Certificate in Civil Structural Engineering (Portugal)

Construction Materials And Testing

AASHTO stands for American Association of State Highway and Transportation Officials, which is a leading organization that sets standards for construction materials and testing in the United States, its standards are widely used in the Certificate in Civil Structural Engineering course, and it provides guidelines for the selection and testing of construction materials, such as asphalt, concrete, and steel, related terms include ASTM, ACI, and ASCE, AASHTO's standards are used to ensure the quality and safety of construction projects, including roads, bridges, and buildings, for example, AASHTO's standards for asphalt pavement design are widely used in the construction of highways and airports.

Absorption refers to the process by which a material takes in a liquid or gas, in the context of construction materials, absorption is an important property of materials such as concrete and asphalt, which can absorb water and other substances, related terms include permeability, porosity, and sorptivity, absorption can affect the durability and performance of construction materials, for example, high absorption rates can lead to reduced strength and increased maintenance costs, absorption is typically measured using standard tests such as the ASTM C642 test for absorption of concrete.

Accelerated testing refers to the process of testing construction materials under accelerated conditions, such as high temperatures or stresses, to simulate the effects of long-term exposure, related terms include accelerated weathering, accelerated degradation, and accelerated life testing, accelerated testing is used to evaluate the performance and durability of construction materials, such as concrete, asphalt, and steel, for example, accelerated testing can be used to evaluate the resistance of concrete to freeze-thaw cycles, accelerated testing can help to identify potential problems and optimize material selection and design.

Acid attack refers to the process by which a material is damaged by exposure to acidic substances, such as sulfuric acid or hydrochloric acid, acid attack can occur in construction materials such as concrete and steel, related terms include chemical attack, corrosion, and degradation, acid attack can weaken the structure and reduce its durability, for example, acid attack can cause concrete to deteriorate and steel to corrode, acid attack can be prevented or mitigated using protective coatings or resistant materials.

Adhesion refers to the property of a material to stick or bond to another material, in the context of construction materials, adhesion is an important property of materials such as asphalt, concrete, and steel, related terms include bonding, cohesion, and friction, adhesion can affect the strength and durability of construction materials, for example, poor adhesion between layers of asphalt can lead to delamination and reduced performance, adhesion is typically measured using standard tests such as the ASTM D4541 test for adhesion of asphalt.

Aggregates refer to the components of construction materials, such as sand, gravel, and crushed stone, that

are used to create concrete, asphalt, and other materials, related terms include fine aggregates, coarse aggregates, and aggregate gradation, aggregates can affect the strength, durability, and workability of construction materials, for example, the size and shape of aggregates can affect the flow and consolidation of concrete, aggregates are typically tested for properties such as gradation, absorption, and specific gravity.

Air content refers to the amount of air that is trapped in a construction material, such as concrete or asphalt, air content can affect the density, strength, and durability of the material, related terms include air entrainment, air voids, and air bubbles, air content is typically measured using standard tests such as the ASTM C231 test for air content of concrete, for example, high air content can lead to reduced strength and increased permeability, while low air content can lead to increased density and reduced workability.

Alkali-aggregate reaction refers to the chemical reaction that occurs between the alkali ions in cement and the silica ions in aggregates, this reaction can cause the concrete to expand and deteriorate, related terms include alkali-silica reaction, concrete cancer, and expansive reaction, alkali-aggregate reaction can be prevented or mitigated using special cements or aggregates, for example, the use of low-alkali cement can reduce the risk of alkali-aggregate reaction.

Aluminum refers to a metal that is often used in construction, such as in aluminum alloys, aluminum extrusions, and aluminum fasteners, related terms include aluminum oxide, aluminum corrosion, and aluminum welding, aluminum is a lightweight and corrosion-resistant material that is often used in structural applications, such as bridges and buildings, for example, aluminum alloys are used in the construction of high-strength and lightweight structures.

Anchors refer to the components that are used to attach or fasten construction materials, such as concrete, steel, or wood, to other materials or structures, related terms include anchor bolts, anchor rods, and anchor plates, anchors can affect the strength and stability of construction materials, for example, the type and size of anchors can affect the load-carrying capacity of a structure, anchors are typically tested for properties such as pull-out strength and slip resistance.

Asbestos refers to a group of mineral fibers that were once widely used in construction materials, such as insulation, roofing, and flooring, related terms include asbestos cement, asbestos removal, and asbestos abatement, asbestos is a hazardous material that can cause health problems, such as lung cancer and mesothelioma, for example, the use of asbestos in construction materials has been banned in many countries due to its health risks.

Ash refers to the residue that is left over after a material, such as coal or wood, is burned or incinerated, ash can be used as a component of construction materials, such as concrete or asphalt, related terms include fly ash, bottom ash, and ash content, ash can affect the strength, durability, and workability of construction materials, for example, the use of fly ash in concrete can reduce the heat of hydration and improve the workability of the material.

Asphalt refers to a type of construction material that is made from a mixture of bitumen, aggregates, and other additives, asphalt is widely used in the construction of roads, highways, and airports, related terms include asphalt concrete, asphalt emulsion, and asphalt pavement, asphalt can affect the strength, durability, and skid resistance of construction materials, for example, the type and amount of asphalt used can affect the load-carrying capacity and ride quality of a road.

ASTM stands for American Society for Testing and Materials, which is a leading organization that sets standards for construction materials and testing, related terms include AASHTO, ACI, and ASCE, ASTM standards are widely used in the Certificate in Civil Structural Engineering course, and they provide guidelines for the selection and testing of construction materials, such as concrete, asphalt, and steel, for example, ASTM standards for concrete testing include the C39 test for compressive strength and the C143 test for slump.

Bearing capacity refers to the ability of a construction material, such as soil or rock, to support a load without failing or settling, related terms include bearing pressure, bearing stress, and bearing capacity ratio, bearing capacity is an important property of construction materials, as it can affect the stability and safety of structures, for example, the bearing capacity of soil can affect the design of foundations and the selection of construction materials.

Bending refers to the process of applying a load to a construction material, such as a beam or a slab, to cause it to deflect or curve, bending can affect the strength and stability of construction materials, related terms include bending moment, bending stress, and bending strain, bending is an important property of construction materials, as it can affect the load-carrying capacity and durability of structures, for example, the bending strength of concrete can affect the design of beams and slabs.

Bitumen refers to a type of construction material that is made from a mixture of hydrocarbons and other additives, bitumen is widely used in the construction of roads, highways, and airports, related terms include asphalt, tar, and pitch, bitumen can affect the strength, durability, and skid resistance of construction materials, for example, the type and amount of bitumen used can affect the load-carrying capacity and ride quality of a road.

Bond strength refers to the ability of a construction material, such as concrete or asphalt, to adhere or bond to another material or surface, related terms include bond stress, bond strain, and bond energy, bond strength is an important property of construction materials, as it can affect the load-carrying capacity and durability of structures, for example, the bond strength between concrete and steel can affect the design of reinforced concrete structures.

Brick refers to a type of construction material that is made from a mixture of clay, sand, and other additives, brick is widely used in the construction of buildings, walls, and structures, related terms include bricklaying, brickwork, and brick masonry, brick can affect the strength, durability, and aesthetics of construction materials, for example, the type and quality of brick used can affect the load-carrying capacity and

appearance of a building.

Cement refers to a type of construction material that is made from a mixture of limestone, clay, and other additives, cement is widely used in the construction of concrete, mortar, and other materials, related terms include Portland cement, blended cement, and cement paste, cement can affect the strength, durability, and workability of construction materials, for example, the type and amount of cement used can affect the compressive strength and workability of concrete.

Chemical attack refers to the process by which a construction material, such as concrete or steel, is damaged by exposure to chemical substances, such as acids or alkalis, chemical attack can weaken the structure and reduce its durability, related terms include chemical resistance, chemical degradation, and chemical corrosion, chemical attack can be prevented or mitigated using protective coatings or resistant materials, for example, the use of chemical-resistant coatings can protect steel from corrosion.

Coatings refer to the layers of material that are applied to the surface of a construction material, such as concrete or steel, to protect or enhance its properties, related terms include paint, varnish, and sealant, coatings can affect the durability, appearance, and performance of construction materials, for example, the use of protective coatings can reduce the risk of corrosion and extend the life of a structure.

Cold joint refers to the interface between two layers of construction material, such as concrete or asphalt, that are placed at different times, cold joints can weaken the structure and reduce its durability, related terms include construction joint, expansion joint, and contraction joint, cold joints can be prevented or mitigated using special techniques or materials, for example, the use of bonding agents can improve the strength of cold joints.

Column refers to a vertical structural element that is used to support loads and transfer them to the foundation, related terms include pier, post, and pillar, columns can affect the stability and safety of structures, for example, the size and shape of columns can affect the load-carrying capacity and durability of a building.

Compressive strength refers to the ability of a construction material, such as concrete or brick, to resist compressive forces without failing or crushing, related terms include compressive stress, compressive strain, and compressive modulus, compressive strength is an important property of construction materials, as it can affect the load-carrying capacity and durability of structures, for example, the compressive strength of concrete can affect the design of columns and foundations.

Concrete refers to a type of construction material that is made from a mixture of cement, water, and aggregates, concrete is widely used in the construction of buildings, bridges, and other structures, related terms include reinforced concrete, prestressed concrete, and concrete masonry, concrete can affect the strength, durability, and workability of construction materials, for example, the type and amount of cement used can affect the compressive strength and workability of concrete.

Corrosion refers to the process by which a construction material, such as steel or concrete, is damaged by exposure to environmental factors, such as moisture or chemicals, corrosion can weaken the structure and reduce its durability, related terms include corrosion resistance, corrosion protection, and corrosion control, corrosion can be prevented or mitigated using protective coatings or resistant materials, for example, the use of galvanized steel can protect against corrosion.

Cracking refers to the process by which a construction material, such as concrete or asphalt, develops cracks or fissures due to stress or strain, cracking can weaken the structure and reduce its durability, related terms include crack width, crack depth, and crack spacing, cracking can be prevented or mitigated using special techniques or materials, for example, the use of fiber-reinforced concrete can reduce the risk of cracking.

Creep refers to the process by which a construction material, such as concrete or steel, deforms or changes shape over time due to stress or strain, creep can affect the stability and safety of structures, related terms include creep strain, creep rate, and creep modulus, creep can be prevented or mitigated using special techniques or materials, for example, the use of high-strength concrete can reduce the risk of creep.

Deflection refers to the amount of bending or curvature of a construction material, such as a beam or a slab, under load, deflection can affect the stability and safety of structures, related terms include deflection ratio, deflection limit, and deflection criteria, deflection can be prevented or mitigated using special techniques or materials, for example, the use of reinforced concrete can reduce the risk of excessive deflection.

Density refers to the mass per unit volume of a construction material, such as concrete or asphalt, density can affect the strength, durability, and workability of construction materials, related terms include bulk density, apparent density, and true density, density is an important property of construction materials, as it can affect the load-carrying capacity and stability of structures, for example, the density of concrete can affect the design of foundations and the selection of construction materials.

Deterioration refers to the process by which a construction material, such as concrete or steel, degrades or decays over time due to environmental factors, such as moisture or chemicals, deterioration can weaken the structure and reduce its durability, related terms include deterioration rate, deterioration mechanism, and deterioration control, deterioration can be prevented or mitigated using protective coatings or resistant materials, for example, the use of weather-resistant coatings can protect concrete from deterioration.

Durability refers to the ability of a construction material, such as concrete or steel, to resist deterioration and maintain its properties over time, related terms include durability factor, durability index, and durability design, durability is an important property of construction materials, as it can affect the life and maintenance costs of a structure, for example, the durability of concrete can affect the design of buildings and the selection of construction materials.

Elasticity refers to the ability of a construction material, such as steel or concrete, to deform or change shape under load and then return to its original shape when the load is removed, elasticity can affect the

stability and safety of structures, related terms include elastic modulus, elastic strain, and elastic limit, elasticity can be prevented or mitigated using special techniques or materials, for example, the use of high-strength steel can reduce the risk of excessive elasticity.

Expansion joint refers to a gap or space between two construction materials, such as concrete or asphalt, that allows for expansion or contraction due to temperature or moisture changes, expansion joints can reduce the risk of cracking or damage to the structure, related terms include expansion joint sealant, expansion joint material, and expansion joint design, expansion joints can be prevented or mitigated using special techniques or materials, for example, the use of flexible sealants can reduce the risk of leakage or damage.

Fatigue refers to the process by which a construction material, such as steel or concrete, fails or breaks due to repeated loading and unloading cycles, fatigue can weaken the structure and reduce its durability, related terms include fatigue life, fatigue strength, and fatigue design, fatigue can be prevented or mitigated using special techniques or materials, for example, the use of high-strength steel can reduce the risk of fatigue.

Fiber refers to a type of construction material that is made from synthetic or natural fibers, such as glass or carbon fibers, fiber can be used to reinforce or strengthen other construction materials, such as concrete or asphalt, related terms include fiber-reinforced polymer, fiber-reinforced concrete, and fiber-reinforced asphalt, fiber can affect the strength, durability, and workability of construction materials, for example, the use of fiber-reinforced concrete can reduce the risk of cracking or damage.

Flexural strength refers to the ability of a construction material, such as concrete or asphalt, to resist bending or flexural forces without failing or cracking, flexural strength can affect the stability and safety of structures, related terms include flexural stress, flexural strain, and flexural modulus, flexural strength can be prevented or mitigated using special techniques or materials, for example, the use of reinforced concrete can reduce the risk of excessive flexural stress.

Foundation refers to the base or footing of a structure, such as a building or a bridge, that transfers the loads to the ground, foundation can affect the stability and safety of structures, related terms include foundation design, foundation depth, and foundation type, foundation can be prevented or mitigated using special techniques or materials, for example, the use of deep foundations can reduce the risk of settlement or failure.

Fracture refers to the process by which a construction material, such as concrete or steel, breaks or splits due to stress or strain, fracture can weaken the structure and reduce its durability, related terms include fracture mechanics, fracture toughness, and fracture energy, fracture can be prevented or mitigated using special techniques or materials, for example, the use of high-strength concrete can reduce the risk of fracture.

Glass refers to a type of construction material that is made from silica and other oxides, glass is widely used

in the construction of windows, doors, and other structures, related terms include glass fiber, glass wool, and glass ceramic, glass can affect the strength, durability, and appearance of construction materials, for example, the use of insulating glass can reduce the risk of heat loss or gain.

Hardness refers to the ability of a construction material, such as concrete or steel, to resist abrasion or wear without degrading or losing its properties, hardness can affect the durability and performance of construction materials, related terms include hardness test, hardness scale, and hardness rating, hardness can be prevented or mitigated using special techniques or materials, for example, the use of hardened concrete can reduce the risk of abrasion or wear.

Insulation refers to the material or system that is used to reduce the flow of heat or sound through a construction material, such as a wall or a roof, insulation can affect the energy efficiency and comfort of a building, related terms include insulation material, insulation thickness, and insulation rating, insulation can be prevented or mitigated using special techniques or materials, for example, the use of foam insulation can reduce the risk of heat loss or gain.

Load refers to the force or weight that is applied to a construction material, such as a beam or a column, load can affect the stability and safety of structures, related terms include load capacity, load rating, and load factor, load can be prevented or mitigated using special techniques or materials, for example, the use of high-strength steel can reduce the risk of overloading or failure.

Masonry refers to the construction of buildings or structures using units of material, such as bricks or blocks, that are laid in a pattern or arrangement, masonry can affect the strength, durability, and aesthetics of construction materials, related terms include masonry material, masonry construction, and masonry design, masonry can be prevented or mitigated using special techniques or materials, for example, the use of reinforced masonry can reduce the risk of cracking or damage.

Material refers to the substance or matter that is used to construct or build a structure, such as a building or a bridge, material can affect the strength, durability, and performance of construction materials, related terms include material properties, material selection, and material testing, material can be prevented or mitigated using special techniques or materials, for example, the use of sustainable materials can reduce the risk of environmental impact or waste.

Mix design refers to the process of selecting and proportioning the ingredients of a construction material, such as concrete or asphalt, to achieve the desired properties and performance, mix design can affect the strength, durability, and workability of construction materials, related terms include mix design method, mix design software, and mix design optimization, mix design can be prevented or mitigated using special techniques or materials, for example, the use of advanced mix design software can reduce the risk of trial and error.

Modulus refers to the measure of the stiffness or rigidity of a construction material, such as concrete or steel, modulus can affect the stability and safety of structures, related terms include modulus of elasticity,

modulus of rupture, and modulus of deformation, modulus can be prevented or mitigated using special techniques or materials, for example, the use of high-modulus materials can reduce the risk of deflection or distortion.

Mortar refers to the material that is used to bind or hold together the units of a construction material, such as bricks or blocks, mortar can affect the strength, durability, and aesthetics of construction materials, related terms include mortar mix, mortar type, and mortar application, mortar can be prevented or mitigated using special techniques or materials, for example, the use of reinforced mortar can reduce the risk of cracking or damage.

Pavement refers to the layer or surface of a road or highway that is made from a construction material, such as asphalt or concrete, pavement can affect the safety and performance of vehicles, related terms include pavement design, pavement construction, and pavement maintenance, pavement can be prevented or mitigated using special techniques or materials, for example, the use of permeable pavement can reduce the risk of stormwater runoff or flooding.

Permeability refers to the ability of a construction material, such as concrete or asphalt, to allow or permit the flow of water or air through it, permeability can affect the durability and performance of construction materials, related terms include permeability test, permeability coefficient, and permeability rating, permeability can be prevented or mitigated using special techniques or materials, for example, the use of impermeable coatings can reduce the risk of water infiltration or damage.

Plasticity refers to the ability of a construction material, such as concrete or asphalt, to deform or change shape without breaking or failing, plasticity can affect the stability and safety of structures, related terms include plasticity test, plasticity index, and plasticity limit, plasticity can be prevented or mitigated using special techniques or materials, for example, the use of plasticizers can improve the workability of concrete.

Pore refers to the small cavities or voids that are present in a construction material, such as concrete or asphalt, pores can affect the permeability and durability of construction materials, related terms include pore size, pore distribution, and pore volume, pores can be prevented or mitigated using special techniques or materials, for example, the use of pore-reducing admixtures can improve the density and durability of concrete.

Rebar refers to the steel bars or rods that are used to reinforce or strengthen construction materials, such as concrete or masonry, rebar can affect the strength, durability, and stability of structures, related terms include rebar size, rebar spacing, and rebar cover, rebar