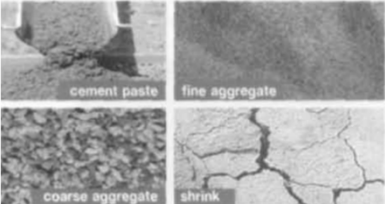



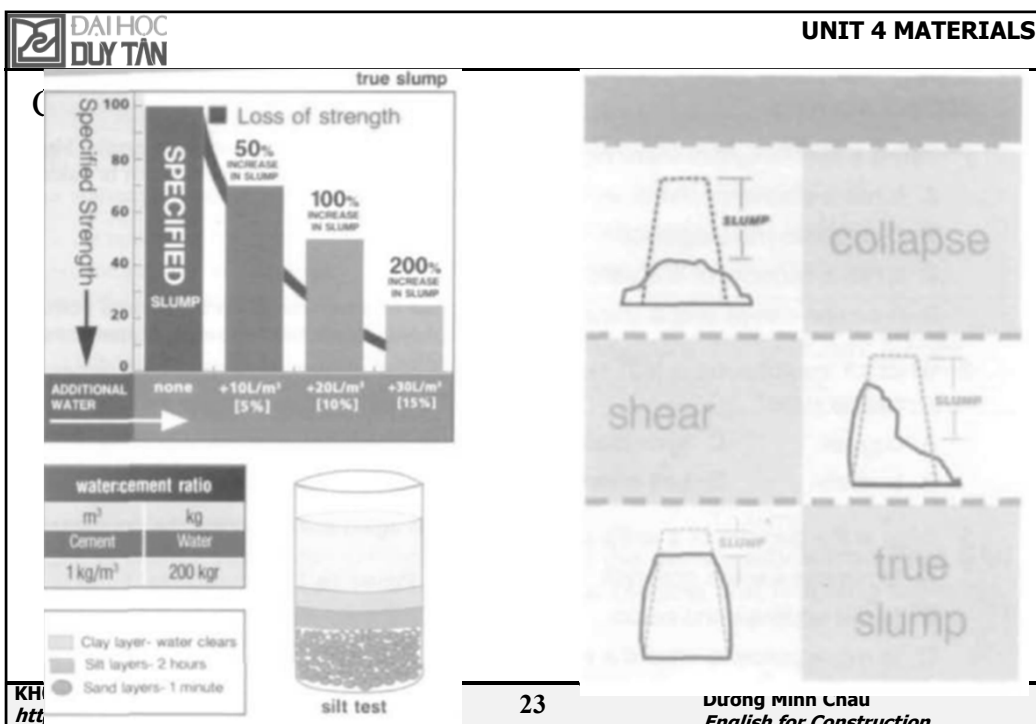
 ĐẠI HỌC DUY TÂN	<h2 style="margin: 0;">UNIT 4 MATERIALS</h2>	
<h3 style="margin: 0;">Concrete work 1</h3> <p>Our concrete starts with (the) finest quality cement and water. We then add the cement paste to the right blend and size of aggregate. Our attention to the mixing process <u>ensures</u> that each concrete blend is perfect. It doesn't matter if you're looking for <u>normal-weight</u> concrete, <u>lightweight</u> concrete, insulating concrete or <u>heavyweight</u> concrete. We can provide exactly what you need.</p> <p>We offer a wide range of fine aggregate and coarse aggregate. They ensure that your concrete <u>binds</u> correctly. This way you can custom design the perfect concrete for you and your building project. We even provide air <u>entrainment</u> to most types of concrete. The additional voids it creates help your concrete set perfectly and <u>prevent</u> it from shrinking. Combined with steel rebars, our concrete can support almost any load.</p> <p>ABC Cement and Concrete can work with you on-site or deliver pre-mixed batches. We'll meet your needs. So come in to ABC Cement and Concrete for the region's best service and highest quality concrete.</p> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;"> <p>1. What ensures the concrete binds correctly?</p> <p>A. air B. cement C. aggregates D. steel rebar</p> </div> <div style="width: 45%;">  <p>2. Why does the company perform air entrainment?</p> <p>A. to ensure proper bonding B. to prevent concrete from setting C. to decrease the number of voids D. to avoid any concrete shrinking</p> </div> </div>		
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 ĐẠI HỌC DUY TÂN	<h2 style="margin: 0;">UNIT 4 MATERIALS</h2>																
<h3 style="margin: 0;">Concrete work 1</h3> <p>3. Match the words (1-8) with the definitions (A-H).</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">1. concrete</td> <td style="width: 50%;">A. to attach something to something else</td> </tr> <tr> <td>2. shrink</td> <td>B. the act of mixing small bubbles into concrete</td> </tr> <tr> <td>3. aggregate</td> <td>C. a mixture of cement, water, and aggregate</td> </tr> <tr> <td>4. set</td> <td>D. to become hard and solid</td> </tr> <tr> <td>5. void</td> <td>E. a gap in a substance</td> </tr> <tr> <td>6. cement paste</td> <td>F. a material that helps bind cement</td> </tr> <tr> <td>7. bind</td> <td>G. to become smaller</td> </tr> <tr> <td>8. air entrainment</td> <td>H. the substance formed when water and cement combine</td> </tr> </table> <p>4. Fill in the blanks with the correct words and phrase</p> <p>Lightweight concrete, normal-weight concrete, coarse aggregate, insulating concrete, fine aggregate, heavyweight concrete.</p> <p>_____ should never be used to support a load. It is only used to control temperature.</p> <p>Large stones or chunks of rock are examples of _____.</p> <p>_____ is the densest type of concrete.</p> <p>Sand is a common _____.</p> <p>_____ is the least dense type of concrete that can still support a load.</p> <p>_____ is denser than the lightest concrete, but still lighter than the heaviest types of concrete.</p>		1. concrete	A. to attach something to something else	2. shrink	B. the act of mixing small bubbles into concrete	3. aggregate	C. a mixture of cement, water, and aggregate	4. set	D. to become hard and solid	5. void	E. a gap in a substance	6. cement paste	F. a material that helps bind cement	7. bind	G. to become smaller	8. air entrainment	H. the substance formed when water and cement combine
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 ĐẠI HỌC DUY TÂN	UNIT 4 MATERIALS
<h3 style="margin: 0;">Concrete work 1</h3> <p><i>Listen to a conversation between a contractor and an employee. Mark the following statements as true (T) or false (F).</i></p> <p>1 _ The man is confused because the concrete won't set</p> <p>2 _ The man thinks heavyweight concrete IS the best choice</p> <p>3 _ The woman wants to use sand as an aggregate</p> <p><i>Listen again and complete the conversation.</i></p> <p>Employee: Excuse me. Ms Brown Could I (1) _____ ?</p> <p>Contractor: Of course. Sam What's going on? Is there (2) _____ ?</p> <p>Employee: Well, not really I'm just a little bit confused about something. I just (3) _____ it with you.</p> <p>Contractor: Sure. Has the concrete set too slowly again?</p> <p>Employee: No, no. That's fine. We fixed (4) _____</p>	
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 ĐẠI HỌC DUY TÂN	UNIT 4 MATERIALS
<h3 style="margin: 0;">Concrete work 1</h3> <p>Contractor: Good. So what's your question?</p> <p>Employee: It's about the type of concrete we're using. Are we using (5) _____ ?</p> <p>Contractor: Yes, we are.</p> <p>Employee: Right. This is a really (6) _____ , so shouldn't we use heavyweight concrete?</p> <p>Contractor: No, lightweight is fine.</p> <p>Employee: I thought that (7) _____ wasn't strong enough.</p> <p>Contractor: I see why you are asking. Actually, though, that's not the case.</p> <p>Employee: It isn't?</p> <p>Contractor No. Lightweight concrete is suitable as long as It has (8) _____</p> <p>Employee: Oh. So, well use pumice as an aggregate. I assume.</p> <p>Contractor: No, that's not correct. We need to go with a coarse aggregate, like gravel.</p>	
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DAI HOC DUY TAN **UNIT 4 MATERIALS**


Concrete work 2


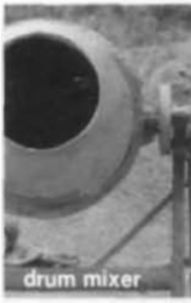



Test	What It Measures
Soundness	The strength of aggregate used in concrete mixes.
Silt Test	The cleanliness of coarse aggregate. Too much fine material can make the aggregate unusable.
Colorimetric Test	The presence of organic impurities in fine aggregate. Too many make the aggregate unusable
Gradation	The distribution of particle size in aggregate. A mix of large and small is desirable
Slump Test	The <u>flowability</u> of a concrete mix. A true slump retains its shape when tested while a collapse or shear breaks apart. Such <u>slumps</u> often mean the mix is too wet
Moisture Test	The amount of water in an aggregate. A high amount of moisture may require a lower water:cement ratio to produce a strong mix.
Air Content Test	The amount of air in a concrete mix. Some air is often desired to help concrete flow.
Specific Gravity	The ratio of an aggregate's mass to the mass of an equal volume of water.


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 ĐẠI HỌC DUY TÂN	UNIT 4 MATERIALS	
Concrete work 2		
<i>Mark the following statements as true (T) or false (F)</i>		
1_ A colorimetric test looks for organic impurities in coarse aggregate. 2_ Aggregate particles should be about the same size 3_ The water cement ratio should decrease when there is a lot of moisture in the aggregate		
<i>Match the words (1 - 8) with the definitions (A-H).</i>		
1. Slit test 2. Slump test 3. Cleanliness 4. Shear 5. Specific gravity 6. Soundness 7. Colorimetric test 8. Gradation	A a test to determine the presence of fine organic matter in fine aggregate. B a kind of concrete slump in which the top portion of the concrete breaks off and slips sideways. C a measurement of the strength of an aggregate used in a concrete mix D a test to measure how easily a concrete mix flows E the distribution of particle sizes in the aggregate used in a concrete mix F a test to determine the presence of very fine material in a coarse aggregate G the ratio of something's mass to the mass of an equal volume of water H a measurement of the presence of silt and other matter sticking to coarse aggregate used in a concrete mix	
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 ĐẠI HỌC DUY TÂN	UNIT 4 MATERIALS	
Concrete work 2		
Read the sentence pair. Choose where the words best fit the blanks		
1 <i>organic impurity / true slump</i> A. A colorimetric test will show if there is a(n) _____ in this aggregate B. A (n) _____ desired for the best workable concrete 2 <i>water cement ratio / air content test</i> A. The _____ showed an acceptable amount of air in this concrete mix. B. The _____ of this mix needs to be increased. 3 <i>moisture test / collapse</i> A Please conduct a _____ on this aggregate B This slump _____ means that the mix is too wet	Listen and complete the conversation Contractor: Good to know. What else? Tester: It has an adequate moisture content. That means we won't have to adjust the (1) _____ in the mix Contractor: Good. Doing that (2) _____ sometimes. Tester: Right. Now, on to the (3) _____. Unfortunately, the aggregate failed the silt test Contractor: (4) _____ what does that mean? Tester: There s a lot of (5) _____ mixed in with the aggregate. We'd have to use more paste to cover it all. Contractor: Of course Is there anything we can do about It? Tester: We can try to remove some of the material It should be do-able but It means more (6) _____	
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 ĐẠI HỌC DUY TÂN	UNIT 4 MATERIALS	
Concrete work 3		
 drum mixer	 belt conveyor	 chute
		MVJ Construction Supply can provide your company with everything it needs for concrete projects. We have equipment for every step of the process.
		 wheelbarrow
Mixing		
Drum Mixers These mixers are available in sizes from 0.10 cubic meters to 15 cube meters. They either tilt to unload or have a discharge <u>chute</u> .		
Countercurrent Mixers These mixers create mod <u>agitation</u> than a drum mixer for greater uniformity. They are especially useful when mixing additives and colors.		
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 ĐẠI HỌC DUY TÂN	UNIT 4 MATERIALS	
Concrete work 3		
Transport		
<u>Wheelbarrows:</u> The average capacity of our wheelbarrows is 170 liters. Smaller and larger sizes are available.		
<u>Buggies:</u> Both our pushcarts and motorized bugles. I have pressurized tires for easy, smooth operation. Their capacity ranges from 0.10 to 030 cubic meters.		
<u>Bucket:</u> We stock many kinds of buckets from small hand-held buckets to large crane-lifted containers.		
<u>Belt Conveyor:</u> Portable belt conveyors are always available. We can work with you to design and build a larger system.		
Finishing		
<u>Screeds:</u> After placing concrete, don't forget to I finish It! These large bars strike off a concrete surface, removing the excess and leaving an even surface behind.		
<u>Floats and trowels:</u> For the final touches, we have a variety of floats and trowels available. They come in various shapes and sizes. They are either hand tools or motorized.		
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 ĐẠI HỌC DUY TÂN	UNIT 4 MATERIALS	
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <h3 style="margin: 0;">Concrete work 3</h3> <p>Choose the correct answers.</p> <ol style="list-style-type: none"> 1. <i>Why is a countercurrent mixer especially useful?</i> <ol style="list-style-type: none"> A. It has a discharge chute B. It produces more agitation C. It has a capacity of 170 liters D. It can be moved with a crane 2. <i>Which of the following is not readily available in multiple sizes?</i> <ol style="list-style-type: none"> A. buggies B. buckets C. wheelbarrows D. belt conveyors 3. <i>What is the purpose of a strike-off bar?</i> <ol style="list-style-type: none"> A. to remove excess concrete B. to mix additives and colors C. to move concrete around a worksite D. to put the finishing touches on concrete </div> <div style="width: 50%;"> <p>Match the words (1-7) with the definitions (A-G)</p> <p>1. finish; 2. mixing; 3. float; 4. buggy 5. belt conveyor; 6. uniformity; 7. place</p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <ol style="list-style-type: none"> A. to put concrete in its final position B. a small man-powered or motorized vehicle used to transport materials at a construction site C. the process of combining and stirring cement water, and aggregate until it forms a concrete mix D. a rectangular tool used to smooth and level the top layer of concrete E. the state of being the same or alike through out F. to alter concrete surfaces to produce the desired final appearance and texture G. a machine for transporting concrete or other material that consists of two pulleys and a continuous loop of material that rotates around them </div> </div> </div>		
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 ĐẠI HỌC DUY TÂN	UNIT 5 BUILDING ELEMENTS	
<p>The foundations, walls, floor, stairs and roof are some of the building elements that all types of building have in common.</p> <p>1. Foundations <i>Read the text and then answer the questions below.</i></p> <p>Foundations are structures that transfer weights from walls and columns to the ground. There are two types of foundations: <u>shallow foundations</u> and <u>deep foundations</u>, shallow foundations are usually embedded a metre into the soil, whereas deep foundations are embedded more in depth. They are recommended in case of very large design loads, a poor soil at shallow depth or site <u>constraints</u>, such as property lines. There are different types of deep foundations and they can be made of timber, steel and reinforced or <u>pretensioned</u> concrete.</p>		
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 ĐẠI HỌC DUY TÂN	UNIT 5 BUILDING ELEMENTS	
<p>1. Foundations</p> <p><u>Geotechnical</u> engineers design foundations to ensure that they have an <u>adequate</u> load capacity with limited <u>settlement</u>, when designing foundations, it is also important to consider scour (when flowing water removes supporting soil from around a foundation) and frost heave (when water in the ground freezes and forms ice lenses).</p> <ol style="list-style-type: none"> 1. <i>What are foundations? How many types of foundations are there?</i> 2. <i>What are the main features of shallow foundations?</i> 3. <i>What are the main features of deep foundations?</i> 4. <i>What do geotechnical engineers design?</i> 5. <i>What must be considered?</i> 6. <i>What are scour and heave?</i> 		
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 ĐẠI HỌC DUY TÂN	UNIT 5 BUILDING ELEMENTS	
<p>1. Foundations</p> <p>The best homes last for generations. It all starts with the foundation. Century Home Builders is known for Its sturdy residential structures. CHB specializes in shallow foundations including:</p> <p>Monolithic foundations</p> <p>In some areas, a <u>monolithic foundation</u> is the most stable option. The floor <u>slab</u> and the foundation are poured all at once. The foundation extends deeper below load bearing walls to support the building load.</p> <p>Spread foundations</p> <p>Century Home Builders provides <u>spread foundations</u> with <u>stem</u> walls. A wide footing is placed two feet below these walls. The stem wall rise above grade to protect structural walls from ground <u>moisture</u> and insects.</p> <p>Foundation piers with grade beams</p> <p>If you live on the coast, you're probably concerned about flooding. In that case, you'd want our <u>foundation pier with grade beams</u>. The grade beams support the load bearing walls, but also provide a crawl space below the house. When a <u>flood</u> occurs. It won't fill your first floor! All CHB homes have our guarantee - they won't shift, crack, or settle when the ground freezes and thaws. CHB constructions are built to last!</p>		
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UNIT 5 BUILDING ELEMENTS

1. Foundations

Mark the statements as true (T) or false (F)

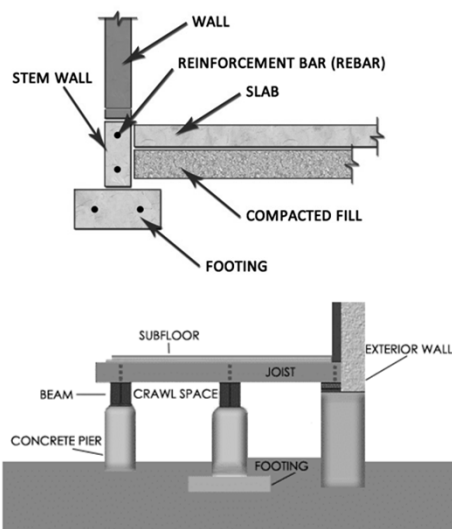
- 1._ A monolithic foundation is created in several stages
- 2._ Stem walls rest on foundation piers
- 3._ Temperature changes in soil can potentially damage a foundation


Match the words (1-9) with the definitions (A-I)


1. Footing	A. a foundation that distributes the weight from walls and columns over an area
2. Freeze	B. a concrete post that sits on piers and support load bearing walls
3. Pier	C. sections of concrete that lie below the foundation
4. Residential	D. a foundation poured with a floor slab and with deeper parts below load bearing walls
5. monolithic foundation	E. a concrete post formed by pouring concrete into a drilled hole
6. spread foundation	F. a structure that rises above grade to which structural walls attach
7. shallow foundation	G. made up of many homes
8. grade beam	H. to become ice due to cold conditions
9. stem wall	I. a foundation that is constructed close to the surface


UNIT 5 BUILDING ELEMENTS


1. Foundations





 ĐẠI HỌC DUY TÂN	UNIT 5 BUILDING ELEMENTS	
<p>1. Foundations</p> <p>Foundations are one of the most essential parts of any building. Builders can use several different types of foundations and piles. The right kind depends on the design of the building and the type of soil.</p> <p>For very heavy loads, it is best to put in a <u>deep foundation</u>. A drilled foundation with <u>cast-in-place piles</u> or a driven foundation with bearing piles is often a good choice. Workers use a pile driver to drive the piles into the ground. These deep foundations are suitable when <u>bedrock</u> can be reached. <u>Caissons</u> may also further support piles in a deep foundation.</p> <p>If the soil contains more clay, then a <u>friction pile</u> or friction plus <u>bearing pile</u> is the best choice. However, horizontal pressure calls for another type of pile. For example, to hold up earth embankments, sheet piles are ideal.</p> <p>Mark the statements as true (T) or false (F).</p> <ol style="list-style-type: none"> 1. Choosing a foundation depends on the type of soil. 2. Driven foundations cannot be used down to bedrock. 3. A bearing pile is best for soil with a lot of clay. 		
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 ĐẠI HỌC DUY TÂN	UNIT 5 BUILDING ELEMENTS							
<p>1. Foundations</p> <p><i>Match the words (1-6) with the definitions (A-F)</i></p> <table border="0" style="width: 100%;"> <tr> <td style="width: 33%;">1. cast-in-place plies</td> <td style="width: 33%;">3. driven foundation</td> <td style="width: 33%;">5. friction pile</td> </tr> <tr> <td>2. drilled foundation</td> <td>4. caissons</td> <td>6. bearing pile</td> </tr> </table> <p>A. a box that is filled with concrete B. a type of deep foundation in which piles are pushed into the ground C. a type of deep foundation formed by creating holes in the ground D. a pile that depends on frictional resistance between itself and the material it passes through E. a pile with a large load capacity that transfers the weight of a load vertically F. a pile formed by pouring concrete into a drilled hole</p> <p><i>Fill the blanks with correct words and phrases</i> <i>Piles; pile driver; deep foundation; friction plus bearing pile; sheet piles</i></p> <ol style="list-style-type: none"> 1. A _____ is used to place piles in the ground. 2. A _____ goes all the way to bedrock. 3. Use _____ to hold up the embankment. 4. Jim ordered some concrete _____ for the new job. 5. A _____ should be used in soil with lot of clay. 			1. cast-in-place plies	3. driven foundation	5. friction pile	2. drilled foundation	4. caissons	6. bearing pile
1. cast-in-place plies	3. driven foundation	5. friction pile						
2. drilled foundation	4. caissons	6. bearing pile						
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 ĐẠI HỌC DUY TÂN	UNIT 5 BUILDING ELEMENTS	
<p>2. Walls <i>Read the text and decide if the sentences below are true (T) or false (F).</i></p> <p>Building walls support the superstructures of building (roofs and ceilings), separate space and give protection against intrusion and the weather. They usually have about three separate components: structural elements, insulation, finish elements or surface.</p> <p>Walls can be <u>loadbearing</u> or non loadbearing depending on their providing structural support to the building or not. Exterior loadbearing walls carry ceiling, roof or upper floor loads to the foundation. Some bearing walls are inside buildings: they support joists at mid span and transfer loads down to the foundation.</p> <p>Usually conventional house walls have an inner wooden <u>framework</u> that may support part of the house, but does not support wall coverings, windows and doors. It contains electrical wiring, plumbing, insulation, and other utilities.</p> <ol style="list-style-type: none"> 1. Walls can define and protect areas, support the superstructures of buildings and delineate a space. 2. There are two kinds of structural walls. 3. Exterior boundary walls give protection against intrusion and weather 4. Loadbearing walls can only be exterior walls. 5. Conventional house walls usually contain electrical wiring or plumbing. 		
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 ĐẠI HỌC DUY TÂN	UNIT 5 BUILDING ELEMENTS	
<p>3. Floor <i>Listen and complete the text with the words from the box.</i></p> <p><i>electrical wood surface covering underfloor strength</i></p> <p>Floor structure <u>contributes</u> to the general (1) _____ of the building system. It is formed of a steel I-beam frame with a horizontal upper (2) _____ to which a number of adjacent composite floor panels is fastened firmly.</p> <p>Floors consist of a subfloor for support and a floor (3) _____ used to give a good walking surface. In modern buildings the subfloor often has (4) _____ wiring, plumbing, and may provide other services built in, like (5) _____ heating.</p> <p>There is a wide variety of floor covering materials: carpet, <u>ceramic tiles</u>, (6) _____ flooring, <u>laminated</u> wood or stone.</p>		
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 ĐẠI HỌC DUY TÂN	UNIT 5 BUILDING ELEMENTS					
<p>4. Roofs <i>Read the text and decide if the statements below are true (T) or false (F)..</i></p> <p>Roofs can be divided in cut roofs, where a carpenter measures, cuts and places every length of wood needed for the frame; and fixed roofs, made of pre-built and assembled <u>trusses</u>. Trusses are custom-designed by computer so as to <u>adapt</u> to the typical weather conditions of the house. As they generally rest only on outside walls, they leave the inside free to move walls and to accommodate different room sizes.</p> <p>When the frame of the roof is ready, a waterproof <u>membrane</u> is placed over it and it is held in place by battens (long pieces of wood) that are nailed into the truss and are the supporting system for the tiles. Tiles are then nailed to the wood. The top of the roof is finished off with ridge tiles that cover both sides of the roof's top row of tiles. Then the end of the wood at the bottom of the roof is covered by a fascia. The fascia allows air to flow safely through the membrane. To take away the water from the building, guttering is attached to the fascia. As heat can go straight out of the roof, insulation is also necessary.</p> <p>When designing the roof structure it must be remembered that all the load on the roof has to be transferred the supporting beams, bearing walls, building foundation and the earth.</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">1.Trusses are designed to adapt to the typical weather conditions of the house.</td> <td style="width: 50%;">3.The top of the roof is finished off with a waterproof membrane.</td> </tr> <tr> <td>2.Battens are long pieces of wood supporting the tiles.</td> <td>4.Then the end of the wood at the bottom of the roof is covered by the guttering.</td> </tr> </table>			1.Trusses are designed to adapt to the typical weather conditions of the house.	3.The top of the roof is finished off with a waterproof membrane.	2.Battens are long pieces of wood supporting the tiles.	4.Then the end of the wood at the bottom of the roof is covered by the guttering.
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 ĐẠI HỌC DUY TÂN	UNIT 5 BUILDING ELEMENTS	
<p>5. Steel Frame</p> <p>There are several important safety concerns when constructing a steel frame First, ensure that each member is in the correct position. Do so by locating the erection mark on each piece. This will tell you how the section shape fits together.</p> <p>Next, if using a bolting connection, use the correct size and strength of bolt. Bolts are labeled by their ASTM <u>designation</u>. An A307 bolt is not suitable for a job requiring an A325, and vice versa. Also be sure to use the proper type of connection. A <u>bearing-type</u> connection should be used where the applied load mainly pulls in one direction. <u>Friction-type</u> connections can be used where the load direction varies. When <u>drilling</u> holes, pay attention to the standard pitch and gauge distances for that structural shape.</p> <p>Welding also has particular connections for specific jobs. Use <u>fillet welds</u> as much as possible. They do not require preparation of the welded material. However, a <u>groove weld</u> is safer if a very strong connection is needed.</p> <p>When erecting a steel frame, place anchor bolts carefully. This allows the <u>bearing plates</u> to be positioned accurately. These plates will hold the columns of the frame in place, with <u>girders</u> connecting between the columns Last, <u>open-web</u> steel joists or bar joists are often used to support roofs and floors.</p>		
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<h3>5. Steel Frame</h3> <p><i>Choose the correct answers</i></p> <p>1 What does an erection mark do?</p> <p>A. indicates what kind of connection to use B. shows how a section shape fits together C. shows the strength and size of a bolt D. indicates a pitch and gauge distance</p> <p>2 When should a bearing-type connection be used?</p> <p>A. when no preparation of the material is needed B. where the load direction varies. C. when a very strong connection is needed D. where the load mainly pulls in one direction</p> <p>3 Which of the following frame components is placed first?</p> <p>A. girders C. anchor bolts B. bearing plates D. columns</p>	<p><i>Fill in the blanks with the correct words and phrases:</i> ASTM, designation, erection mark, anchor bolt, friction-type connection, section shape, bearing plate, bearing-type connection, steel frame.</p> <p>1. The wide flange is a common steel frame _____</p> <p>2. Use a strong _____ to secure the frame to the foundation</p> <p>3. That bolt has a(n) _____ of A325</p> <p>4. A building with a(n) _____ can be built many stories high.</p> <p>5. The bolt transfers the load in a(n) _____</p> <p>6. Look at the _____ to tell where this piece goes</p> <p>7. Anchor bolts are fastened into a(n) _____</p> <p>8. A load is transferred along connected pieces in a _____</p>
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<h3>5. Steel Frame</h3> <p><i>Match the words (1-9) with the definitions (A-I).</i></p> <p>1. girder 2. groove weld 3. bolting 4. pitch 5. open-web steel joist 6. column 7. gauge 8. fillet weld 9. member</p>	<p>A. the distance between a row of bolts in a steel frame connection B. a type of welding used in steel frame construction that joins pieces of metal that are at 90 degree angles C. an individual piece of a structural frame, made of steel, timber, or concrete D. the primary horizontal piece of a steel frame E. a type of welding used in steel frame construction that does not require preparation on the material that is welded F. a lightweight truss used to support a roof or floor in steel frame construction G. the distance between the center of holes in a row of bolts in a steel frame connection H. the primary vertical piece of a steel frame I. the use of strong cylindrical metal fasteners to join pieces of a steel frame</p>
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