Wood Material

Wood has served man since he appeared on Earth, and has decisively contributed to his survival and to the development of civilization. Moreover, wood continues to be the raw material for a large number of products even in modern times, although other competitive materials (metals, cement, plastics) are available. The value of wood is preserved in many traditional uses, and grows steadily with its use in new products to meet the increasing needs of man.

After harvesting in the forest, the wood is converted into a great number of products by sawing, slicing, gluing, chipping, pulping, modification by impregnation with chemicals, or chemical processing. In chemical products, the change is so drastic that their wood origin cannot be recognized. Products of primary industrial processing include poles, posts, lumber, laminated wood, veneer, plywood, particleboard, fiberboard, pulp and paper–and, in turn, these are made into products for final use (furniture, etc.). Products of chemical processing are synthetic fibers, photographic films, explosives, chemicals, and many others.

Wood is also an important fuel material for cooking, heating, and production of steam, which may be utilized as a source of energy. About half of the world's production of wood is used as fuel. With the existing energy problems, wood, as a renewable product of nature, is acquiring a greater importance as fuel.

These multiple services are due to certain advantages: wood is aesthetically unrivaled as a material, because it is available in a great variety of colors, textures, and figures; it gives a feeling of "warmth" to touch and sight, which is not possessed by competitive materials; it is very strong mechanically in relation to its weight; it is insulating to heat and electricity, exhibits little thermal contraction and expansion, and has good acoustical properties (utilized in making musical instruments); it does not oxidize (rust) and shows considerable resistance to mild concentrations of acids; it may be easily machined with small consumption of energy; nailing or bonding with metal connectors, as well as gluing, is easily achieved; wood is the main source of cellulose, which is the basis of numerous products; it is found in most parts of the world, and is a renewable resource in contrast to petroleum, metal ores, and coal, which are gradually but steadily exhausted; it is biodegradable; it is a importance of the tree symbol which frequently appears in cultures all over the world, representing birth, regeneration and life itself.

With their roots in the earth, their trunks rising above living beings and with their branches and leaves covering our heads, trees embrace the three levels of human experience. A tree is like a skeleton, supporting the body of the world. It is also a symbol of growth, death, reincarnation and fertility. Its outline converts it into an obvious symbol of an erect phallus, and as such it has been widely represented and venerated. In the same way, the water absorbed by the ground and the sap which flows in the tree are symbols of semen, as the appearance of leaves in spring coincides with the image of birth and life. Throughout the extensive history of religion, wood, and trees constantly appear as sacred objects. This sacred character sometimes derives from the establishing of a symbolic relation between trees and spiritual strength or protective being, but in other cases the character is determined by the tree's own sacred nature. In fact, the tree is a symbol of all the cosmos, not just in the physical sense, but also in the moral. It is the tree of knowledge, of good and evil; it is the tree of life and of death. It is our world in definitive.

B. Find the Persian equivalents of the following terms and expressions and write them in the spaces provided.

1. anisotropic material ....
2. arboreal species ....
3. cambium ....
4. chestnut ....
5. conifers ....
6. contraction ....
7. coriaceous leaves ....
8. damp regions ....
9. deciduous forests ....
10. destructive agents ....
11. elm ....
12. epiphytic plants ....
13. erosion ....
14. expansion ....
15. exploitation ....
16. fair-sized tree ....
17. foliage ....

18. fungi ....
19. harvesting ....
20. humidity ....
21. hygroscopic ....
22. laminated wood ....
23. leafed trees ....
24. ligneous bushes ....
25. mosses ....
26. phloem ....
27. pine ....
28. plywood ....
29. pruning ....
30. pulp ....
31. regeneration ....
32. regulator ....
33. resins ....
34. sap ....
35. scrub ....
36. starches ....
37. stomata ....
38. tropical forest ....
39. trunk ....
40. vegetable society ....
41. veneer ....
42. waxes ....

Unit 2

Section One: Reading Comprehension

Wood: Organoleptic and Physical Properties

Wood is, without doubt, one of the most noble and useful raw materials given to us by nature, without which man would never have reached the high level of progress and well-being which he enjoys at the moment. At first it was vital material to make the first tools, houses and boats to cross and sail on the rivers. Then, wood was used to make the majority of objects and useful tools on which humanity relied for centuries to make progress and develop its own life. Part of wood technology has survived under the work of craftsmen, retained by a few, but most of it has been irremediably lost, replaced by other materials and methods, fruits of man's industrial revolution. In spite of everything, it would be wrong to treat this material lightly.

Wood has the unappreciable, not to say unique, value of being the only natural which man is able to continually renew. Oil will be used up one day, coal and other mines will be exhausted. But a well-cared for forest, or sometimes even uncared for, will go on producing wood indefinitely. Nowadays, wood retains a prominent place in the world economy, as much for the high figures of its annual production (2500 million cubic meters) as in the different international markets, given the existing appreciation of its qualities and physio-chemical properties, and also mechanics which make it, for the time being, irreplacable.

Organoleptic Characteristics

As for the organoleptic characteristics, we find the following:

1) Colour 2) Lustre (natural shine) 3) Translucidity 4) Smell

Intense or accentuated colour is more normal in hardwoods and conversely, the colours white and pale ivory are usually found in softwoods. The colour of healthy woods can be uniform or varied. At first, the sapwood and heartwood have a similar tone and are almost the same in the early and late zones or areas, as for example in the birch and the boxwood. Wood of varied colours are those which have different sapwood and heartwood, like the lime and plum trees. The colours of the heartwood can range from white to black, there are a lot of yellows and duns; with a few reddish tones and even fewer greys and greens.

Woods are very lustrous in their radial section, much less so in the tangential section, and almost not at all in the front. The lustre can have different degrees, satinized, shiny, silky, metallic, iridescent and pearly. The lustre can be increased and intensified with suitable polishing and varnishing.

Translucidity is a characteristic which increases with percentage of resinous materials and also with the proximity to the sapwood. This is much more translucid than the heartwood specially if it is damp, so the species with the highest water content are more translucid than those without.

The smells are caused by the evaporation slowly produced by the resins and essential oils contained in the wood. Normally, a good smell indicates healthy wood, and an unpleasant smell is a symptom of a negative change. In hot regions, there are more perfumed woods than in mild areas. The intensity of the smell is directly related to the durability. The smell in strongest in recently cut wood, and lessens with time. The smell is not a very usual characteristic in wood, however there are some with a specific smell which help to identify them. One such is sandal wood, which has a very characteristic sweetish perfume.

Physical Properties

As for the physical properties of wood, the most outstanding are the following:

1) Hygroscopicity 2) Retractability 3) Density
4) Homogeneity 5) Plasticity 6) Hardness
7) Fissility 8) Durability 9) Conductibility
10) Porosity

Wood is a hygroscopic material and absorbs or releases humidity depending on its environment. The variations in its water level bring about the variation weight as well as in volume. When it loses water, there is a reduction in the dimensions and retractability, a change of shape, a deformation or curving, and often cracking. Contraction or retractability, is always greater in young than in old fibres, and in softwoods than hard ones. The density of wood is a very important physical characteristic, although it is necessary to distinguish between absolute and apparent density. The first is constant, as a question of the weight without the hollows of cellulose and its derivations, and the second, which includes the wood's ducts and pores, is very

A. Translate the following passage into Persian.

Botanical Aspect of a Tree

It is much simpler to define what a tree is from the botanical point of view. Any timber-bearing, perennial when its main trunk has reached a height of at least 6 metres, has reached maturity in its habitual climax. Other ligneous plants, lower than this height, are called bushes, scrub, lianas, etc. Some trees can look like bushes, but this is nearly always due to inadequate growth according to its specific nature. Turning to a structural analysis of tree trunk, we find six main concentric layers, in this order:

1. the bark	2. the liber	3. the cambium
4. the sapwood	5. the heartwood	6. the pith or heart

The outside zone of a tree trunk includes the bark and the liber. The bark is the protective layer and its thickness depends on the type of tree. For example, the bark of the pine tree can reach several centimetres. The liber or bark is a kind of spongy generative layer through which sap can easily pass.

The intermediate zone of tree trunk includes the cambium and the sapwood. The cambium is an almost invisible layer, however all the tree's strength to live and grow is in this apparently insignificant film. The cambium, on its inner face, does not cease to produce ligneous cell (xylem) and on its outer face, liber cells (phloem). The sapwood is really the functional part of the wood, where the sap rises, storing nutrients and taking them to another part of the tree. Most of the sap circulates in the ligneous ring of the current year, and if, for some illness, this ring is blocked, it is quite probable that the tree will die, as the older rings cannot keep it alive.

The central zone of the tree trunk includes the heartwood and the pith or heart. Both the heartwood and the heart form the dead part of a tree. The heartwood or the wood itself, is made up of the fibres which have achieved maximum development and resistance in reality constituting the receptacle for the tree's waste substances, which converts it into toxic material for the majority of the organisms which could feed on it. The only function of the heartwood is to make the tree rigid and strong. The pith is also a dead part, and can have a circular, poligonal or star-shaped section, but it is of little importance to the elaboration of the wood, as it is generally very small and splits, so its physical and mechanical characteristics are generally very deficient.

B. Find the Persian equivalents of the following terms and expressions and write them in the spaces provided.

1. accentuated colour ....
2. acicular leaves ....
3. aerial buds ....
4. agglomerate ....
5. beech ....
6. birch ....
7. boxwood ....
8. cellular ....
9. circulatory system ....
10. colorations ....
11. conductibility ....
12. density ....
13. ducts ....
14. ebony ....
15. embrionic tissue ....
16. fibrovascular faces ....
17. fissility ....
18. genera ....
19. gregarious plants ....
20. heartwood ....
21. homogeneity ....
22. intensity ....
23. lignificated ....
24. limba ....
25. lime ....
26. lustre ....
27. mahogany ....
28. maple ....
29. medullar radii ....
30. meshes ....
31. mimusops ....
32. monochrome ....
33. naked seeds ....

34. oak ....
35. ocoteas ....
36. organoleptic ....
37. palisander ....
38. parallel grains ....
39. perfumed woods ....
40. physio-chemical properties ....
41. plasticity ....
42. plum ....
43. poplar ....
44. porosity ....
45. prefabricated ....
46. rabbet ....
47. radial section ....
48. retractability ....
49. sandal wood ....
50. sapeli ....
51. sapwood ....
52. sinuous ....
53. sprout ....
54. tangential section ....
55. techno-economic possibilities ....
56. translucity ....
57. walnut ....
58. wood-producing plants ....
59. xylem ....

B. Find the Persian equivalents of the following terms and expressions and write them in the spaces provided.

1. agricultural wastes ....
2. alkali ....
3. ash ....
4. biomass ....
5. cambial tissues ....
6. caustic soda ....
7. cell-wall component ....
8. char production ....
9. decomposition ....
10. degradation ....
11. enzymatic hydrolysis ....
12. exothermic ....
13. extractives ....
14. fermentation ....
15. gasification ....
16. genetic manipulation ....
17. gums ....
18. hemicelluloses ....
19. holocellulose ....
20. lamella ....
21. lignification ....
22. lignin-like compounds ....
23. low-molecular weight-products ....
24. mannose ....
25. microfibrils ....
26. monomers ....
27. monosaccharides ....
28. morphological sites ....
29. needles ....
30. oil crisis ....
31. oven-dry weight ....
32. oxidizing agents ....
33. pectic substances ....
34. petrochemical industry ....
35. pitch ....
36. pits ....

37. polymerization ....
38. pyrolysis ....
39. silvichemicals ....
40. solubility ....
41. stumps ....
42. suberins ....
43. tannins ....
44. tars ....
45. wood-based chemicals ....
46. xylose ....
47. yeast ....

Unit 4

Section One: Reading Comprehension

Mechanical Properties of Wood

The mechanical properties of wood are measures of its resistance to exterior forces which tend to deform its mass. The resistance of wood to such forces depends on their magnitude and the manner of loading (tension, compression, shear, bending, etc.). In contrast to metals and other materials of homogeneous structure, wood exhibits different mechanical properties in different growth directions (axial, radial, tangential) and therefore, it is mechanically anisotropic.

In the following, each mechanical property of wood is considered separately and in relation to the influence of various factors.

Strength in Tension. The strength of wood in tension shows considerable differences if loading is axial (parallel to grain) or transverse. Strength in axial tension is much higher–up to 50 times and more. In the transverse direction, the influence of radial or tangential loading is not consistent. The values of strength in axial tension of different temperate woods vary from about 50 to 160 N/mm^2 (50-160 MPa, 7250-23200 psi), whereas in transverse tension the range is 1-7 N/mm^2 (1-7 MPa, 145-1015 psi). In certain tropical woods, axial tensile strength may reach 300 N/mm^2 (300 MPa, 43500 psi).

Strength in Compression. The strength of wood in compression is also different if loads are applied parallel or transverse to the grain. Axial compression strength is higher–up to about 15 times–and varies between 25 and 95 N/mm^2 (25-95 MPa, 3625-13775 psi), whereas transverse values vary between 1 and 20 N/mm^2 (1-20 MPa, 145-2900 psi). It has been observed that in softwoods, tangential compression strength is higher than radial, whereas in hardwoods the situation is opposite. The strength of wood in axial compression is smaller in comparison to metals, but higher incomparison to most other construction materials, such as brick and stone. Also, wood differs from other materials (metals, minerals) because its strength in compression is about half that compared to its strength in tension. The difference is due to the structure of wood. The skeleton of wood is made of cellulose chain molecules which impart very high strength in axial tension. The other constituents (hemicelluloses and lignin) contribute to compression strength, marine borers may minimize the strength of wood, but incipient stages of attack also have adverse effects. Toughness is especially reduced by incipient decay. Plant parasites, such as mistletoe, also reduce strength. In any case, the use of attacked wood should be avoided where strength is of primary concern.

B. Find the Persian equivalents of the following terms and expressions and write them in the spaces provided.

1. abrasion ....
2. adverse effect ....
3. air-dry conditions ....
4. anisotropic ....
5. axial ....
6. basswood ....
7. bending ....
8. black locust ....
9. brittle ....
10. cavities ....
11. cell lumina ....
12. cleavage ....
13. compression ....
14. crates ....
15. defects of wood ....
16. deform ....
17. fatigue ....
18. fir ....
19. hornbeam ....
20. juniper ....
21. knots ....
22. linear ....
23. longitudinal ....
24. magnitude ....
25. mass ....
26. modulus of elasticity ....
27. moisture content ....
28. phenomenon of cree ....
29. residual strength ....
30. rupture ....
31. saturation point

32. scratching ....
33. shear ....
34. shrinkage ....
35. specific gravity ....
36. spruce wood ....
37. sycamore ....
38. tension ....
39. tool handles ....
40. toughness ....
41. transverse ....
42. wedge ....
43. willow ....

Unit 5

Section One: Reading Comprehension

The Drying of Wood

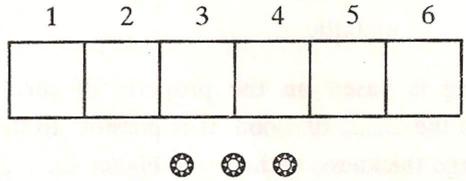
Lumber and other wood products usually contain considerable quantities of moisture recently cut. Irregular exit of this moisture will cause defects (checking, warping, etc.); and if moisture is kept above a certain level, the wood is subject to attack by fungi. For these and other reasons mentioned below, proper drying of wood is necessary. Moist wood should be dried properly (i.e., gradually, uniformly, and to a certain moisture level depending on its intended use). Such drying has important advantages:

1. Shrinkage in use is reduced, and warping and checking are avoided.
2. The wood is protected from attack by stain and decay fungi.
3. The weight of wood is reduced and, therefore, the cost of transportation is lower.
4. Drying results in higher strength, assuming that no defects develop, especially checking. Also, the nail-holding capacity of wood increases.
5. Satisfactory painting, finishing, and (usually) preservative treatment require air- or kiln-dried wood.
6. The high temperatures of kiln-drying would kill fungi and insects that may dwell in wood.

The factors that influence drying are heat, relative humidity, and air circulation. Heat is needed to evaporate moisture. The higher the air temperature, the faster the rate of moisture exit from the interior of wood to its surface. Relative humidity determines the drying capacity of the air. Drier air (lower relative humidity) has a higher drying capacity and can hold more moisture in the form of water vapor. Drying capacity of the air is considerably affected by its temperature: the warmer the air, the higher the drying capacity, because a rise of temperature causes a fall in relative humidity. Thus, by controlling relative humidity, it is possible to control the rate of moisture exit and, therefore control the magnitude of stresses that develop in wood due to shrinkage. As a result, defects of wood during drying may be avoided or reduced. Air circulation is needed to transport heat to wood and to remove moisture from its surface. Air circulation affects the drying rate.

Wood may be dried out of doors or in a kiln. Air-drying is usually done

f. In the latter type, heat captured by the collector is transferred inside the kiln by air or a closed circuit of water.



Section Two: Further Reading

Kiln-Drying

Kiln-drying is usually carried out in steam-heated kilns, equipped with means for temperature and humidity control, air circulation, and removal of moist air. Conventional kiln-drying is carried out as follows:

There are two kiln types–compartment and progressive. In a compartment kiln, the lumber remains stationary during the drying period. Drying conditions (temperature, relative humidity) are changed at intervals, but remain constant for certain periods throughout the kiln. In a progressive kiln, the lumber is progressively move toward the exit. Drying conditions are not constant throughout the kiln, which is long. At the entrance, the conditions are milder (low temperature, high relative humidity) and progressively become more intense (temperature is raised and relative humidity reduced). Consequently, there always are piles in different drying stages. Periodically, one pile or more is removed, the rest are moved toward the exit, and new piles are introduced in the kiln. Progressive kilns are rare, and are mainly used to dry softwoods. The possibility of control is limited, and the final moisture content becomes relatively uniform only if successive loads of woods have about equal initial moisture and similar drying behavior.

Kilns are usually made with bricks, and their floors and roofs are concrete. Metallic (usually aluminium) kilns are also available; they are prefabricated (can be enlarged or reduced in size), mobile, and heat faster. In general, kilns should provide thermal insulation; and the door should close tight in order to avoid waste of heat and steam. The inner side of the walls, as well as all metallic surface, should be suitably coated for protection against corrosive organic acids; such acids are produced especially when drying beech, oak, chestnut, and other species containing large amounts of extractives.

14. flooring ....
15. fungal attack ....
16. immobile ....
17. instrumentation ....
18. kiln-drying ....
19. lumber boards ....
20. moisture content ....
21. nail-holding capacity ....
22. relative humidity ....
23. saturated solutions ....
24. semi-automatic ....
25. sensor ....
26. solar drying ....
27. sprinkling ....
28. steam-heated kilns ....
29. strickers ....
30. transverse permeability ....
31. trial and error ....
32. unpiling ....
33. warping ....
34. well aerated ....

Unit 6

Section One: Reading Comprehension

Wood Preservation

Wood may be protected from the action of destructive agents–such as fungi, insects, marine organisms, and fire–by preservative treatment (i.e., introduction of suitable chemicals into its mass). In this manner, the durability of wood is considerably increased.

The destruction or degradation of wood in the form of logs or products has much greater economic consequences than the attack of standing trees in a forest. Harvesting and processing increase the value of wood, and replacement of products is usually expensive. Other problems may also arise, such as the interruption of electric power or telecommunication during the replacement of poles.

Increasing the natural durability of various wood products is especially important for products exposed to environmental conditions that favor biodegradation, such as poles, piling, railroad ties, posts, and mine timbers. The consequences of a quick degrade are greater in countries that are poor in local production of wood; however, the problem has wider implications due to a worldwide deficiency of wood, which is expected to intensify in the future.

Preservatives

Chemicals suitable as preservatives should be toxic to attacking organisms, or render wood less flammable. In addition, it is desirable that they should be able to enter more or less easily into the mass of wood, not leach or evaporate, not be hazardous to humans or animals, not be flammable or odorous, not decompose or discolor wood or oxidizing metals, not be expensive, and be chemically stable. None of the available preservatives meet all these requirements, but their deficiencies in this regard vary depending on intended use. Chemicals that have a wide use satisfy a greater number of these requirements.

Wood preservatives against fungi, insects, and marine organisms are divided into three categories: water-borne, oils, and organic solvent (oil-borne). Fire retardants belong to the water-borne type, but they are separately discussed because their manner of action is different.

C. Write the answers to the following questions.

1. What are elastomers or elastomeric adhesives based on?
2. How can we classify synthetic resins?
3. Why are synthetic adhesives called synthetic resins?
4. How is casein prepared?
5. What do natural adhesives include?
6. Why are natural adhesives replaced by synthetic ones?
7. How is an adhesive solidified and anchored on a wood surface according to the mechanical view?
8. When was the use of adhesives increased?
9. In what country the first adhesive factory was built?
10. What substances were used as adhesives in ancient times?

Section Three: Translation Activities

A. Translate the following passage into Persian.

The Effect of Preservatives on Wood

The introduction of preservatives in the mass of wood affects not only its durability but also other properties of this material. The changes induced depend on the properties of preservatives and the conditions of treatment. These relate to painting, flammability, odor, strength, electrical resistance, gluing, weight of wood, and oxidation of metallic connectors.

Painting of wood treated with creosote is problematic. The difficulty is less pronounced sometimes after treatment, but the results are not satisfactory. Also, the wood may bleed. With pentachlorophenol, the type of solvent is important, because the preservative itself has no adverse effects; heavy oils create problems similar to those of creosote. Also, wood treated with water-borne preservatives is painted without difficulty after drying, while some preservatives of this category impart color to light-colored woods.

Flammability is affected after treatment with creosote; the wood becomes more flammable, but after sometimes, when the more volatile compounds are evaporated, there is no problem. Certain water-borne preservatives (e.g., zinc chloride) reduce flammability, but high doses reduce the strength of wood as well.

The odor imparted by creosote, pentachlorophenol, and other preservatives is reduced with time, but has no practical importance when the wood is used out-of-doors.

Electrical resistance is not substantially affected by creosote, but water-borne preservatives may reduce it, unless by-products are formed that are insoluble in water.

Gluing of wood treated with water-borne preservatives is easier in comparison to oils and oil-borne preservatives.

The weight of wood is affected in proportion to the weight of retained preservative, but changes of weight may also be due to changes of the moisture content of the wood.

Finally, oxidation is a problem only with water-borne preservatives when the moisture content of wood is kept high.

B. Find the Persian equivalents of the following terms and expressions and write them in the spaces provided.

1. adhesives ....
2. alkaline ....
3. biodegradation ....
4. bituminous coal ....
5. chemical bond ....
6. cost-effective ....
7. deterioration ....
8. discoloration ....
9. distillation ....
10. fire-retardant action ....
11. flammability ....
12. gap filling ....
13. gums ....
14. impregnation ....
15. inorganic chemicals ....
16. insoluble ....
17. layer of foam ....
18. leach ....
19. long-lasting protection ....
20. marine borers ....
21. marine organisms ....
22. mechanical anchoring ....

Unit 7

Section One: Reading Comprehension

Wood as a Raw and Construction Material

As a construction material, wood is strong, durable, light in weight, and easy to work. In addition, it offers natural beauty and warmth to sight and touch. Although it has become necessary to employ conservation measures to ensure a continued supply, wood is still used in construction in many and varied forms.

There are two major classes of wood: softwood and hardwood. These terms do not indicate the relative hardness, softness, or strength of a wood. Softwoods are the evergreens, and are used for general construction. Hardwoods come from deciduous or broad-leaf trees, and are typically used for flooring, stairs, paneling, furniture, and interior trim.

The manner in which a tree grows affects its strength, its susceptibility to expansion and contraction, and its effectiveness as an insulator. Tree growth also affects how pieces of sawn wood (lumber) may be joined to form structure and enclosure.

Grain direction is the major determining factor in the use of wood as a structural material. Tensile and compressive forces are best handled by wood in a direction parallel to its grain. Typically, a given piece of wood will withstand $^1/_3$ more force in compression than in tension parallel to its grain is only about $^1/_5$ to $^1/_2$ of the allowable compressive force parallel to the grain. Tensile force perpendicular to the grain will cause the wood to split.

Wood's shear strength is greater across its grain than parallel to the grain. It is therefore more susceptible to horizontal shear than to vertical shear. The manner in which lumber is cut from a log affects its strength as well as appearance.

Plainsawn Lumber

–may have a variety of noticeable grain patterns
–tends to twist and cup, and wears unevenly
–tends to have raised grain
–shrinks and swells less in thickness, more in width

Quartersawn Lumber

–has more even grain patterns

–wears more evenly with less raised grain and warping

–shrinks and swells less in width, more in thickness

–is less affected by surface checks

–is more expensive and results in more waste in cutting

To increase its strength, stability, and resistance to fungi, decay and insects, wood is seasoned by air-drying (a lengthy process) or through the use of kilns. It is impossible to completely seal a piece of wood to prevent changes in its moisture content. Below a moisture content of about 30%, wood expands as it absorbs moisture and shrinks as it loses moisture. This possibility of shrinkage and swelling must always be taken into account when detailing and constructing wood joints, both in small and large scale work.

Shrinkage tangential to the wood grain is usually twice as much as radial shrinkage, vertical grain lumber shrinks uniformly while plainsawn cuts near a log's perimeter will cup away from the center.

The thermal expansion of wood is generally much less than volume changes due to changes in moisture content. Moisture content is therefore the controlling factor.

Wood defects affect the grading, appearance, and use of the wood. They may also affect the wood's strength, depending on their number, size, and location. Defects include the natural characteristics of wood, such as knots, shakes, and pitch pockets, as well as manufacturing characteristics, such as splits, checking, and warp.

Wood is decay-resistant when its moisture content is under 20%, if installed and maintained below this moisture content level, wood will not rot.

Species that are naturally resistant to decay-causing fungi include redwood, cedar, bald cypress, black locust, and black walnut. Insect-resistant species include redwood, eastern red cedar, and bald cypress.

Preservative treatments are available to further protect wood from decay and insect attack. Of these, pressure treatment is the most effective, especially when the wood is in contact with the ground.

Men are doing things with wood today that will change our old ideas about it. They are making wood that won't burn and wood that won't shrink or swell. They are even making wood that won't rot and that can't be eaten by insects.

What is more, scientist are making many new products from wood. Among these products are glues, plastics and flavorings.

7. debarking ....
8. delimbing ....
9. destructive distillation ....
10. enclosure ....
11. energy plantations ....
12. excelsior ....
13. fast-growing species ....
14. fiberboard ....
15. flavorings ....
16. grain pattern ....
17. hydrolysis ....
18. industrial residues ....
19. ingredients ....
20. interior trim ....
21. liquification ....
22. log's perimeter ....
23. masts ....
24. mine timber ....
25. noncondensable ....
26. nutrients ....
27. oromas ....
28. packaging material ....
29. pakkawood ....
30. particleboard ....
31. pharmaceuticals ....
32. piling ....
33. plainsawn lumber ....
34. poles ....
35. pyrolysis ....
36. quarter sawn lumber ....
37. roundwood products ....
38. spiral grain ....
39. structural material ....
40. swelling ....
41. technology of production ....
42. thermal energy ....