to sustainability."

Driving force

In Rossiglione, Ms Zuaro is less keen to wait for change, ducking under scaffolding, checking finishes and asking workers for updates.

"What's interesting is the contrast between the building materials and the techniques that rely heavily on the past, but can be used today thanks to technological advances," she says.

Tiles are made from marble that has been ground down and baked hard; wires and circuit boxes are coated to cut emissions; blinds are incorporated into the double glazed doors and windows, and solar panels are used to generate electricity.

Windows are large to let in natural light, and even when they are closed, there is a current of air that helps the building and its inhabitants breathe.

Ms Zuaro is particularly pleased with the school's underfloor heating system.

There are none of the problems associated with maintaining and changing air conditioning filters - and in summer, the hot water is switched for cold, cooling the building.

An added bonus is that the system is fuelled by debris collected from the surrounding woods, cutting heating costs.

Too much?

The main complaint that has been levelled against "green building" is the extra costs that are involved.

Ms Zuaro estimates that the school in Rossiglione will cost between 15% and 20% more than a traditional building.

"If you want to do it on the cheap, then this isn't the method," she admits. "But it is about spending smart, rather than as little as possible.

Text 4

Is Concrete Environmentally Friendly?

Concrete is in its raw essence a very green material. It is hewn from rock and the earth, ground into a fine powder, mixed with a few other raw components, the most important being water, and then mixed and allowed to set, wherever it is needed.

In its raw state concrete powder is environmentally friendly, as it is of the environment itself – a natural component. Here it is known as cement, before it hardens and becomes like stone. But it is in the industrial extraction of the materials, the mixing, and of course the application of concrete that is ceases to be both biodegradable and environmentally friendly.

Working with Concrete

Concrete (as dry cement) is available in many dry forms and comes as a raw powder in many sizes – in small sacks for the home user, or in huge containers for builders, construction engineers, and many other professional tradesmen. Concrete is now perhaps the most commonly used material on the planet. It is everywhere – in roads and paths, walls, houses, bridges; and has a wonderful versatility in that it can be mixed with many other materials like stone, bitumen, asphalt, to give greater strength to structures and surfaces.

But it is only in its most rawest and natural state that concrete could be described as green, and only as a powder can concrete be biodegradable, when it is most similar to its original form. In working with concrete, when it is mixed and churned with water, it becomes loose and putty like, and from this point on there is a short period when it can be applied before it starts to set and harden.

This industrial use of concrete is the essence of all building projects: when the material comes out of the mixer and is laid down, or used to form bricks, or mixed with other materials. There can be a lot of industrial waste during this process: much of the concrete will not be used immediately, and will harden and not be used. Also a lot of water can be used, and wasted during this process, which is not so green or environmentally friendly. Pollution of water can also occur at this and every stage of the process – from extraction of concrete through to its eventual application – and particularly if this water then becomes ground water or reaches the river systems, the natural environment can become polluted and degraded.

Disposing of Concrete

In its final form, as waste, concrete is far from being either biodegradable or environmentally friendly. It generally has to be smashed up and removed in chunks. One of the benefits of working with concrete is that it is adaptable, hard wearing and long lasting, but once it has started cracking, or becoming uneven, then it needs to be replaced, or covered with further layers of new concrete.

There are other green materials that can be used for some building and construction purposes – more wood can be used in house construction, for instance. But in generals humans need to wean ourselves off our devotion to and reliance upon ugly grey, environmentally unfriendly concrete. Materials that work with and do not despoil the natural environment need to be found and experimented with.

Text 5

Green cement: an industry revolution?

Cement produces more carbon dioxide than the whole of the aviation industry. But now there's a variant that actually absorbs greenhouse gases.

The argument about which is the greener construction material, concrete or steel, could be about to take a new turn. UK scientists say they have discovered a way of producing cement which, instead of emitting carbon dioxide, absorbs it from the atmosphere. Given that cement accounts for about 5% of the world’s carbon dioxide emissions, more than the aviation industry, and that concrete production is set to grow 50% by 2020, the discovery could be the breakthrough of the decade in the construction industry.

The cement has been developed by Novacem, a spin-off company of Imperial College in London. It uses different raw materials to conventional Portland cement. According to Nikolaos Vlasopoulos, the company’s chief scientist, when they were developing the cement they wanted to cross the boundary and make a material that was carbon negative. “That was our goal from the outset,” he says.

Traditional Portland cement is made by heating limestone and clay in giant kilns at about 1,500ÞC to produce clinker. This is ground with gypsum to make cement. The International Energy Agency estimates that for every tonne of cement releases an average of 0.83 tonnes of CO2. About half of this is generated from the vast amounts of energy needed to heat the kilns and the other half is released in chemical reactions as the limestone decomposes.

According to Vlasopoulos there is little that can be done to reduce the CO2 emissions given off when clinker is produced. “Unless you have a way to capture it and encapsulate it, it’s going to be released into the atmosphere.”

However, instead of limestone, Novacem’s cement uses magnesium oxides. Vlasopoulos is coy about the exact technique – a patent is still pending – but says they have developed a way of converting magnesium silicates, which are abundantly available, into magnesium oxide, which is used as the raw material for the cement. The advantage of using magnesium oxide is that the production process requires lower temperatures – typically in the range of 650ÞC to 700ÞC – and it does not give off any carbon dioxide in the reaction.

Lower temperatures open up the possibility of decreasing the carbon footprint further by using biomass. Traditional cement production relies on a mix of fuels such as coke and coal, as well as used tyres, meat, bone meal and packaging waste. For the past decade cement makers have been working on ways to reduce their energy consumption. “There has been a move to switch to lower carbon content fuels,” says Vlasopoulos. “The problem is that they cannot sustain the temperatures as easily as when you use coke or coal to fire the kilns. If you use lower temperatures we can be much more flexible in the types of fuel we use."

Of course this still means that carbon dioxide is produced, but Novacem's cement absorbs carbon dioxide when it hardens; Portland cement does this too but Novacem's cement absorbs it in much greater amounts. Portland cement soaks up anywhere between 0.2 and 0.5 tonnes, which, taking into account the production process, leaves an overall carbon footprint of between 0.3 and 0.6 tonnes. Vlasopoulos says production of a tonne of his cement generates 0.4 tonnes of CO2 but absorbs 1.1 tonnes when it hardens meaning on balance it absorbs 0.7 tonnes of CO2 from the atmosphere. This compares favourably with steel which produces an average 1.7 tonnes of CO2 for every tonne produced.

The big question of course is when will the cement be available? Work on developing full-scale production facilities is now under way and the company is working with Rio Tinto Minerals on how best to get hold of magnesium silicate, but, says Vlasopoulos, it will be three to five years before it is commercially available. "It needs some time to fall into place; we need to build production plants and get the market on board."

And there's more to come. Vlasopoulos and his team are also working on a way to recycle its magnesium oxide cement. "Normally with concrete you break it up and recover it as aggregate and use it instead of sand and gravel. We propose recycling it to make cement again. It's not something that will happen now as you need a stock of buildings to do it with but in the long term this is our goal."

Concrete facts

- Global cement production accounts for about 2 billion tonnes of CO2 every year – that's 5% of all CO2 emissions
- Global cement production in 2007 = 2,690 million tonnes
- Global cement production by 2012 = 3,370 million tonnes
- Chinese cement production in 2007 = 1,240 million tonnes, a threefold increase from 1995. It is predicted that by 2012 it will produce over half of global output
- The EU produced 310 million tonnes of cement in 2007

Text 6

Eco-Housing in the UK

Eco-housing, or houses built in accordance with the principles of sustainable development, which use resources and technologies that capitalise on renewability, are a fast-developing industry in the UK be they individual projects, or whole estates, designed to accommodate and create a new community.

Individual or one-off projects, such as those detailed on other pages on this website, For example yurts, straw-bale houses or dwellings built underground, might reflect the owner or architects unique vision, or maybe use one material pre-dominantly. But how to incorporate ecological design and 'green thinking' into projects and buildings that can appeal to a wider group of people - those who like the idea, but don't necessarily have the time or money to invest in such a project? How can eco-housing live alongside or even replace traditional housing units and estates in the UK?

This article will look at 3 examples of larger ecologically-built projects.

The Bed ZED Project, London

The Bed ZED Project, or Beddington Zero Energy Development, is the UK's largest carbon-neutral eco-community in the UK. It was built in 2002 in Wallington, Surrey, Within the London Borough of Sutton, and comprises of 82 residential homes. The Project was developed by the Peabody Trust, a social housing initiative in London, that aims to fight poverty within the capital. The intention with this project, built in partnership with both an architect and an environmental consultancy firm, was to create a housing project that incorporates new approaches to energy conservation and sustainability, and also to build a thriving community to live within it.

The houses are equipped with key features, both technological and common sense - for example, designed in south facing terraces to maximise solar heat gain, that utilise renewable, and conservable, energy. A small-scale combined heat and power plant on site, powered by wood off-cuts, provides most of the energy to the estate. All buildings have a thick insulation jacket, made from recycled materials. The project has a legally-binding green transport plan, incorporating a car pool system for residents, great public transport links, and is linked in to a cycling network. For these, and many more social and environmental initiatives and technologies, Bed ZED has won many national and International awards for sustainability, design, Innovation and more. It is an inspiring achievement on a local and social level.

Slateford Green Housing, Edinburgh

A second public housing eco-project is the Slateford Green Estate, in Edinburgh. The project, consisting of 120 homes, was developed by a housing association together with the Scottish housing agency, in 2000, at a cost of £9.5 million.

It is a car-free estate, with the space that parking would have consumed, instead being used for gardens, allotments and a large children's play area, around a large central pond with environment-friendly reed beds. The reed beds filter the quality of surface and storm water. This artificial wetland area has been planted with native, low maintenance species, chosen to encourage wildlife. Some of the features in the houses include insulation from recycled newspapers, photovoltaics, a recyclable aluminium roof, and a breathing wall membrane, layered upon an engineered timber structure.

The Findhorn Foundation Eco-Village

On Scotland's north-east coast, near the town of Forres, is the Findhorn Foundation, an intentional community, based upon the values of spirituality and sustainable living. Part of its project is an eco-village, which consists of 45 ecologically-built buildings (so far, although the vision is much more). They have developed a unique construction system that is energy efficient and environmentally sound. All the buildings features are ecological innovations. Some of the original buildings are reconstructed whiskey barrels, bought from nearby distilleries; and there are also later-built straw bale houses and earth ships, which use recycled car tyres.

It is a wonderful place, well worth a visit, and the ecovillage project is a tremendous resource or education and information about building 'green'.

These 3 examples are just the larger examples of eco-building in the UK. It is important to understand how these examples have placed both the concept of building with sustainable resources, and creating a vibrant human community at the core of their philosophy. These 2 parts form the central structure of the principle of sustainable development - for now, and for future generations.

Text 7

Sustainable Architecture Can Help Reduce Carbon Dioxide Emissions

Carbon dioxide is in the air like never before, but not just as measurable parts per million in the earth's atmosphere. Increasingly the subject of everyday conversation and cultural discourse, rising CO2 emissions are seen by many as no less a threat than terrorism, uncontrolled immigration, avian flu or escalating gasoline prices.

A new exhibit on green architecture at the National Building Museum contributes to the discourse. Atmospheric carbon dioxide and its planetary consequences are what former vice president Al Gore talks about in the documentary, "An Inconvenient Truth."

Carbon dioxide was also the focus of a presentation at last month's conference, "The Architecture of Sustainability," sponsored by the American Institute of Architects national committees on design and on the environment.

Addressing the conferees packed into the Corcoran Gallery of Art auditorium, New Mexico architect Edward Mazria delivered a sobering, persuasive opening presentation about carbon dioxide and global warming. He also delivered a daunting challenge to architects: Design all new buildings, whatever the type, to use half the fossil fuel energy used now by buildings of that type.

By the year 2030, the goal is for new buildings to be "carbon-neutral" and use no energy from fossil fuels that produce greenhouse gases. This means that less than 25 years from now, ideally no oil, coal or natural gas would be burned to build, heat, cool and light new buildings.

The 2030 challenge (see http://www.architecture2030.org/) is predicated on the fact that buildings and the construction industry account for about half the energy consumed in the United States. Thus Mazria contends that architects, responsible for designs of a substantial portion of new projects as well as renovation of existing buildings, could contribute significantly to reducing carbon dioxide emissions.

Innovations could include configuring buildings to be heated, cooled, ventilated and lighted more efficiently; specifying green and recycled construction materials; buying renewable energy while harnessing solar, wind, geothermal and biomass energy; and exploiting available and emerging energy technologies.

Mazria acknowledged that attaining the 2030 objective would not be easy, especially because it requires changed attitudes and behavior in sectors of the building industry beyond the influence of architects. It also requires that public attitudes and behavior change. Nevertheless, he thinks architects could exercise more leadership than in the past.

Before exhorting architects to take the lead and meet what he sees as the profession's most pressing design challenge, Mazria convincingly displayed charts, graphs, maps and photos documenting the scientific rationale for worrying about carbon dioxide. He set forth facts and observations, most of which are familiar but are rarely presented coherently.

Fossil fuel depletion: Given known petroleum reserves and rates of accelerating consumption throughout the world, oil could be depleted in about 42 years and natural gas in about 64. Coal eventually would be the only fossil fuel. This assumes marginal increases in use of renewable energy sources.

Atmospheric carbon dioxide: Today, atmospheric carbon dioxide measures about 378 parts per million, compared with about 300 parts per million 450,000 years ago. Yet by 2100, carbon dioxide content could be as high as 700 parts per million. Most of this projected increase would be attributable to continuing use of fossil fuels for buildings, construction, transportation and manufacturing.

Climate change: Carbon dioxide is called a greenhouse gas because it traps solar heat within the atmosphere. Having the effect of a greenhouse's glass roof, carbon dioxide prevents this heat from radiating back out into space. Trapped atmospheric heat is absorbed by the earth's surface, slowly raising the temperature of water, land and vegetation.

Quantitative estimates vary, but scientists generally agree that global warming is a reality, asserting that even a one-degree Celsius increase in average global temperature would make the earth warmer than it has been in the past million years. More alarming, a rise of two to three degrees Celsius is conceivable, and perhaps unavoidable, by the end of the 21st century.

Consequences of climate change: Mazria described the likely catastrophic effects of progressive global warming if temperature forecasts prove accurate. Melting polar ice would raise sea levels, inundating tens of thousands of miles of coastland and displacing tens of millions of people around the globe. Much of Florida, the Gulf Coast and Maryland's Eastern Shore would disappear.

Hurricanes and storms would be more frequent, more severe and longer-lasting. Water for farming, industry and cities would diminish, as lakes and rivers become warmer and more evaporation occurs.

Agricultural productivity would decrease, forest fires would increase and both wildlife and vegetation would vanish or relocate.

As humans, animals and plants migrate in response to rapidly changing conditions, disease will move with them. Thus, public health could be as worrisome as flooding.

After stating the scientific case and voicing the 2030 challenge, Mazria added an appropriate epilogue about the need to make sustainability an integral part of architectural education. In many architecture schools, he pointed out, sustainability is still viewed by both faculty and students as optional.

But I would extend Mazria's exhortation. Sustainability concerns everyone, not just architects. All students everywhere, from elementary school onward, must learn what is happening to the earth and what must be done about it. Without informed citizens and clients, architects will never meet the 2030 challenge, no matter how many green buildings they design.

Roger K. Lewis is a practicing architect and a professor of architecture at the University of Maryland.

Text 8

GKK Design Corporatist Frankfurt Skyscraper

Approval has been given for a conservatively designed twin towers to be located in the heart of Frankfurt's skyscraper district on Neue Mainzer Strasse.

The project comes from the sketchpads of architects GKK and was originally named Kaiserkarree. The project has now been renamed Taunusturm, a rebranding that goes hand in hand with some of the changes that have been made to it as it has progressed through development.

Since it was first proposed in 2008, originally the tower was to stand at a height of 135 metres, this has been bumped up to a slightly more impressive 160 metres and a 60 metre residential tower has also been added across the road from the main tower.

Uniformly box shaped in appearance, the office tower aims to convey a look of sturdiness and stability which is probably apt for the district and the current financial climate unless you're not a Scottish bank in which case the Leaning Tower of Piza might be more fitting.

Constructed from steel and glazing the tower rises from ground level to a flat peak minus any sort of decoration, spire, helipad or anything else to add a bit of interest. The facades are glazed with a grid work of steel, making long, thin windows rather than the fully glazed curtain wall popular in many designs these days.

When complete the tower will provide premium office space with a restaurant which will be open to the public occupying the top floor, offering views of the city below. The ground floor will contain shopping spaces to go and spend hard earned wages in along with the odd café and restaurant in.

The residential part of the project sports a similar look to the taller tower, with the addition of a sky garden on its roof. it will house 54 apartments along with more shopping space on its ground floor, which is always good to see.

At present there are no construction details but with approval given it should be long before this tower comes to fruition, providing no one changes their minds again.

Text 9

Milan Convention Centre Offers Glacial Roof

Plans are afoot in Milan to build what will be Europe's largest ever indoor convention centre, a building that will be draped in a massive glazed roof with a difference.

The internal figures for the plans are massive and entail 18,000 seats, an additional 1,500 seat auditorium that creates a semi circular metallic bulge to one corner thats supported by a series of struts, 73 meeting and hospitality rooms, and 54,000 square meters of exhibition space. Providing shelter come rain or shine is one end the roof that protrudes outwards creating a tail that acts as a canopy for a long twisting walkway which serves as one of the entrance routes for those using the complex.

Despite the scale of the scheme the real talking point is set to be the roof that transforms the traditional shed-like exhibition centre into something a bit more special.

Undulating contours of glass blanket the roof creating a crystalline glacial landscape that will create an ever-changing myriad of reflections, sparkling points of light, and shadows as the sun crosses the sky from day to day. The similarities with a glacier should become much stronger at night as the general illumination of the glass covering will give it a truly ice-like appearance.

Moving past the aesthetics of the roof, it's a complex structure that has been designed to consist of 8000 metres of thin aluminium, glass and LED lights that will emit 1 watt per metre creating a truly ambient light. These slivers of the roof can each have amorphous silicon photovoltaics integrated into them which with a power output of 25 watts per metre can light it employing only 5% of the total space on offer.

The project is being developed by Fondazione Fiera Milano who have put a 40 million euro budget on the scheme which should be enough to get it going.

Text 10

Artotel Eyes Up Shoreditch Hotel Site

Scott Brownrigg has designed this futuristic glass clad hotel to stand in Hoxton, currently one of the trendiest areas of East London.

The site stands near the eastern end of Old Street overlooking the junction that sees Paul Street, Great Eastern Street, Rivington Street and Pitfield Street all converge. The design responds to the shape of the site much in the same manner as the Flatiron Building by creating a prow that is angled towards the centre of the junction although it eschews a triangular shape by filling out broadly around the site.

With double skinned glazing wrapping around the main body of the building, at the base the edges of the tower stands above the pavement around much of its length that exposes a central slope. This spirals up and into the tower from ground level like a loading ramp for a UFO. The only thing missing is the electronic beeps from Close Encounters and a spot of smoke.

The creation of this space in and around the foot of the tower will allow the developer to utilise the area as a public space that can be used by local creatives such as artists as well as improve pedestrian permeability in and around the site.

This isn't the first tall building that's been dreamed up for the site. Previously architect firm Bluebase came up with their own mixed-use designs for the area that featured a 26 storey tower whilst over the road Shoreditch House, a sixties tower block already exists and adds a bit of height to the area.

If built the 20-storey structure will be the first of Park Plaza's Art'otel brand (that's a trademarkable contraction of Art Hotel) to open in London boasting 350 rooms and a new public gallery. If it goes ahead the developer is looking at getting it open in 2012 just in time for London's Olympics.

Text 11

Skinny Tower Nears Completion In Paraguay

Construction is currently underway on an insanely skinny skyscraper which will will be Paraguay's tallest residential tower when completed.

Located in Asuncion City, the project named Icono Loft is the handiwork of architect Carlos Jimenez and when complete will stand at a quite lofty 142 metres.

Although box shaped the architect can rest easy in his bed from fears of being shot for unleashing another boring lump of concrete on the world as the design is sufficiently interesting enough for the tower to live up to its name.

Rising from the ground the tower extends upwards to its peak decorated with exposed framework, which also runs up the sides of the tower. Its facades have long panels of vibrant red concrete running up them broken by panels of glazing, giving it a distinctive, instantly recognisable look on the skyline.

Glazed balconies jut out from the tower giving it some texture and an overall modern and funky look bound to impress anyone. Thanks to its free form floors residents will be able to more or less chose their own floor layouts making each apartment unique, an unusual and attractive selling point for most towers.

The tower also boast panoramic views of the city from any of its floors, although some may argue that some of these views may have been wasted with the lack of floor to ceiling glazing in the scheme.

Purely residential in use the tower will have one 195 square metres loft per floor and offer some luxury features to lure potential residents to part with their hard earned cash such as a lobby area, heated pool and terrace to chill out on, spa and gymnasium to go and look good in, coffee bar and business centre as well as secure parking and 24 hour security within the tower.

At present there are now specific opening times for the tower but fingers crossed it shouldn't be too far in the future.

Text 12

0-14 tower, Dubai: The hole story

It turns out it's 1,326. But don't let the whimsical appearance fool you – this is one of Dubai's most technically advanced and ecologically efficient buildings

If ever a building was needed to lift an ailing development, this is it. Most of the projects in Dubai's Business Bay have ground to a halt because of the downturn, but that only gives this particular tower an even higher profile. It's the most advanced building on the development and the most unique building in Dubai – in fact, there's nothing quite like it anywhere in the world.

From a distance, the 0-14 tower looks like a giant chunk of sculpted Swiss cheese – except that the concrete facade has rounded corners, a curvaceousness accentuated by the sides of the building that are pinched in towards the core. The most striking element of the facade is that it is punctuated by some 1,326 randomly positioned, randomly sized holes. "We wanted the character of the building to be different from the usual slick, curtain-walled buildings of Dubai," says Jesse Reiser, principal of

New York architect Reiser + Umemoto. “We also wanted it to be column-free and have the solar shading as part of the building shell.”

This means the facade also supports the 22 floors of the building – the floor slabs span from the core to the facade without columns. Pulling this off was a unique challenge for the Dubai Contracting Company (DCC).

So why did Reiser design such an unusual building? The main motivation was for the external shell to act as a giant brise-soleil. The giant holes aren’t glazed; rather there is secondary glazing that spans between floors one metre behind the main facade. “Originally there was no gap between the exoskeleton and internal spaces, but detailing windows in the holes became monstrously complex,” explains Reiser. This also has the benefit of allowing cool air to circulate between the two facades.

The floorplates feature cut-outs where the holes span across them, which creates a stack effect because air can be pulled up the full height of the building. According to Reiser, the building should use about 30% less energy than standard to keep cool.

Unfortunately, all these holes and the curvaceous nature of the facade mean it is proving difficult to build. The building was originally scheduled to be completed at the end of this month but it won’t be ready now until August. “Most of the steel rebar in the tower is at a 45º angle rather than 90º because of the holes,” explains Jihad Choueiri, the project manager for DCC.

The holes may look random, but there are clear diagonal paths of solid structure which is where the rebar is concentrated. According to structural engineer Ysrael Seinuk, the curved nature of the shell makes for a very efficient structure that could be much higher than planned, but it does mean the rebar has to be curved to follow the sinuous shape of the building facade.

“We did a lot of research into the best method of construction as there was no precedent for this,” explains Choueiri. This being Dubai, there wasn’t much time, so while Choueiri was doing the research, work got under way on the building’s foundations – in February 2007. Choueiri had 10 months before construction started on the facade to work out how to build it. Initially DCC suggested building it conventionally. “It could have been done with conventional columns and cladding, which would have been cheaper and quicker,” says Choueiri. But the architect wasn’t having it. "It wasn't about the cheapest way of building, but about a very pure form expressing the concept and we wanted to do it," says Reiser.

So DCC focused on how to build it as the architect wanted. When it approached the big formwork companies to design the shuttering for the facade, it found they weren't interested because they didn't want to spend time developing such a specialised solution. In the end Choueiri found a Chinese company prepared to put the time in. He also had the same problem with the internal cladding, as this had to curve to follow the shape of the facade; again he found a Chinese cladding specialist prepared to take the job on. "They've done an excellent job," says Choueiri. After a lot of trial and error on full-sized mock-ups, DCC developed its construction method for the facade. The first step was to erect the outer layer of formwork, then position the moulds used for creating the holes. These are made out of a grade of expanded polystyrene that is strong enough not to compress under the weight of the concrete yet could be hacked out reasonably easily once the concrete has cured and the shuttering has been removed. Despite there only being five different sizes of hole, each one is unique because of the building's curve. Where a hole straddles a floorplate a special semi-circular mould was used to create one half of the opening; the other half was constructed when the next storey was built.

With the moulds positioned, work could start on fixing the rebar. "In places we have had to bend the steel in three dimensions because of the curve," explains Choueiri. "There is no machine that can do this so we had to do it by hand." With the rebar in place the shuttering was closed and the concrete poured. Because the rebar was at a 45◦ angle there was no way conventional concrete vibrators could be used to compact the concrete, so a special high-density self-compacting concrete was used to ensure there were no voids in the finished concrete. The shell was 600mm thick up to the third floor and 400mm above this.

Unfortunately building each floor has proven much slower than a conventional structure. "When we started, the first floor took one month, then we got this down to three weeks and we are now down to 14 days," says Choueiri. "In the programme we allowed just one week per floor."

Conventional floors are constructed in two halves with the columns on one half and the floor slab on the other, which is fast and efficient. "Structurally we had to cast the whole slab in one go which changed everything," says Choueiri. Not only was it much slower, it also meant twice as much scaffolding and more labour was needed.

The building is built up to the 18th floor, so close to being topped out: the glazing has already been installed lower down and the basement areas are finished. A special rail is fitted between the external shell heat and the glazing, enabling it to be easily cleaned. Once the structure is finished it will be painted white to help reflect the fierce Dubai heat. Will this be enough to keep the building cool? Choueiri thinks so. "We had some floors ready last summer and you could feel the difference in temperature from the outside, and that was without the aluminium window wall in place," he says.

Dubai Business Bay will have more than 200 towers when it's finally completed but 014 is guaranteed to always stand out from this particular crowd.

Text 13

Metamorphosis

By Jeffrey Smilow, P.E.

To build a new skyscraper in New York City that changes shape from a rectangle to an octagon as it rises, engineers used diagonal columns and an off-center elevator core. Designing the foundations around existing footings and rail lines posed additional challenges.

Of the many recently constructed high-rise office building in New York City, perhaps none presented a greater challenge that the new Bear Stearns headquarters building, at 383 Madison Avenue.

The Bear Stearns Companies, Inc., a global investment banking, securities, and brokerage group, had outgrown the 1920s-era building on Park Avenue that had been its headquarters and wanted to take advantage of the amenities a newer building could offer, including column-free office space and a larger floor area for its securities trades. Engineered by New York City-based Cantor Seinuk Group to replace an existing 20-story building, the 45-story sky-scraper that will serve as the company's new base of operations not only fulfills these requirements; it also stands as one of the 15 tallest buildings in the city.

The structure is 815 ft (248 m) tall and encloses 1.2 million sq ft (114,800m2) of office space. Yet only 40 percent of this massive building's footprint is situated on natural bedrock; active underground rail lines occupy the other 60 percent. Multiple rail lines passing beneath the building carry passengers into Grand Central Terminal. Tracks run on two levels at depth of up to 50 ft (15 m) below the street. A secondary tunnel system below the tracks houses numerous utility lines as well as major steam lines.

The railroad lines imposed severe logistical and construction constraints: the new supporting structure for the building had to be located between the existing tracks yet could not encroach upon the operating clearances of the railroad. Additionally, the railroad tracks, although temporarily closed off during construction, had to be protected from any damage that might be caused by construction.

To avoid the expense of total demolition and reconstruction, the existing footings that had supported the original building on the site were used to the fullest extent possible. However, to support the increased bulk of the new building, additional footings were added where required. For the most part, rock capable of safety supporting 40 tons/sq ft (3,830 kPa) was located directly below the lower track level, thereby minimizing the footing sizes and the extent of excavation. However, at one major column line, the utilities tunnel – a turn-of-the-century structure of unreinforced concrete – ran below the lower track. The walls of this tunnel, which still services many of the buildings in the area, varied in thickness from as little as 3 ft (0.9 m) to as much as 10 ft (3 m) and extended as much as 15 ft (4.5 m) below track level. To avoid disturbing the tunnel structure, a new footing was located on top of the steam tunnel foundation wall.

The steel infrastructure of the old building was left in place below the steel level but was encapsulated in concrete to update its load-carrying capacity. Silica fume additive was specified to ensure a high-quality, dense concrete mixture. In addition to negating the need for major demolition, this approach simplified construction: pumping concrete was easier that maneuvering large steel members within the confines of the train facility.

The concrete encapsulation formed walls 30 in. (762 mm) thick between the railroad tracks. The new, 8,000 psi (55,160 kPa) concrete walls extend from the foundations to grade level, where they support approximately 60 percent of the new building columns. Steel grillages distribute the load of the new columns linearly along the length of the bearing walls. The grillages are 18 in. (457 mm) wide and vary in length from 4 to 17 ft (1.2 to 5.2 m). Each weighs as much as 35 tons (32 Mg).

Because there was no room for elevator pits above the railroad tracks, the elevator core had to be offset to the west side of the building. The eccentricity of the core had both positive and negative effects on the design. On the negative side, the eccentric core reduces the efficiency of the lateral bracing system, which is concentrated in walls around the core. On the positive side, it provides a large zone of uninterrupted floor area on each floor. This wide-open area provided very desirable for the trading areas, located on floors 3 through 11, and for the executive dining areas, on floors 12 and 13. Each trading floor provides approximately 23,000 sq ft (2,317 $m^2$0 of trading space, typically divided into 30 by 42.5 ft (9 by 13 m) bays. The distance between the walls separating the railroad tracks dictated the latter dimensions.

Visually, the building is composed of three distinct zones, one rectangular and two octagonal. Each differs from the others in significant ways structurally. The base footprint is a 212 by 2000 ft (64.6 by 61 m) rectangle. Within this part of the building, the locations of the steel columns are mainly dictated by the train shed below.

Above the base, the building shape changes from a rectangle to an octagon. The change begins at the 10th floor, where the rectangular dimensions shrink to 185 by 196 ft (56 by 60 m). Then, on the 12th floor, the building becomes an octagon, the overall dimensions begin 172 by 185 ft (52 by 56 m).

On the 18th floor, the final change occurs, this time to a smaller octagonal tower. The tower is the tallest part of the building, rising 27 floors to the rooftop. Within the transition floors, the building columns undergo significant shifts. The most significant transition occurs between floors 14 and 17, which house the building's mechanical systems. Here the core shifts to the center of the tower. To accomplish a major shifting of the structural system, multistory sloped columns that change position by as much as 42 ft (12.8m) are used. The columns are as large as 24 by 20 in. (610 by 508 mm) with cover plates and weigh up to 1,000 lb/ft (1,488 kg/m). Forces within these members can reach 5,000 kips (22.2 million N).

The sloping columns are constructed in two orthogonal planes, some joints of which have four intersecting sloping columns. At the connection points are solid steel nodes fabricated with multiple layers of 4 in. (102 mm) steel plate. Each node was shaped to accept the sloped column end in full bearing, and then was welded all around. This method, selected by the steel fabricator ADF Group, based in Montreal, worked very well. Fabrication tolerances were such that fit-up in the field was typically well within American Institute of Steel Construction standards. Connections to the steel nodes were typically made via partial-penetration and full-penetration welds. The use of nodes minimized the size o the connection joints and prevented misalignment of the major bolted connections.

A second critical transition occurs on floors 18 and 19. Below the 18th floor, all of the building's structure is based on an orthogonal grid. Above it, the octagon perimeter is totally off the grid of the building's base. The perimeter of the octagon is composed of a rigid moment frame with columns spaced 30 ft (9m) on center, with column-free corners. This rigid moment frame forms a perimeter tube that is a key component of the lateral bracing system.

To join the columns of the octagon to the rectangular zone below, a two-storey-high ring truss wall was built on the perimeter of floors 18 and 19. (Since these floors are primarily for information technology equipment, window access is not important). The ring truss picks up all the perimeter columns of the tower octagon, transferring their load to the orthogonal structure below. This is the most critical and complex transfer in the building.

In addition to the truss wall, the lateral bracing system relies on both steel diagonal members and concrete shear walls. At the base of the building, the lateral bracing system is manly located in and around the core and is formed by steel diagonal bracing elements laid north-south, as well as by concrete infill shear walls running east-west at the backs of the elevator shafts. A vertical Vierendeel truss, with columns spaced 10 ft (3 m) on center, is positioned on the east facade of the building to help the lateral bracing system compensate for the twisting effect produced by the eccentric core.

To reduce field erection costs, the Vierendeel truss was fabricated with tree-like components. The trees are composed of a two-storey length of column with half the length of the beam members shop-welded to the column shaft. The resulting trees were just 10 ft (3 m) wide, suitable for shipping on standard trucks. The trees were connected to one another on-site with end-plate moment connections.

Infill concrete shear walls were key components of the lateral bracing system. In the core area at the rear wall of the elevator shafts, an 18 in. (457 mm) thick concrete shear wall was used in place of the typical diagonal bracing. Proposed by the structural engineer, the added concrete was the most cost-effective way to control building movement. The Cantor Seinuk Group had used mixed concrete shear wall and steel bracing schemes in numerous high-rise projects. The effectiveness of these schemes derives from their improved stiffness over steel and from their added mass, both of which help reduce building movements from wind and seismic activity. Additionally, in work in and around elevator cores, the use of concrete walls circumvents the trouble and expense associated with spray fireproofing around steel bracing. They also obviate the need to construct fire-rated drywalls around elevator shafts and steel bracing and to use extra steel for intermediate elevator rail support systems on tall floors. Turner Construction, of New York City, the construction manager on the Bear Stearns project, confirmed the cost-effectiveness of partial concrete shear walls. Four concrete shear walls were used, each one terminating at a different floor.

A wind tunnel study was performed to determine the actual response of the lateral bracing system to wind loads in midtown Manhattan. The tests determined that peak local wind pressures are as high as 70 psf (3,352 Pa), but that accelerations at the upper floors would be less than 0.018g – well within acceptable limits for building movement.

In addition to the engineering complexities described above, many special components were introduced in the building structure to meet the special needs of Bear Stearns. The most prominent of these components are two 85 ft (26 m) long pickup trusses on the second floor. Each truss supports the 43 floors above it, extending almost the full height of the building. Together, the pickup trusses create an 85 by 100 ft (26 by 30.5 m) column-tree area in the main lobby on the first floor. The pickup trusses each weigh approximately 700 tons (635 Mg). Their compression members are formed by 24 by 28 in. (610 by 711 mm) steel members with 3 in. (76 mm) thick cover plates, the combined weigh exceeding 1,200 lb/linear ft (1,786 kg/m). The tension members in the trusses resist forces as high as 6,000 kips (26.7 million N). To avoid welding members that are subject to tensile forces and that have flanges more than 2 in. (51 mm) thick, which in any case requires special welding techniques and special material properties, all of the tension members were constructed of plates with fully bolted end connections.

Another innovative structural component introduced in response to architectural requirements is the support system for the corners of the lower 10 floors. The architect called for column-free corner offices with wraparound windows. However, the storefronts at the ground floor were to have corner columns. The transition from corner columns to column-free corners is accomplished using sloped columns on opposing building corners. The horizontal forces generated by the sloped columns are transferred through spandrel beams and are balanced by matching columns in the opposite corner of the building.

The Bear Stearns headquarters is complete and was occupied in February.

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ENGINEERING THE FUTURE

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