Common Formwork System

Formwork contributes a major part of cost in most of the building construction activities. The selection and effective use of formwork also dominate the success of a project in terms of speed, quality and dimensional accuracy of the final product. An appropriate formwork system is always cost and labour effective, convenient to handle, fulfilling complicated physical or engineering requirements, and most important of all, it should be safe to use.

The construction industry is extremely active in Hong Kong in the past decades. A great number of building or infrastructure projects are being constructed every year. Some of these projects are constructed using rather traditional ways, while there are also examples of projects that employ advanced and sophisticated construction methods, sometimes even with techniques and systems that are pioneer of its kind in Hong Kong. Experience proves that formwork is one of the key factors that guarantee the success of these jobs.

This article tries to demonstrate some formwork systems that are commonly used in Hong Kong. Some features, advantages and constraints of using these systems will also be highlighted in the captions of the photos.
Timber formwork often regards as a traditional type of formwork system, which is labour intensive, time consuming, and with low output. However, it is still the most popularly accepted system for most of the typical projects with usual size and complexity in the design and structure. This photo shows this traditional timber formwork system is being used in the Royal Peninsula project.
An example of complicated timber formwork used in the Festival Walk project. Note that complicated phasing arrangements are usually required in the implementation of works of such scale, this makes the application become much more complex in reality.
The erection of regular beam and slab form in a typical reinforced concrete frame structure.
A cross-section view showing the complicated beam and slab formwork arrangement using timber and plywood.
It would be quite complicated for using timber to erect wall form. The one as shown here can show the complexity it involves. The formwork here is using timber panels, they are being cut in the size which can be handle by human worker, and stiffened by stud and waling strips, to act as the formwork for the load bearing wall of a high-rise structure.
Example of a gigantic-sized column formwork formed by the enclosing of large-sized plywood board and strengthened by steel yoke.
Constructing formwork for column in irregular shape is rather difficult, such as those in trapezium, circular or even elliptic section. The one shown here is an elliptic-sectioned column used in the Festival Walk project.
A rare combination to form a circular column using steel mould and stiffened PVC tube as formwork to the column.
For all structural elements within an usual building structure, formwork of staircase is regarded as the most difficult part to design and erect. The example as shown in this photo can best illustrate that statement.
The formwork at its half-finished stage for a typical scissors type staircase layout used in most Hong Kong residential buildings.
The other alternative that can be used more readily as a substitute to timber formwork for usual building type is steel mould. This kind of mould is usually constructed in mild steel sheet, strengthened by mild steel angles or channel, and fabricated into a large shutter panel to form part or all of a wall section. Due to the size and weight of the panel shutters, it can only be worked with the help of crane. The one shown here is the most popular system used in almost recent housing projects under the Housing Authority.
For most steel form systems, the shutter panels are often incorporated with an attached scaffold so that workers can make access into the work areas more conveniently and safely. Note in the photo the platform on top of the form with handrail, and the attached scaffold on the external wall below the shutter form.
A column form comprising of two pieces of "L-shaped" steel panels. In order to allow the panels are slid in place more conveniently without engaging the crane, a simple trolley is provided on the outer side of the panel.
A kind of quite seldom-seen metal form system - the aluminium form. Instead of using steel, this kind of formwork system makes use of aluminium sheet and angle/channel sections as its main components. Since aluminium (or its alloy) is about 2.5 times lighter than its counterpart steel, it has thus the advantages of lighter weight. In order to make it possible to be handle manually by labour under site condition, aluminium form usually constructed in smaller panels. At a result, a lot of panel boards are required to form a shutter making it quite difficult to compose section of larger or complicated size.
A portion on a typical floor of a residential project using aluminium panels as formwork for wall and slab.
Table form, sometimes also called the flying form, is another popular formwork system for casting floor slab, especially for certain office building where flat slab design is employed. The example seen here is the system used in the Oxford House project.
The composition of table form is often quite simple; it has a soffit made of coated plywood board for the casting of the floor slab. Below the soffit is the supporting frame usually in the form of trussed pedestals, which can be raised and lowered for placing and releasing of the form after the slab concrete has been cured. The photo shows the table form being released and pushed out on rollers for immediate lifting to the upper floor.
Lifting of the table form from the lower floor for immediate erection on the floor above.
Another example of table form made of mild steel sheet and sections. It is used for the casting of slab with beams to form a grid frame structure for a primary school project.
One rare example of steel formwork for the casting of beam. The project as shown here is the construction of the Headquarters building for the Hong Kong Jockey Club, in which the in-situ concrete beams are the primary beam members. The slab is cast on top of precast concrete sub-slabs that further supported by precast secondary beams spanning between the main beams.
For casting concrete structure of very large size, such as the inner core of the Extension to Hong Kong Convention and Exhibition Centre, which is 150m long and 60m high, the most appropriate option may be using large size panel shutters as the one shown in this photo. The panel shutter can be made up to 10m x 10m in size, composed of a coated plywood shutter panel which is stiffened on the back by mild steel channels.
The application of the panel shutter system for the casting of the gigantic core walls as in the complicated environment in the Hong Kong Convention and Exhibition Centre project.
The slip form, a kind of mechanical formwork system suitable for use in casting continual walls of simple shape and section, like the lift and lobby core in a residential project as shown in this photo. The yellow-coloured shutter panels mounted on top of the core wall are the formwork, which can be raised by rows of hydraulic jack. The entire system is further secured and stiffened by trusses and waling strips positioned on both sides.
The look of the slip form as seen on the platform level seeing the row of yoke frame with the hydraulic jack mounted above the form.
The jump form, another kind of mechanical formwork applying similar working principle as for the slip form, is recently introduced for the construction of the Concord Block. One special feature in this project is that the use of jump form, besides for the core wall as for most other similar construction, the form is also used in the construction of the "wings" that accommodate the residential units. (see also the comparison table appended)
Close up to see the layout of the jump form for the construction of the "Wings" in a Housing Authority’s Concord project.
One of the features in the design of the Housing Authority’s Concord Block is that it allows the use of more advanced formwork system in construction in order to have quicker and cheaper result. The one as shown here is a project in Tin Shui Wai using a kind of climb form to construct the core walls, while the construction of the "wings" is still using the usual steel form system.
A view of the inner panels from the climb form for the Tin Shui Wai Concord project. The blue frame above the shutter panels is the girder system that transmits the lifting action as well as to support the entire formwork system, which include the work platform and scaffold that attached to it.
Another example of using climb form as in the Lee Gardens redevelopment project.
Detail showing the roller and rail system that makes the shutter panels easily released in the climb form for the Lee Gardens redevelopment project.
The external view seeing the set-up of the jump form for the construction of the core wall in the Cheung Kong Centre project.
A model illustrates the use of the Jump-form system in an actual project – the Cheung Kong Center.
An enlarged view of the Jump-form model.
Structures with complicated shape and section are often nightmare for construction planners, such as buildings with irregular shape or layout, odd angle or curvature, multi-levelled and non-repeated elements. The curved and wing-shaped roof of the Ground Transportation Centre at the entrance of the new airport Passenger Terminal Building, is a typical example of this kind. The contractor used a specially designed formwork that hanged on a pair of supporting truss, to cast the roof in alternate sections.
The formwork arrangement for the casting of the roof of the Ground Transportation Centre as seen from the underside.
Waffle form is a special type of formwork particularly for the casting of floor slab with beam ribs running through it in close grid. Usually rows of basin-like glass reinforced fabric moulds are placed on timber or metal joist to form the shape of the floor and the rib beams. The one shown in the photo is the passenger unloading deck in the new airport under construction with the GRF mould and the reinforcing bar already in position.
Combination of a travelling-type prop frame system and a table form supporting the waffle, the connecting structure between the Ground Transportation Centre and the Passenger Terminal Building of the new airport at Chek Lap Kok is being constructed.
Another type of travelling form system with hanging panel shutters used to construct the elevated expressway above the Ma Wan Island.
The type of travelling form that cast the approach bridge of the Ting Kau Bridge on the Castle Peak Road side. The approach bridge is in the form of viaduct and is constructed using balanced cantilever method.
A similar example of travelling form that used in the new Tsing Yi South Bridge. This one is even more gigantic in size when compare to the one that construct the Ting Kau Bridge.
The tunnel form that used for the casting of the immersed tube for the Western Harbour Crossing. The feature of tunnel form is that it can form and cast the wall and floor of a structure at the same time. The soffit and side panels can easily be adjusted to position or released to remove the form by simple levers or hydraulic action.
The close-up look of the tunnel form for the casting of the immersed tube of Western Harbour Crossing.