Modern Materials

INTRODUCTION TO DAMP PROOFING:

Damp proofing is a type of moisture control applied to walls, residential floors or commercial buildings to prevent moisture, mold and moisture.

Damp proofing problems are one of the most frequent problems occurring in homes these days; they occur mainly in old buildings or poorly constructed buildings.

Frequently damp proofing products keep the moisture away from the buildings, where vapour barriers retain internal moisture to the walls.

CAUSES OF DAMP PROOFING IN ROOFS :

- Usage of poor quality of construction material.
- It has a bad design.
- Fault in construction.
- Leakage through down passes can cause moisture.

- If the roof of low quality, rainwater can also enter into the house.
- Small roof slopes or faulty junctions between roof slabs and parapet walls can cause damping.
- The rainwater falling on the outer walls & parapet causes moisture.

METHODS OF DAMP PROOFING:

Damp-Proof Course (DPC):

Damp Proof Course is a wall through the structure by stripe action known as rising damp, it is the effect of water rising from the ground to the building . Some problems involves salt damp, lateral damp, rising damp & mould . There is some damp proof course that makes damp proofing problems could not occur again.

Different Types of Damp Proof Courses

There are various types of remedial damp-proof courses which can be installed into your property. The appropriate damp proof course will be chosen to suit the construction of the property.

Damp Proof Course Injection – This system involves a cream or liquid being injected into the wall in order to act as a water repelling layer to stop the damp from the ground rising above the damp proof course. This is commonly known as a chemical damp proof course injection. The system is injected in holes that are drilled into the wall at least 150mm above the external ground level.

Mortar Injection Damp Proof Course – This is similar to the use of creams or liquid injected into the wall. Instead of cream or liquid being used a chemical enhanced mortar is used and caulked into the holes drilled in the wall. This is used where the construction of the wall may be of random rubble and are prone to having voids within the structure. The mortar fills the hole in the masonry.

METHODS OF DAMP PROOFING:

Cavity walls:

A cavity wall consists of two parallel walls/masonry skins, separated by a continuous air space.

It consists of three parts: outer wall/leaf (10 cm thick of outer wall), cavity/air space (5 cm-8 cm), and inner wall/leaf (minimum 10 cm thick).The two leaves forming a cavity in the middle or may not be of the same thickness . The provision of continuous cavity walls efficiently prevents the transmission of moisture from the outer to the inner wall.

Under India’s climatic conditions (hot-dry / hot-humid), cavity type construction is most desirable.

ADVANTAGES OF DAMP PROOFING:

- The use of cement leads to a better water system.
- It gives the roof a reasonable slope.
- It is durable and sustainable.
- It repairs other voids or cracks that are already present in roof slabs.

DISADVANTAGES OF DAMP PROOFING:

- Normal cracks sometimes develop in this damp proofing process.
- Also, it provides additional weight to the entire structure.
- It leads to the level problem.
- Sometimes it creates ugly patches up to the roof.

WATERPROOFING IN BUILDING CONSTRUCTION:

Waterproofing is basically a process designed to prevent water from penetrating into a structure. Typically waterproofing is done in various layers and stages to create multiple barriers so that water cannot penetrate the structure. A structure is waterproofed by the use of membranes and coatings to protect contents underneath or within as well as protecting structural integrity.

FACTORS AFFECTING A BUILDING:

Every building can be referred to as a living thing as it also addresses the problems of deterioration if proper care is not taken and maintenance is not involved.

In this way, some natural factors like air, water, climate, wind and humidity govern the life of building, apart from the occupancy load. Water (through humidity and rains) is the prime source of degrading or harming a structure, right from its foundation to its plaster if the structure is not well protected from it.

PROBLEMS IN A BUILDING:

- Natural factors
- Fire
- Water
- Wind
- Earthquakes
- Unnatural Factors
- Demolishment

Waterproofing: The process:

Of all the points mentioned above, the commonly addressed problem are confined to water. Water through various forms and sources harms the structure. This happens in the following ways:

- Seepages through walls, sills, lintels, extensions, beam-brickwork joint.
- Capillary rise through foundation, external wall, common walls, exterior wall-floor joints, columns.
- Up thrust action and buoyancy in contours against retaining wall, under reinforced basement flooring and underground basement spaces.

Indication of Paints Peeling Off From the Roof Surface

Indication of Cracks Developing On External Surface

IMPORTANCE OF WATERPROOFING:

Building waterproofing is a process which is designed to prevent water from penetrating a building. Usually extensive waterproofing measures are added to a building at the time of construction, to provide moisture control from the start.

From the point of view of its occupants, building waterproofing is important because

- It keeps a building dry.
- It also reduces internal humidity, making a building more comfortable to work in and protecting objects inside the building from damage as a result of humidity and water vapour.
- Building waterproofing is also important to the integrity of the building itself.

Types of Water Proofing Methods

CEMENTITIOUS WATERPROOFING METHOD:

Cementitious waterproofing is the easiest method of waterproofing in construction. The materials for cementitious waterproofing are easily available from suppliers of masonry products, and they’re easy to mix and apply.

APPLICATIONS OF CEMENTITIOUS WATERPROOFING:

Cementitious waterproofing is used in the following type of structures:

- Water Treatment Plants
- Sewage Treatment Plants
- Bridges
- Dams
- Railway & Subway Systems
- Marine Cargo Ports & Docks
- River Locks/Channels & Concrete Dykes
- Parking Structures & Lots

BITUMINOUS COATING WATER PROOFING METHOD:

- Bituminous coating is a type of coating used for waterproofing and flexible protective coat in accordance with its formulation and polymerization grade. Its flexibility and protection against water can be influenced by the polymer grade as well as reinforcement of fibre.
- Bituminous coating is also called as asphalt coating. The most common applications of bituminous coatings include areas that are beneath wet surfaces. It is an excellent protective coating and waterproofing agent, especially on surfaces such as concrete foundations.

THERMAL INSULATION:

Thermal insulation is the reduction of heat transfer(i.e., the transfer of thermal energy between objects of differing temperature) between objects in thermal contact or in range of radioactive influence. Thermal insulation can be achieved with specially engineered methods or processes, as well as with suitable object shapes and materials.

THERMAL INSULATION:

Heat flow is an inevitable consequence of contact between objects of different temperature. thermal insulation provides a region of insulation in which thermal conduction is reduced, creating a thermal break or thermal barrier, or thermal radiation is reflected rather than absorbed by the lower-temperature body.

The insulating capability of a material is measured as the inverse of thermal conductivity (k). low thermal conductivity is equivalent to high insulating capability (resistance value). in thermal engineering, other important properties of insulating materials are product density (p) and specific heat capacity (c)..

Sound insulation and fire protection materials

- **Introduction**
- The levels of desired sound insulation, for different types of buildings and between the individual rooms or apartments of a building can be achieved by the following contraction measures of noise control and sound insulation.
- Wall Insulation : Vertical Barriers Walls and partitions are the vertical barriers to noise. Their proper design and construction may insulate the sound to the desired level. Wall construction, used for sound insulation, may be four types.
- Rigid and Massive Homogeneous Walls.
- Partitions of Porous Materials
- Double Wall Partition.
- Cavity Wall Type Construction.

Floors :

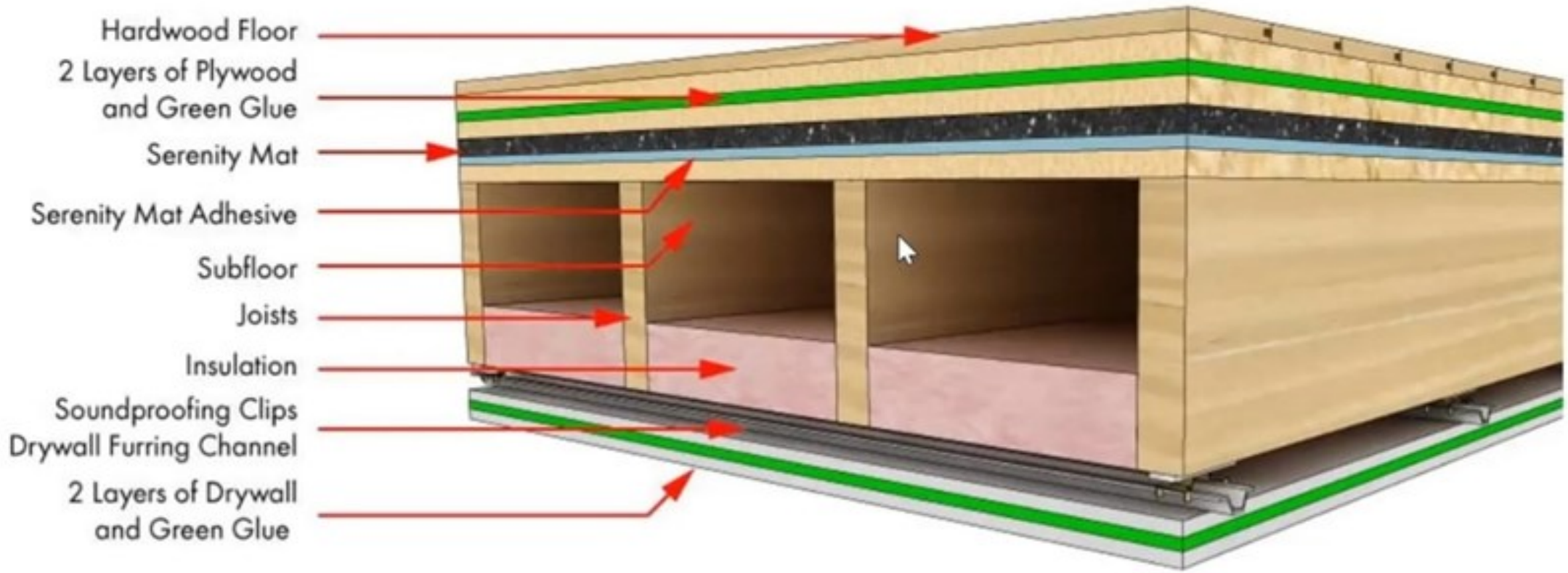
Transmission of sound takes place more easily through floors. This is on account on the fact, that invariably the sound producing source has actual contact with the floor. Hence the floor serves as the most common path for the transmission of impact noise. The ordinary R.C.C. floor weighing less than 220 kg/sq.m has a sound reduction of only 45 dB. Thus bare concrete and timber floors do not function effectively as barrier against impact sound. A floating floor resting on a resilient material like glass wool, mineral wool, quilt, hair felt, cork, rubber etc. has an increased rating for impact sound insulation.

Image of Soundproof Floor :

Wooden Joist Floors -

The performance of wooden joist floors is greatly influenced by the amount of indirect or flanking sound, transmitted through the walls. The factor is not important in concrete floors, since the concrete floors are considered heavy, rigid and stiff enough to restrain the vibrations from the walls. In timber floors, this factor can be taken care of by increasing the stiffness and thickness of the wall below the floor.

The Image is in the next page


Hardwood Floor
2 Layers of Plywood and Green Glue
Serenity Mat
Serenity Mat Adhesive
Subfloor
Joists
Insulation
Soundproofing Clips
Drywall Furring Channel
2 Layers of Drywall and Green Glue

Other Sound Absorbing Materials:

Hair Felt: This material was used by Mr. Sabin in his experiment on sound proofing. He used 25mm thick hair felt provides sound absorption coefficient of 0.60.

Quilts and Mats: They are made from mineral wools or glass wool and are mostly used as sound absorbing materials. The sound absorption value depends upon the thickness of the mat and quilt.

Acoustic Plaster: It consist of granulated materials mixed with cement and 20mm thick plaster having density of 0.1 gm/cm3 has sound absorbing coefficient of 0.3.

Fire Proofing or Protection:

Every building contains the some materials like furniture, clothing, eatables etc. which can catch fire easily or vulnerable to fire. However, the engineer should plan, design and construction the building in such away so that safety of all occupants may be ensured to the maximum possible extent during fire or any other natural or man made disaster or accident.

Fire Resisting Materials

Mineral wool : This is any fibrous material formed by spinning or drawing slag and molten mineral or rock materials such ceramics Applications of mineral wool as include thermal insulation (as both structural insulation and pipe insulation, though it is not as fire-resistant as high-temperature insulation wool), filtration, sound proofing, and hydroponic growth medium.

Timber: Timber has unique property of self insulation and slow burning and offer considerable resistance to fire. When subjected to fire, timber first get charred to certain depth thereafter, this charred layer serves as insulation to check the spread of fire to the inner portion.

Stone: Stone are most unsuitable building material for preventing safety against fire. Lime stone crumbles to powder in fire. Granite when exposed to severe heat or fire, explodes and disintegrate.

Bricks: Bricks are not seriously affected by the fire until 1200 or more temperature is reached. This is due to that bricks are poor conductor to heat.

Cast Iron: This material is rarely used as structural material at present. This material flies into pieces when heated and suddenly cooled. Hence this material must be covered either in one brick wall or in the concrete, if used anywhere in the construction.

Glass: Bad conductor of heat and low heat coefficient to thermal expansion, due to which it can be used in the building but sudden change in the temperature can cause crack in it.

Asbestos Cement: It can be formed by mixing asbestos fibre to ordinary Portland cement which has great fire resistivity against fire

Plastering: Cement or lime plaster has very high fire resistive value and is commonly employed to cover the walls ceilings, joists etc., to protect them from fire.

SOLID AND HOLLOW CONCRETE BLOCKS

Solid and hollow concrete blocks are manufactured in factories to meet the requirements of building blocks in cities and towns. These blocks may be called as artificial stones, since they replace the stones in the masonry construction. They are manufactured with lean mixes of cement, sand and aggregates of sizes less than 12 mm. Instead of sharp edged aggregates, round aggregates are professed in the manufacture of these blocks. The properties and uses of these blocks is given in this article.

SOLID CONCRETE BLOCKS

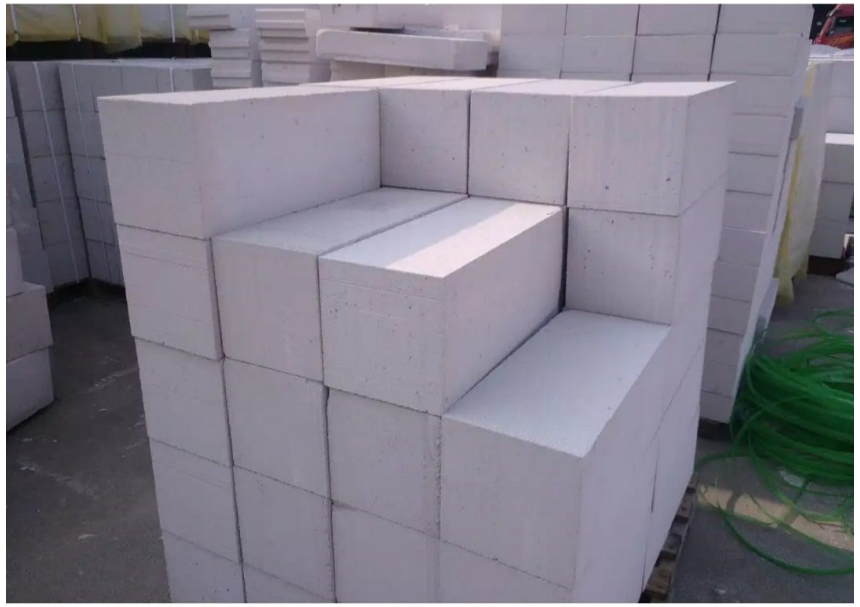
- Solid concrete blocks of size 400 mm × 200 mm × 150 mm are commonly manufactured. To reduce the weight of the block no fine concretes are preferred. No fine concrete is the concrete in which fine aggregate is not used, but round aggregates of size less than 12 mm are used. IS:2185 (part I) 1983 covers the requirement, for such blocks.
- The blocks should satisfy the strength requirement of 4 N/mm2. Their density should be as low as possible, so that handling is not difficult. They should have sharp edges which are at right angles to each other.
- These blocks are used for load nearing wall construction also.

HOLLOW CONCRETE BLOCKS:

- To reduce the weight of concrete blocks, they may be made hollow as. Hollow blocks of sizes 400 mm × 200 mm × 190 mm (nominal size 400 × 200 × 200 mm) and also of sizes 400 mm × 300 mm × 190 mm (nominal size 400 × 300 × 200 mm) are manufactured. IS:2185 (part I) 1983 covers the specifications for these blocks.
- These block need richer mixes. Fine aggregates up to 60% and coarse aggregates up to 40% are used.
- These blocks also should satisfy the strength requirement of 4 N/mm2. They should have truly right angled corners.
- Advantage of using concrete blocks is that the construction activity is fast. Mortar requirement for finishing the surface is less. Pointing alone is sufficient, in other words plastering is not necessary.

What is Autoclaved Aerated Concrete Block :

These blocks are also known as light weight hollow blocks. autoclaved aerated brick is an eco friendly and certified Green Building material which is light weight load bearing, high insulating durable building blocks



Preparation

AAC Blocks are prepared as solid blocks from cement , water, and materials like ground sand , pulverized, fly ash together with additives to aerate and stabilize the air bubble. The resultant mixture is a thick liquid which is then poured into steel moulds to form large cakes. after a few hours this mixture sets and can be cut into a series of individual blocks off required size by means of taut steel wires. The blocks are then autoclaved at 10 to 15 atmospheric pressure in high temperature for about 18 hours.

Fly Ash Brick

Fly ash bricks building material such as masonry unit. Fly ash Bricks are made from the fly ash which is obtained as a waste material

Characteristics of AAC Blocks

1. Light weight
2. Environmental impact
3. Fire resistance
4. Sound insulation
5. Thermal insulation
6. Strength and durability
7. Accuracy

Disadvantages of AAC Blocks

1. Non load bearing material
2. Brittle Nature
3.Water Absorption is very high
4.High cost

INTERLOCKING PAVER BLOCKS : INTRODUCTION

- Concrete block pavement was introduced in The Netherlands in the early 1950s as a replacement for baked clay brick roads. Blocks were rectangular in shape and had more or less the same size as the bricks
- Earlier days non-interlocking bricks were used but now interlocking bricks were used.

INTRODUCTION

- ICBP gives excellent performance when applied at locations where conventional systems have lower service life due to a number of geological, traffic, environmental and operational constraints.
- Many number of such applications for light, medium, heavy and very heavy traffic conditions are currently in practice around the world.

ADVANTAGES

- High dimensional accuracy.
- Good quality of blocks ensures durability of pavements,
- Will not be affected by thermal expansion & contraction.
- ICBP doesn’t require curing.
- Low manpower.

ADVANTAGES

- ICBP provides ready access to underground utilities without damage to pavements.
- Easy maintenance.
- Use of coloured blocks facilitates traffic markings.
- ICBP is resistant to punching loads & horizontal loads.
- Low maintenance cost.

LIMITATIONS

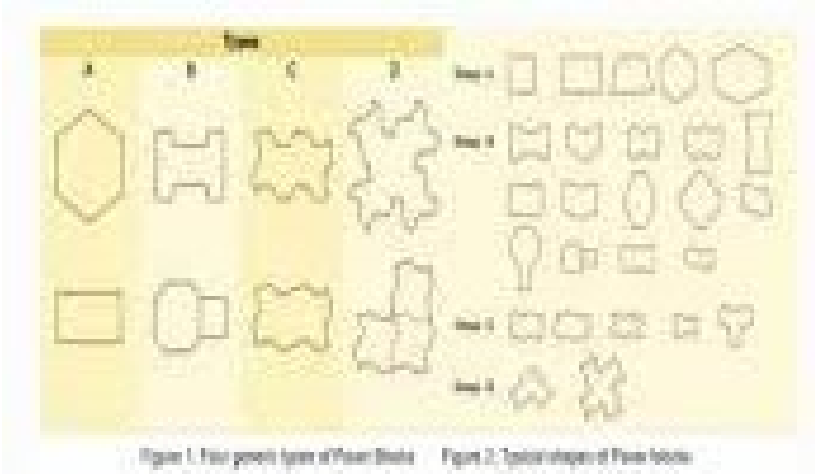
- Quality control of bricks at the factory premises is a prerequisite for durable “ICBP”.
- Deviation of base coarse.
- High quality coarse bedding sand and joint filling material are essential for good performance.
- Not suited for high speed roads.

APPLICATION OF ICBP TECHNOLOGY:

Some of the proven areas where ICBP technology is being applied are listed below

- Non-traffic Areas: Building Premises, Footpaths, Malls, Pedestrian Plaza, Landscapes, Monuments Premises, Premises, Public Gardens/Parks, Shopping Complexes, Bus Terminus Parking areas and Railway Platform, etc.
- Light Traffic: Car Parks, Office Driveway, Housing Colony Roads, Office/Commercial Complexes, Rural Roads, Residential Colony Roads, Farm Houses, etc.
- Medium Traffic: Boulevard, City Streets, Small Market Roads, Intersections/Rotaries on Low Volume Roads, Utility Cuts on Arteries, Service Stations, etc.
- Heavy and Very Heavy Traffic: Container/Bus Terminals, Ports/Dock Yards, Mining Areas, Roads in Industrial Complexes, Heavy-Duty Roads on Expansive Soils, Bulk Cargo Handling Areas, Factory Floors and Pavements, Airport Pavement, etc.

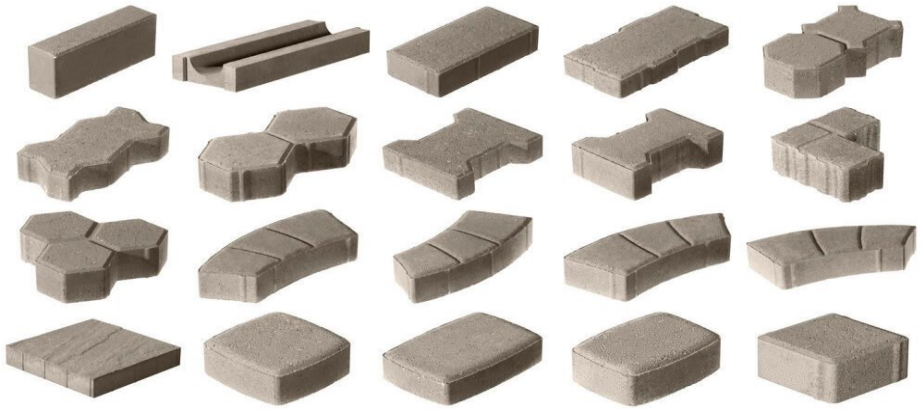
SHAPES & CLASSIFICATIONS:



There are four generic shapes of paver blocks corresponding to the four types of blocks as below

- Type A: Paver blocks with plain vertical faces, which do not key into each other when paved in any pattern.
- Type B: Paver blocks with alternating plain and curved/corrugated vertical faces, which key into each other along the curve/corrugated faces, when paved in any pattern.

SHAPES & CLASSIFICATIONS:



- Type C: Paver blocks having all faces curved or corrugated, which key into each other along all the vertical faces when paved in any pattern.
- Type D: L' and 'X' shaped paver blocks which have all faces curved or corrugated and which key into each other along all the vertical faces when paved in any pattern.

OPERATIONS INVOLVED:

- Installation of sub-surface drainage structures.
- Leveling and compaction of subgrade
- Provision and compaction of sub-base course (where needed)
- Provision and compaction of base-course and checking for correct profile
- Installation of edge restraints

OPERATIONS INVOLVED:

- Provision and compaction of coarse bedding sand
- Laying of blocks and interlocking
- Application of joint sealing sand and compaction
- Cleaning of surface
- Filling any remaining empty portions in the block layer especially near edge restraint blocks with in situ concrete.

ESTABLISHING OF LAYING PATTERN

The blocks can be placed in different bonds or patterns depending upon the requirement, some popular bonds commonly adopted for block paving are

1. Stretcher or running bond
2. Herringbone bond
3. Basket weave or parquet bond

The typical layouts of these bonds are given in Fig.

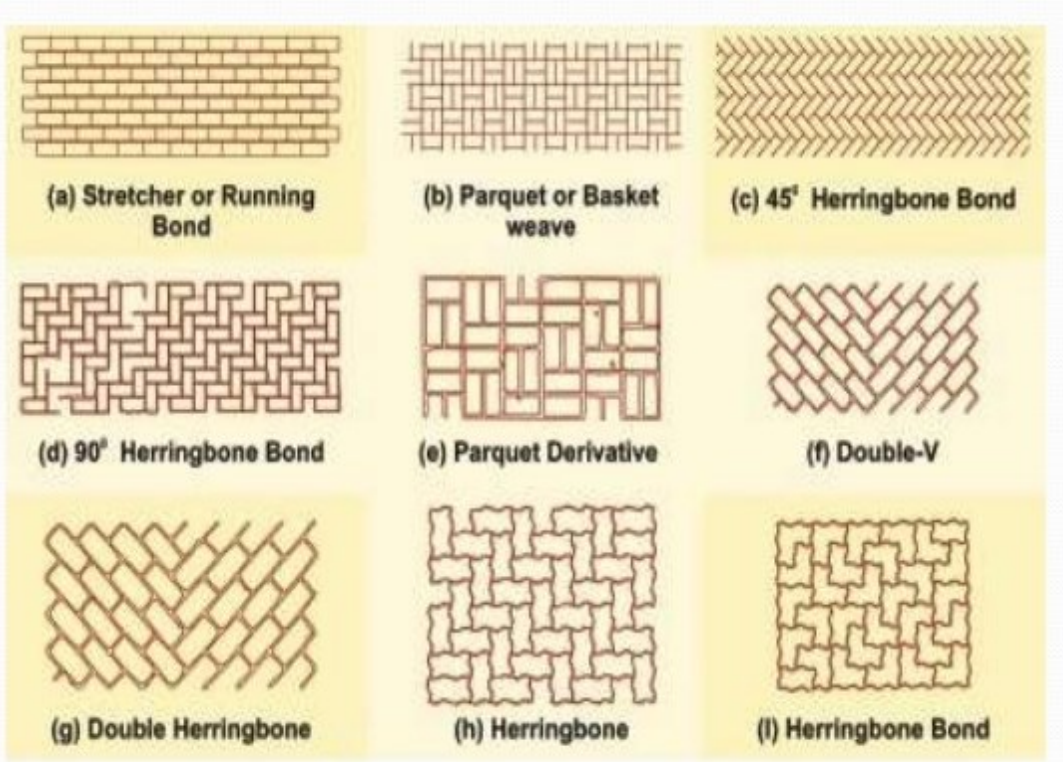


Figure 8: Various Laying Pattern

Aluminium Composite Panel(ACP)

Aluminium composite panel (ACP) is a general term for panels constructed from two sheets of aluminum bonded to a core. Also known as Sandwich Panel. It is structure made of three layers.

ACP laminates have emerged as a very preferred material for facades, curtain walls. Face lifting of building for beauty can be achieved by using these composite panels. It is used in exteriors as well as interiors of buildings.

Aluminium Composite Panel (ACP) is usually made 3mm to 5mm(aprox:4mm) thick. It is composed of non-combustible **low density Polyethylene (LDPE)** sheet laminated and sandwiched between two anodized aluminium sheets(0.3mm) on each side and painted with special techniques. The upper sheet is coated with Polyvinylidene and LDPE sheets, adhesive film compounds are applied.

Properties of ACP

1.Super peeling degree: The aluminum-plastic composite panel adopts a new process to improve the most important technical index of the aluminium composite panel-peel strength to an excellent state, so that the flatness and weather resistance of the aluminum composite panel are improved accordingly.

2.The material is easily processed: The weight of each square meter of engineering aluminum-plastic board is only about 3.5-5.5 kg, so it can reduce the damage caused by the earthquake disaster, and it is easy to carry. Its superior constructability requires only simple woodworking tools to complete cutting, various shapes such as planning, bending into an arc, and right angle can cooperate with the designer to make various changes. The installation is simple and quick, and the construction cost is reduced.

3.Excellent fire performance: The middle if the fire-resistant aluminum-plastic board is a flame retardant PE plastic core material, and the two sides are extremely difficult to burn aluminum layer. Therefore, it is a safe fireproof material that meets the fire resistance requirements of building codes.

4.Impact resistance: Strong impact resistance, high toughness, bending without damaging the topcoat, strong impact resistance, and no damage due to wind and sand in areas with large wind and sand.

5.Super weather resistance: because of the use of fluorocarbon paint that can resist the ultraviolet rays of the sun, it has unique advantages in weather resistance. It does not damage its beautiful appearance in hot sunlight or cold wind and snow.

6.Uniform and colorful coating: After the chemical conversion treatment and the application, the adhesion between paint and aluminum-plastic board is uniform and the colors are diverse, allowing you to choose a large space and show your individuality.

7.Easy maintenance: Aluminum composite board has a significant improvement in pollution resistance. It needs to be maintained and cleaned after several years of use. Due to its good self-cleaning properties, only neutral detergents and water are needed.

Application of ACP

Cladding:

Owing to its high durability, and flexibility the ACP can be used for cladding in the interior as well as external architecture. ACP can withstand rigorous wear and tear and thus modern-day construction is cladded with the Aluminum composite panel; this extends the lifespan of the structure and façade. Also since aluminum is a lightweight metal, it’s easy to handle and install thus increasing the likeability amongst constructors.

Fig: Cladding of ACP sheets

Partitions

Most of the office structures these days intend to use the available floor space to optimum levels. To achieve this, they make internal partitions forming split spaces. The material which is increasingly being used for making these partitions are ACP panels. Again owing to the ease of handling and maintenance, ACP is one of the perfect materials for making partitions; in case if you do away with the idea of having partition and want to increase the space, it can be easily done; you just need to unscrews and move them to wherever you might want. ACP is also cost effective than most of the variants and in view of all these advantages, it is widely used in the construction world.

Fig: Partition of ACP sheets.

False ceiling

False ceiling not only enhance the beauty appeal of interior design but also help in temperature control. Hence, the ACP panels are ideal for this application since they are comprised of polyethylene core that acts as an heat-proofing agent for regulating the heat. The aluminium sheet on the outside offers durability that increases the lifespan of the material when compared to other materials which are available for similar purposes.

Fig: False ceiling of ACP.

Signage

ACP’s can be used to make versatile outdoor signage. As the signage and hoardings are used for displaying outside where it has to withstand the temperature changes and impact of harsh weather, ACP is the ideal material to cater this application.

*ACP can be used in various work in external and internal construction.

Fig: Signage on ACP sheet.

Installation of ACP (Rout and Return wet seal method)

1. Making holes in the walls to fixed the brackets.
2. Fixing MS profile.
3. Fastening Aluminium profiles.
4. Routing ACP to create groves.
5. Formation of tray and also fixed the aluminium angles.
6. Attaching Aluminium cleats to tray.
7. Inserted backer rod.
8. Filling the grooves with silicone weather seal.

Advantages of ACP

-Very rigid, robust, and solid substance though it is very small in weight.
-It’s pleasingly versatile and easy to deal with.
-It’s easy to use, and we can install it easily.
-It offers a broader range of colours.
-It’s UV immune and chemical resistant.
-ACP is environmentally sustainable .
-It is a very inexpensive cladding material relative to other options present on the market.

Disadvantages of ACP sheet

-They are vulnerable to dentition during floods and hurricanes.
-The joints must be properly closed and proper water resistance must be performed such that there can be no entry of water further into the building mostly during rainfall.

Fig: Spaceship Earth, U.S
(a example of uses of ACP in construction

Fig: Amity University, Jaipur
(Using ACP sheet in external construction)

Galvalume Sheets

Originated:

Galvalume is a trademark name invented in 1972 by Bethlehem Steel. It is used to describe a metal roofing product.

Definition:

Galvalume is a roofing sheet that has a coating of zinc, silicon, and aluminum. All these coatings protect the metal and are the primary form of the steel made of oxidation.

It protects the base metal and sacrificial metal coating.

Composition:

It is designed with a combination of zinc, silicon, and aluminium. The composition on using these 3 elements in a Galvalume coat is 50% of aluminium, and less than 50% zinc, with a very low amount of silicon.

Usage:

- It is used for outdoor roofing as a metal panel mainly for iron-based protection and is rustproof.
- Galvalume coating lets it stay protected and is a better resistance in nature in comparison to carbon steel.
- The composition of Aluminium and Zinc helps to be protected from the natural calamities.
- Since zinc is the composition, it is comparatively more oxidized than steel. It has its capacity of resistance when exposed to ice, rain, and snow.

Thickness:

The thicknesses of the Galvalume are approximately 1 mil. thick. Its manufacturing includes the hot-dip process, and basically, thickness difference depends on the coating.

Durability:

It is durable for more than a decade, and less likely to rust. Galvalume is a more aesthetically pleasing material.
It tends to better performance, mainly when exposed to water or any other liquids which has an oxidation process.

Advantages:

- Standard price as it has a durability of more than 10-15 years
- It is corrosion resistance and has self-healing properties.
- The composition of aluminium and zinc helps to be protected from the natural calamities.
- Since zinc is the composition, it is comparatively more oxidized than steel. It has its capacity of resistance when exposed to ice, rain, and snow.

What Type of Metal Is Galvalume:-

Galvalume coating is most commonly applied to carbon steel. However, most materials that can be galvanized can also be coated with Galvalume. Some additional metal types include:

- Cast Iron
- Ferritic Stainless Steel
- Martensitic Stainless Steel
- Low Alloy Steels

When is Galvalume Used:-

One of the most popular applications of Galvalume steel is for outdoor metal panelling and roofing. Galvalume is used because it has superior resistance to corrosion in outdoor environments than standard galvanized steel. It is able to resist corrosion when exposed to snow, ice, and rain.

When Should Galvalume Not Be Used:-

Galvalume should not be used in alkaline environments. The aluminium in Galvalume does not hold up well to that type of environment, so galvanized steel may be a better choice in that instance.

Also, Galvalume does not do well if it is damaged. If the panel will be subject to scratches and indentation, then galvanized steel may be better suited as the material for the application. Even fastener installation may be enough to damage the Galvalume coating