Analysing low rise buildings construction essay

A low-rise building is defined as any occupiable building which is divided at regular intervals into occupiable levels which is lower than a high-rise To be considered a low-rise building an edifice must be based on solid ground, and fabricated along its full height through deliberate processes (as opposed to naturally-occurring formations) and have at least one floor above ground.

An individual building in this category is generally defined as one with connected interior spaces. Any low-rise building with more than one disconnected interior space may only count as a single building if it was built as a single unit and if the separate parts form an architecturally integral whole. On the other hand, it is possible to consider a house with connected interior spaces as more than one building if the different parts are not intended to form a single development and do not form an architecturally integral whole. We can define a building as a low-rise building when it meets one of the following criteria:

- Buildings associated with major architects or other major building companies.

- Buildings which are especially prominent because of their size or position.

- Any buildings housing commercial uses.

- Buildings added at the request of a company.

- Buildings of significant historical or architectural interest

Structural forms:

The main forms of low-rise buildings:

Generally speaking, there are two forms of low-rise builings and they are:

- Traditional

- Modern

Traditional construction:

I can describe traditional buildings as usual, customary, well-known, long-established, regular buildings that we get used to see in our streets and in our neighbourhoods. But technically speaking, a traditional building is a building with a traditional construction, and a traditional material, a good example for it is a loadbearing masonry brick and block building.

TRADITIONAL METHODS OF CONSTRUCTION:

The term ‘ traditional build’ is most often used to describe a structure where the internal load bearing leaf of the walling is of masonry construction and tied with stainless steel ties to an outer leaf of either block or brick.

Although Modern Methods of Construction are taking building practices into the future, traditional brick and block methods still remain one of the most widely used build types in the UK and Ireland.

There are many varied forms of construction and blocks take many different forms:

Dense Concrete Blocks:

Dense Concrete Blocks have a high strength factor and are therefore used for foundations, external leafs of walls that are to be rendered and for

internal load bearing partitions. They do not, however, have a very high insulation value or acoustic rating.

Lightweight Aerated (Aircrete) Blocks:

Lightweight Aerated (Aircrete) Blocks are suitable for foundations, internal and external leaves of cavity walls, solid walls, internal walls and party walls. They provide a far greater thermal efficiency but usually require the application of an external wall insulation system to achieve current building regulations.

Thin Joint Systems:

Thin Joint Systems (which are actually classed as an MMC due to the innovative process) have been designed to speed up the build process. The blocks are laid using a proprietary mortar (instead of sand / cement) which is applied using a special scoop. The system allows a single leaf to be taken up to roof height without waiting for the external leaf offering a similar construction speed of panellised systems.

Single Skin Construction:

On the continent, Single Skin Construction used with external insulation has been the standard method of building for decades. With rising densities, higher land costs and the rising cost and shortages of skilled labour, UK architects and developers are now specifying this method of construction.

Following the erection of a lightweight single skin of blockwork, WBS offer a range of insulation systems that are specifically designed to meet thermal guidelines.

Once the insulation is fixed to the blockwork, a wide variety of render finishes or brick façades can be installed to give modern, seamless finishes or to replicate traditional construction without the cost or reliance of skilled labour.

WBS systems provide designers unlimited options when designing a new build construction with these systems. Whether multi-storey, low rise of traditional two storey dwellings, the architect has unlimited scope to incorporate curved elevations, features, contrasting textures & colours to give these structures a unique look and feel.

Modern Methods of Construction (MMC):

MMC: the facts

MMC is the term used to embrace a range of technologies and processes involving various forms of supply chain specifications, prefabrication and off-site assembly.

MMC:

Makes use of more effective materials

Speeds up housing delivery

Enables high standards of design quality

Can help to reduce resource consumption.

It is increasingly regarded as a means of improving quality, reducing time spent on site, improving on-site safety and overcoming skills shortages in the construction of housing.

Typical forms of MMC:

A good overview of MMC is provided in the National Audit Office report: Using modern methods of construction to build homes more quickly and efficiently.

Volumetric construction:

Where the whole dwelling is prefabricated off site in modules which are then assembled on site. Modules may be constructed in a variety of forms from a basic structure to fully finished and serviced units. English Partnerships' Summit House was constructed using this method.

Panelised construction:

Where flat panels are produced off-site and assembled on site to produce a three-dimensional structure. The most common approach is to use open panels, consisting of a skeletal structure. More complex, or closed panels involve more prefabrication typically including lining materials and insulation. Services, windows, doors, internal finishes and external cladding may also be incorporated.

Hybrid

A method also referred to as semi-volumetric that combines both the panelised and volumetric approaches. Typically, volumetric units for highly serviced areas such as kitchens and bathrooms (sometimes referred to as "

pods”) are used with the remainder of the dwelling or building constructed using panels.

solid structures

The primary building decision is one of structural form. There are (permissibly over-simplified) three basic divisions of structural form:

Solid construction,

Skeletal construction

And surface construction.

Solid is the most intuitive form, from cave and rock temple to loadbearing brickwork. During the historical stage of experimentation, the builders of solid structure fully utilised the virtues of stone and its ability to contain compressive loads. Great skill and ingenuity was employed in enclosing space by the transfer of non-vertical reactions through arches, vaults, domes and abutments to vertical forces at foundation level. Solid construction relies on a heavy homogeneous wall mass within which, in the ideal state, compressive forces are uniformly distributed. ‘ Solid’ buildings have structural limitations. Usually they are of modest heights and have short spans (say up to 7. 6m). If tall, their forms are confined to those in which each storey has an idontical plan. Special consideration is necessary for problems of crack control and differential movements, and these problems will be dealt vith in detail in other sections of this handbook. Fire resistance and thermal-insulation properties are good; but their insulation against noise requires specific investigation because of mass transmission effect.

SUPER STRUCTURE:

COLUMN REINFORCEMENT

A column is a slender, vertical member that carries a superimposed load. Concrete columns, especially those subjected to bending stresses, must always be reinforced with steel. A PIER or PEDESTAL is a compressive member that is short (usually the height is less than three times the least lateral dimension) in relation to its cross-sectional area and carries no bending stress. A bearing wall could be classified as a continuous pier. In concrete columns, vertical reinforcement is the principal reinforcement. However, a loaded column shortens vertically and expands laterally; hence, lateral reinforcements in the form of lateral ties are used to restrain the expansion. Columns reinforced in this manner are called tied columns.

Rebar cages are fabricated either on or off the project site commonly with the help of hydraulic benders and shears, however for small or custom work a tool known as a Hickey – or hand rebar bender, is sufficient. The rebars are placed by rod busters or concrete reinforcing ironworkers with bar supports separating the rebar from the concrete forms to establish concrete cover and ensure that proper embedment is achieved. The rebars in the cages are connected by welding or tying wires. For epoxy coated or galvanized rebars only the latter is possible.

FORM WORK FOR REINFORCEMENT

Formwork is the term given to either temporary or permanent moulds into which concrete or similar materials are poured. In the context of concrete construction, the falsework supports the shuttering moulds.

The carpenter makes up two pairs of formwork shutters or forms, and nails them in place around the rebar steel. Shot pieces of timber are placed onto the footing concrete to allow locate the concrete formwork in the correct place. Then bangs in 75mm nails to hold up the column clamps until they are assembled and just nipped up. A clamp set consists of four lengths of 75 x 8 steel with a hook on one end and overlapping slots in the other end, to take the steel wedges that do the work. The clamps are positioned alternately up the column, So that the wedging force changes direction with each clamp as shown below.

Column Formwork – Arco metal column clamps

COLUMNS AGGREGATES OR CONCRETE CASTING

A column in structural engineering is a vertical structural element that transmits, through compression, the weight of the structure above to other structural elements below. A concrete column is structural member subjected primarily to compressive stresses.

Aggregates are inert granular materials such as sand, gravel, or crushed stone that, along with water and Portland cement, are an essential ingredient in concrete. For a good concrete mix, aggregates need to be clean, hard, strong particles free of absorbed chemicals or coatings of clay and other fine materials that could cause the deterioration of concrete.

CAVITY WALLS

Cavity walls consist of two ‘ skins’ separated by a hollow space (cavity). The skins are commonly masonry such as brick or concrete block. The cavity serves as a way to drain the water back out through weep holes in the base

of the wall system. A cavity wall with masonry as both inner and outer skins is more commonly referred to as a double Wythe masonry wall.

Cavity wall insulation is used to reduce heat loss through a cavity wall by filling the air space with a porous material. By doing this the porous material absorbs the escaping water and air. The leaves of a cavity wall must be a minimum of 90mm thick with a minimum 50mm cavity in between. If the cavity is between 50 and 75mm wide the ties should be placed at a maximum spacing of 900mm horizontally and 450mm vertically. If the cavity is between 76 and 100mm wide the ties should be positioned at maximum intervals of 750mm horizontally and 450mm vertically.

The wall ties are often used to hold sheets on cavity insulation in place and the type and thickness of this insulation will be dictated by the Building Control officer.

The cavity, in a cavity wall, is there to prevent moisture from travelling from the outside skin to the inside skin. The cavity also, in almost all cases, is used to insulate the internal wall against heat loss from inside. The tables indicate that a standard concrete masonry unit with a type N mortar (1: 1: 6 by proportion) will yield a minimum f’m of 1500 psi. This strength is sufficient for most mid to low-rise bearing wall structures.

A typical cavity wall.

BRICKS

Bricks are made from clay. Clay bricks (and tiles) are very durable and extremely versatile. In days gone by when bricks were shaped and fired by hand in small batches, different coloured clays, of different compositions,

from different areas were used brickwork was as much of a visual delight as it was practical. With the increasing demand for housing larger and larger automated factories are producing more and more standard bricks and the effect is, for the most part, purely practical construction.

Advantages of Brick wall

Brick typically will not require painting and so can provide a structure with reduced life-cycle costs.

The appearance, especially when well crafted, can impart an impression of solidity and permanence.

Masonry is very heat resistant and thus provides good fire protection.

Unreinforced Masonry structure built in compression with (Preferably in lime mortar) has the life of more than 500 years as compared to 30 to 100 for steel or RCC structure.

BLOCKS

Blocks are made from cast concrete, i. e. Portland cement and aggregate, usually sand and fine gravel for high-density blocks. Blocks may be produced with either solid or hollow centers to reduce weight or improve insulation. The use of block work allows structures to be built in the traditional masonry style with layers (or courses) of overlapping blocks. In Ireland and the UK, blocks are usually 440 mm Ã- 215 mm Ã- 100 mm excluding mortar joints (approximately 17. 3 in Ã- 8. 5 in Ã- 3. 9 in).

Advantages of Blocks

It’s a common building material for the load-bearing walls of buildings.

In case of Hollow block the holes inside concrete block allow reinforcement bars and concrete (creating reinforced concrete) to run vertically through the block to compensate for the lack of tensile strength.

POST AND LINTEL

Post and lintel (or Post and beam) is a simple architrave where a horizontal member (the lintel-or header) is supported by two vertical posts at either end. This form is commonly used to support the weight of the structure located above the openings in a bearing wall created by windows and doors.

BEAMS

A beam is a structural element that is capable of withstanding load primarily by resisting bending. The bending force induced into the material of the beam as a result of the external loads, own weight, span and external reactions to these loads is called a bending moment. Beams generally carry vertical gravitational forces but can also be used to carry horizontal loads (i. e., loads due to an earthquake or wind). The loads carried by a beam are transferred to columns, walls, or girders, which then transfer the force to adjacent structural compression members.

CONCRETE SLAB

A concrete slab is a common structural element of modern buildings. Horizontal slabs of steel reinforced concrete, typically between 10 and 50 centimeters thick, are most often used to construct floors and ceilings, while thinner slabs are also used for exterior paving.

Making of first floor concrete slab

Preparing the panels of the cast: The cast of the slab is mainly made out of flat wood panels. On the side exposed to the concrete, the panel is covered with an oil based liquid that prevents humidity from concrete to pass in the wood of the panel.

Covering the wood panels of the cast with oil based liquid.

Installing the cast of the slab: Wood panels are mounted on a wooden structure supported by metal poles. All metal poles are adjusted at the exact same height and many of them are needed to support the complete floor. Where one wood panel cannot fit, simple wooden planks are used to make the cast where one wood panel cannot fit; simple wooden planks are used to make the cast.

Wood panels mounted of the wooden structure making the cast of the slab

Casting the stairs: For casting the stairs, a first wooden ramp is made with the right slope. Reinforcement is installed directly on the ramp. Then, wooden planks are used to cast each step from the parking up to the ground floor.

Wooden ramp to cast the bottom of the stairs. Stairs with the iron rebar’s & wooden planks.

The cast of last steps of the stairs. Stairs cast viewed from the ground floor.

Casting and reinforcement: This demonstrates the reinforcement of dropped beams and inner beam, how they are connected to making the floor slab a complete monolithic unit.

Lower and upper part of the slab with the large beam at the junction of 2 parts.

Connection between the long central beam in the length of the slab and one central beam in the width of the slab. You can see the thickness of the 2 beams comparing to the thickness of the slab. Below the connection is a supportive column.

Installing iron reinforcement: The slab is 25cm thick and iron reinforcement is done in 2 layers. The first layer is made of standard iron mesh mounted on plastic distancers. The second layer is made of strong iron bars, positioned to form supportive iron beams in the slab. Those iron beams are placed based on the static calculations made by our static engineer and supervisor.

Second layer of iron reinforcement made of strong iron bars forming supportive beams.

First layer of iron reinforcement made of standard iron mesh mounted on plastic distancers.

The wooden squares, visible in the reinforcement, are cast for the verticals, where pipes and cables will pass.

Pouring concrete: Pouring concrete is done quickly with the use of Mobile mixers for cement and aggregates mixes. Concrete pump is used to spread the concrete to the proposed slab. Poker Vibrators are used to compact and settle the concrete in the slab and beams. Concrete Masons will level the poured concrete with range and other leveling equipments in other to achieve accurate proportion of concrete thickness.

Stairs are finished. We can now climb from the ground floor to the first floor.

Pouring concrete progression: pouring, spreading, equalizing.

STEEL TRUSS (I Section Beams)

I section beams is use in the John Laing building

The horizontal elements of the " I" are flanges, while the vertical element is the web. The web resists shear forces while the flanges resist most of the bending moment experienced by the beam. Beam theory shows that the I-shaped section is a very efficient form for carrying both bending and shear loads in the plane of the web. On the other hand, the cross-section has a reduced capacity in the transverse direction, and is also inefficient in carrying torsion, for which hollow structural sections are often preferred.

ROOF COVERING (Flat)

A flat roof is a type of covering of a building. In contrast to the sloped form of a roof, a flat roof is horizontal or nearly horizontal. Materials that cover flat roofs typically allow the water to run off freely from a very slight inclination.

Traditionally flat roofs would use a tar and gravel based surface which, as long as there was no pooling of water, was sufficient to prevent penetration. However, these surfaces would tend to fail in colder climates, where ice dams and the like could block the flow of water. Similarly, they tend to be sensitive to sagging of the roof reversing the subtle grading of the surface.

Modern flat roofs tend to use a continuous membrane covering which can better resist pools of standing water. These membranes are applied as a

continuous sheet where possible, though sealants and adhesives are available to allow for bonding multiple sheets and dealing with structures penetrating the roof surface. Far more expensive flat roof options include sealed metal roofs using copper or tin. These are soldered interlocking systems of metal panels.

Environmental impacts of buildings and construction:

The construction and operation of buildings contributes significantly, directly and indirectly, to most of our environmental challenges. Buildings are tremendous consumers of resources and generators of waste (44% of world’s pollution is from buildings). The industrial processes used to manufacture building materials and equipment contributes to waste and pollution as well. Buildings and the infrastructure that supports them consume, open space and displace habitat. Poor indoor environments can inhibit productivity, and in some cases, can even threaten the health of building occupants.

Sustainable design recognizes the interdependence of the built and natural environment, for example in the UK, consumption associated with the built environment and construction industry in the UK can be summarized as bellow:

- 6 tonnes of material per person per year

– 1. 5 tonnes for new infrastructure (roads/railways etc.)

– 1. 5 tonnes for new buildings

– 3. 0 tonnes for repair and maintenance

- 300 million tonnes quarried aggregates per annum, only 10-15% of this total is recycled

- 70 million tonnes of construction waste per annum (which is 17% of the total UK waste)

- 70% of energy use can be directly or indirectly attributed to the use of buildings and infrastructure

(Source DETR 1998)

It is estimated that 5. 1 million new homes are needed in England, this will jeopardise the land and the environment and if it was not carried out carefully this will have a great negative impact on the economy too. Its worth noting that the housing sector is 25% of UK Construction Activity which worth around £10bllion/annum.

The government stated that “ We need to build the right housing, in the right place and to the highest standards of quality and good design” I don’t see them paying any attention to the environment of the sustainability of their design (http://architecturaltechnologies. blogspot. com/2009/01/sustainable-design-and-construction. html accessed on 12th of Dec.)