

# [Skeleton construction system essay sample](https://assignbuster.com/skeleton-construction-system-essay-sample/)

Every construction material and system has its own characteristics which to a greater or lesser extend influence the layout, span length, construction depth, stability system, etc. This is also the case for precast concrete, not only in comparison to steel, wood and masonry structures, but also with respect to cast in-situ concrete. Theoretically, all joints between the precast units could be made in such a way that the completed precast structure has the same monolithic concept as a cast in-situ one. However, this is a wrong approach and one, which is very labour intensive and costly. If the full advantages of precast concrete are to be realised, the structure should be conceived according to its specific design philosophy: long spans, appropriate stability concept, simple details, etc. Designers should from the very outset of the project consider the possibilities, restrictions and advantages of precast concrete, its detailing, manufacture, transport, erection and serviceability stages before completing a design in precast concrete

skeletal systems

Portal frame and skeletal systems consist of linear elements (beams, columns) of different shapes and sizes, combined to form the skeleton of a building. They are very suitable for buildings, which need a high degree of flexibility. This is mainly because of the possibility to use large spans and to achieve open spaces without interfering walls. There are two basic types: The portal frame, consisting of columns and roof beams, and used for single-storey retail warehousing and industrial manufacturing facilities. The skeletal structure, consisting of columns, beams and slabs for low to medium-rise buildings with a small number of walls for high rise. Skeletal frames are used chiefly for commercial buildings, offices and car parks, but sometimes also for apartment buildings

Variations of skeletal frame systems:

1. Structural system 1:
The system consists of columns with corbels, inverted t-beams and slab components. Columns are restrained at their bases and are spliced at each floor. Beams are temporerely simply supported on the corbels, but rigid joints are formed afterwards. Floor slabs are simply supported.

Structural system 2:
The system consists of frames, beams ans slabs. Frames are one-storey high, simply supported on top of each othr, and are connected by a simply supported beam on each floor. Floor slabs are also simply supported.

Structural system 3:
The system consists of one and two storey high columns, beams and floor slabs. columns are restrained at their bases and erected with staggered joints. Beams are temporarily in simply supported state. They are designed to have permanent rigid joints after construction. Floor slabs are simply supported from beam to beam.

Structural system4:
Structural system 4 comprises unspliced four storey high continuous columns with corbels, plus beams and floor slabs. The columns are resrained at their bases. Beams behave as simply supported at temporary stage, but are designed to have rigid joints after construction. floor slabs span from beam to beam, and are simply supported.

Structural system 5:
The system consists of T-shaped and L-shaped columns with beams suspended at the point of zero bending moment. floor slabs span from beam to beam and are simply supported. Frames of L or T-shaped columns are placed simply supported on top of each other. At each storey, these frames are connected bye beams spanning from frame to frame. All rigid joints are prefabricated as an integrated part of the columns.

Structural system6:
The system consists of unspliced two storey high continuous columns and freely supported large floor units. columns are restrained at their bases. Floor units span in two directions and are supported only at the columns. hidden beams are incorporated. rigid joints between slabs and column drops are formed after erection.

Structural system7:
The system consists of L-shaped and T-shaped frame units placed on top of each other. Simply supported floor slabs span between the frames. The frame units are placed simply supported on the base and on top of each other hinged connections are made between the frame units as pin-joints at the mid-span of the beams.

Structural system 8:
The system shown is formed by H-shaped frames with cantilever beam. Slabs are simpley supported by spanning them from beam to beam. The connections between the H-shaped frames are formed as pin-joints at the mid-hieght of the columns and between the cantilevers beams. All rigid joints are made as an integrated part of the fram units. Slabs span from frame to fram.

Structural system 9:
The system consists of unspliced four-storey high continuous columns with cantilever attachements for supporting the beams. Floor slabs are simpley supported on the beams. The columns are restrained at their bases. Beams are simply supported on column-attachements. all rigid joints are made as integrated parts of the columns.

For Horizontal Loads:
Braced skeletal system
-stability is provided by shear walls, shear cores or other bracing systems. -the base may be pinned or moment resisting connections.
-beam-column connections may be rigid or pinned.

Behavior of structure

This Figure describes the structural model and behavior of a skeletal free system subjected to horizontal and vertical forces. It also covers a load path description. The vertical forces are transmitted from the double T floor slabs to the beam and to the frame, the double Ts are acting as simply supported slabs. The horizontal transverse force is transmitted from the façade components to the floor slab structure, and by diaphragm action to the frame structure. The floor slab structure can act as a continuous beam spanning from frame to frame. The horizontal longitudinal force from wind or notional force is transmitted from the gable or from gravity centers to the floor slab structure and further on to the bracing walls. These walls are considered as vertical beams restrained at the foundation or at the basement structure. They are able to sustain the longitudinal force as bending moment and shear at the wall foundation intersection. In Skeleton Structures, exterior and interior wall panels are not structural members, they are used for protection and privacy.

Benefits:
-fast and easy fabrication
-Enhanced building aesthetics
-durability
-fire safety
-Protection of health and hygiene
-prevention of flooding and erosion
-containment of hazardous substances
Contribution to traffic safety
-protection against traffic noise
-thermal comfort
-good life cycle economy
-fexibility in building spaces

Limitations:
Limitations in precast skeletal structure include:
\* Decreased flexibility in architectural design.
\* Might include complicated joints.
\* Needs a skilled workforce and quality production.

COMPONENTS OF THE SYSTEM

A. Load-bearing architectural spandrel
B. Exterior column
C. Double tee or hollow-core slab
D. Interior column
E. Inverted tee beam or Composite beam
F. Shear wall
G. Stairs

SLABS
\* Slab dimensions depends on the type of extrusion or slip forming machine used. These slabs are produced in many countries.
\* Solid slab
\* Short spans
\* Min slab depth
\* Typically depth 90-200 mm
\* Hollow core slab
\* Intermediate spans
\* Internal longitudinal voids replace
\* 200 mm depth can span 7. 6 m, 250 mm can span 9. 8 m \* Double tee
\* Longest spans
\* Common depth 300, 350, 400, 460, 510, 610 , 815 mm
\* Single tee
\* Longest spans
\* Common depth 915mm

\* Hollow core:

Hollow-core slabs, also known as planks, are used in a wide range of buildings as floor/wall components:
\* multifamily and single-family housing.
\* schools
\* hotels
\* health-care centers
\* offices
\* manufacturing facilities
Hollow-core slabs typically measure 8 to 12 in. thick, but they can be made as thin as 4 in. or as thick as 16 in. Long hollow cores, or voids, run the entire length of each piece, giving the material its name. In some applications, the cores can be used to run mechanical and electrical equipment.

Beams:
\* Horizontal members that support deck components such as double tees and hollow-core slabs, beams typically are considered structural components. Three types cover the majority of uses: rectangular beams, inverted T-beams, and L-beams they are used as heavily loaded main beams sometimes with an apery part with a reduced width to provide a ledge for the support of slabs. \* To further simplify construction , the rectangular beams have a shape large enough to support the floor slabs out sides the column faces. They are often used as girders

Rectangular shaped beams

\* I\_shaped often have end blocks in the bearing zone for butter transfer of forces from the support to the beam .
\*  I \_ shaped beams

\* T\_shaped imply economical production because demoulding of the beams by removing altering the side walls of the moulds is not necessary. Tee beams are often use as bridge beams .

T\_ shaped beams

\* Inverted tee beams: are used in bridges and viaducts . slabs are concreted in site on the beams to carry the traffic load for smaller spans the inverted tee beams are used as a structural mould .

Inverted tee beams

\* Beams are designed as prestressed or partially prestressed.

Rectangular beam L-shaped beam Inverted tee beam AASHTO beam

Columns:
Columns are often the breech\_ block of the fabricated concrete structure in order to enable the use of other standardized concrete elements in a structure one has to allow for deviations from standardization in the columns. Columns may have corbels at several faces.

They act as standard elements in the center part of structures. But in the end facades or in the connections with other structures their dimensions should be adapted to the special conditions of their position in the structure. The dimension of the cross section of columns can be standardized but their length and special adjustments cannot. With the exception of very slender columns which are prestressed in a view of transport and erection , columns are normally designed in ordinary reinforced concrete . only in single story buildings were the binding moments are large and the vertical forces relatively small , prestressing is considered useful

Columns : section and details

HOW DO ALL THESE ELEMENTS RELATE:

The beams in this system of framing rest on concrete corbels that are integrally cast with the column. Beams are placed on bearing pads on the corbels. There is a weld plate cast into the top of each beam at the end

Topped hollow-core roof slabs supported on beams are joined to a column with vertical rods.

Topped double-tee floor slab are supported by inverted-tee in this detail. Reinforcing bars that pass through hollow tubes cast into the column connect the beams and column. The site cast topping ties all the components together and gives a smooth, level surface.

A minimum-headroom, minimum-cost floor system for parking garages uses untopped double tees. The stems of the tees are dapped so that the beam need be no deeper than the tees

A typical detail for the slab-wall junctions in the structure

In addition to structural elements, skeletal structures include circulation and privacy/protection elements, respectively, stairs and wall panels.

STAIRS:

\* Precast concrete stairs can be used in any application where a stair tower or individual steps are required. \* They are fabricated either in an open-Z configuration, in which the upper and lower landings are cast in one piece along with the tread/riser section, \* or as shorter components consisting of only the tread/stair section supported by separate landing components.

Z-SHAPED SEPARATE SECTIONS

WALL PANELS:
\* Exterior wall panels protect the building from external environment, as well as provide privacy for its users. \* There are endless possibilities of material for wall panels, most abundant are glass and concrete. Keeping in mind that cladding options (ex: stone) for concrete panels are also available. \* Typical concrete panels consist of two layers of concrete separated by vacuum or a Styrofoam and air barrier. \* Window openings are freely designed in those non load-bearing wall panels.

Connecting wall panels to skeletal structure

Connecting wall panels to beams and columns

Connecting roof wall panel to roof slabs, showing layers of concrete and insulation.