



## **6D-BUILDTECH Building Systems**

### **Products and services**

#### **Introduction**

From single family residential housing to very large commercial properties, building construction technology and methods have changed very little over the past 100 years. Most significant building structures in the are constructed on-site and are based upon a custom design that is the result of the work of a project team of design professionals. About 95% of the current market is cast-in-situ construction. This antiquated model of 'one off' custom design and labor intensive on-site construction is under ever-increasing time, budget and liability pressures.

The cost, time, and difficulty of building a cast-in-situ concrete structure makes precast concrete an obvious choice. Well designed and executed precast concrete solutions can offer dramatic improvements in quality, speed, and economy. For aggressive building programs precast may be the only feasible solution. The biggest negatives to precast concrete are that big, heavy things are expensive to move and lift, and connection detailing and performance are critical to a precast structure's performance. It's easy for a precast structure to be offer faster and more economical construction than a cast-in-situ, but more of a challenge for it to offer the versatility and performance of cast-in-situ.

This is where many precast systems fall short. This document describes how 6D-BuildTech reinvents the precast concrete construction process; how the system's unique connections and immediate stability lend to improvements in speed, safety, and performance, and how unusual precision in design and manufacturing allows 6D-BuildTech to build what conventional precast cannot.

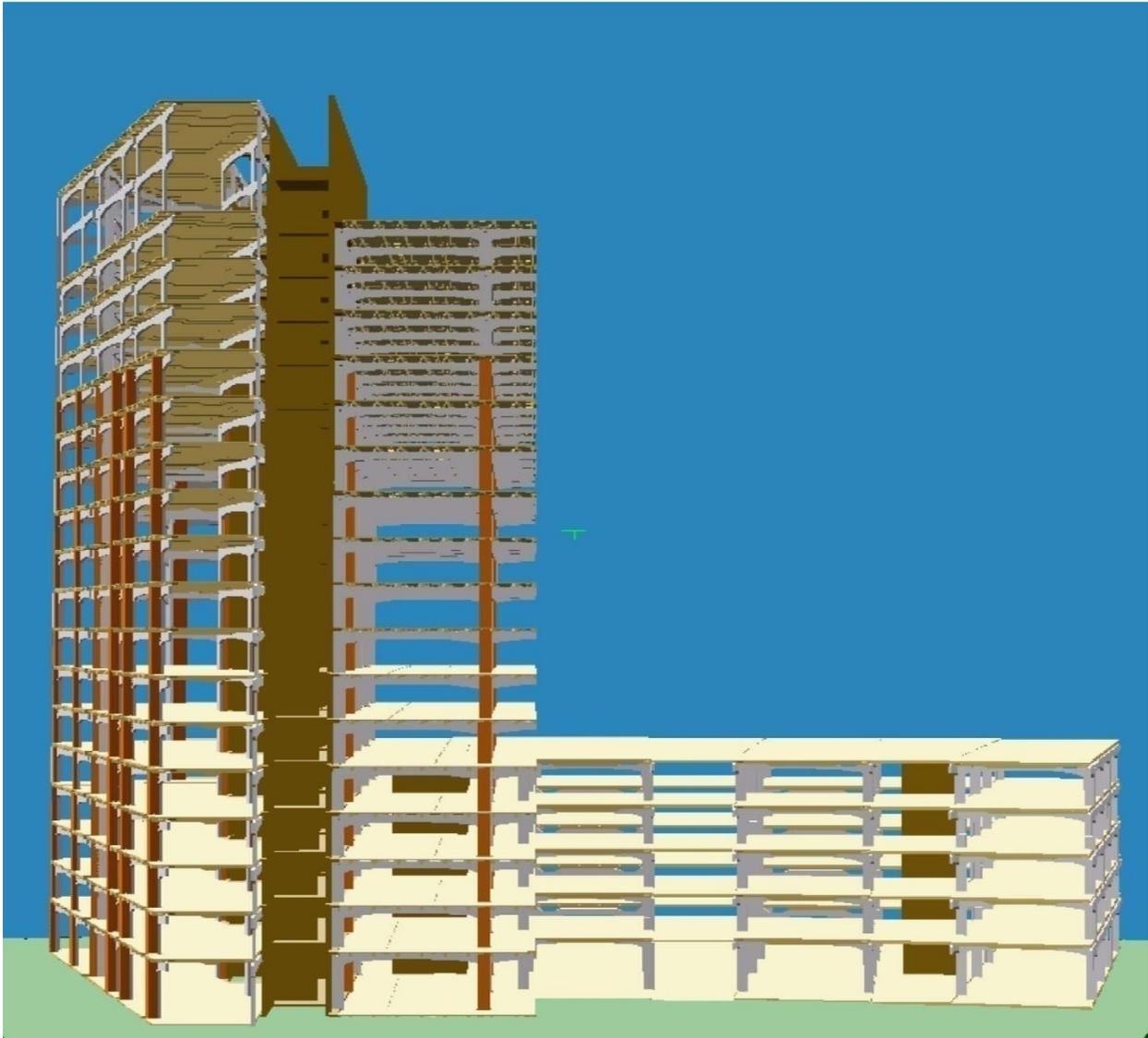
## Connections

In designing and building with precast concrete, the first focus should be on the connections. It does not require great skill to precast a concrete frame, wall or floor element; the challenge lies in effectively connecting the parts in a way that maximizes economy and performance. The way in which the parts are connected has a significant impact on the cost and speed of construction, as well as on the performance of the structure under superimposed gravity, wind, seismic and thermal loads.



- Bolted connections - instant stability
- 6D-BuildTech delivers the durability of concrete with the connectivity of steel - Eliminates need for shoring
- Eliminates imbed connection fatigue and failure associated with conventional precast construction

## The 6D-BUILDTECH Space Frame System



**Figure 1. 6D-BuildTech Space Frame Example**

The most basic 6D-BuildTech Space Frame System includes precast concrete frame and floor elements with two major innovations. First, the Space Frame system uses precast concrete elements with bolted connectivity similar to that employed in steel building construction. Hardened threaded rods are used to connect the elements without the use of imbed plates which have a high fatigue and failure rate. The bolts pass completely through the precast elements.

Secondly, the 6D-BuildTech Space Frame System design eliminates the pinned joint. See a typical pinned joint connection below. No matter how this connection is secured (bolted through the imbed plate, or cast in concrete) it is always the weakest point in the structure. This limitation is primarily related to the joints limited ability to resist lateral loads imposed by wind and/or seismic activity on the structure.



**Figure 2. Conventional Precast Pinned Joint Connection.**

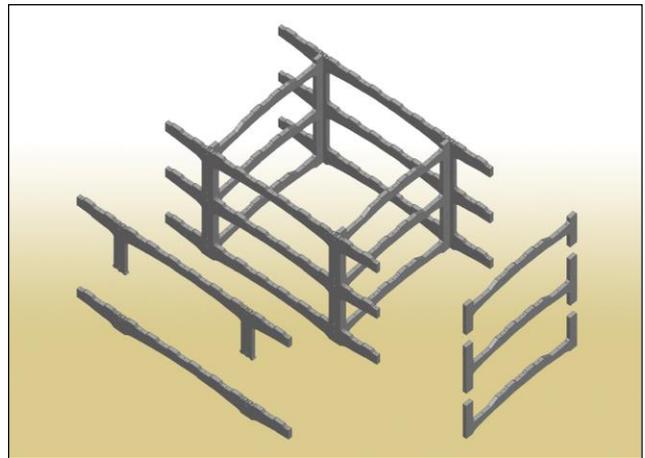
6D-BuildTech Space Frame replaces the pinned joint in conventional precast using a moment joint (Figure 3). The overlap of the spacer element form mid-floor height on the lower floor to mid-floor height on the floor above transforms the joint into a rigid joint giving the structure the stiffness to carry lateral loads imposed on the structure.

## 6D-BuildTech Moment Joint



**Figure 3: Moment frame provides stability construction and structural integrity in taller buildings.**

The patented **6D-BuildTech** Space Frame system uses engineered and manufactured structural components that interlock or easily connect to form high quality, durable, and beautiful finished buildings. With the 6D-BuildTech system, rapid assembly of these structural components replaces the labour intensive build on-site approaches to deliver a finished structure faster, safer and at lower cost. In addition, this system is designed with green principles in mind to minimize the impact on the environment.



**Figure 1: 6D-BuildTech Module**

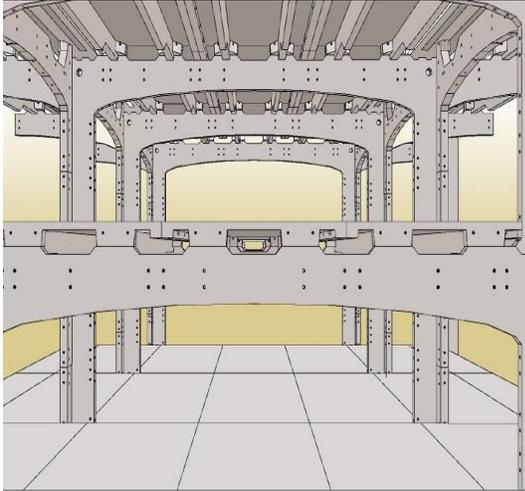
Structures built employing this system utilize highly configurable blocks that include the framework, roofs, floors, and exterior walls. Structures can be built in time frames not achievable using conventional construction methods.

The design and manufacturing of the blocks make them aesthetically appealing (symmetric angles, terraces, cantilevered porches, etc.), more durable than conventional buildings and less expensive to maintain and insure.

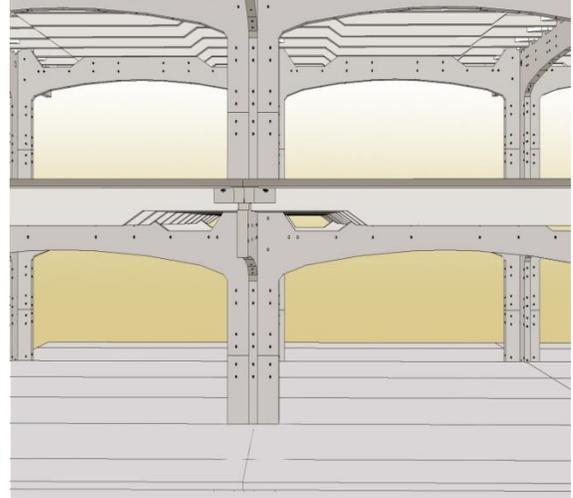
### **6D-BuildTech Reduces Total Life-cycle Costs Compared to Cast-in-situ systems**

While its structural characteristics are comparable to cast-in-situ systems, the 6D-BuildTech approach reduces overall life-cycle costs in a number of ways:

- 6D-BuildTech's space framing system offers options for readily accessible chase areas for Mechanical, Electrical and Plumbing (MEP). This can make both initial installation and maintenance of MEP easier and lower cost than other systems.
- Because all dimensions are modular, components of interior construction (e.g., partitions, plumbing runs, HVAC units and duct runs, etc.) can all be largely prefabricated for finish-out of space. This allows space to be readied for occupancy in a fraction of the time required for construction, which puts more money in the owner's pocket.
- This system can also integrate with a water collection system to provide landscape irrigation, further reducing the cost of ownership.
- 6D-BuildTech is structurally and architecturally engineered. When assembled, this delivers a stronger finished building with fewer maintenance issues.



**Accessible chase areas through frame block**



**Accessible chase areas through spacer block**

### **6D-BuildTech Space Frame Advantages**

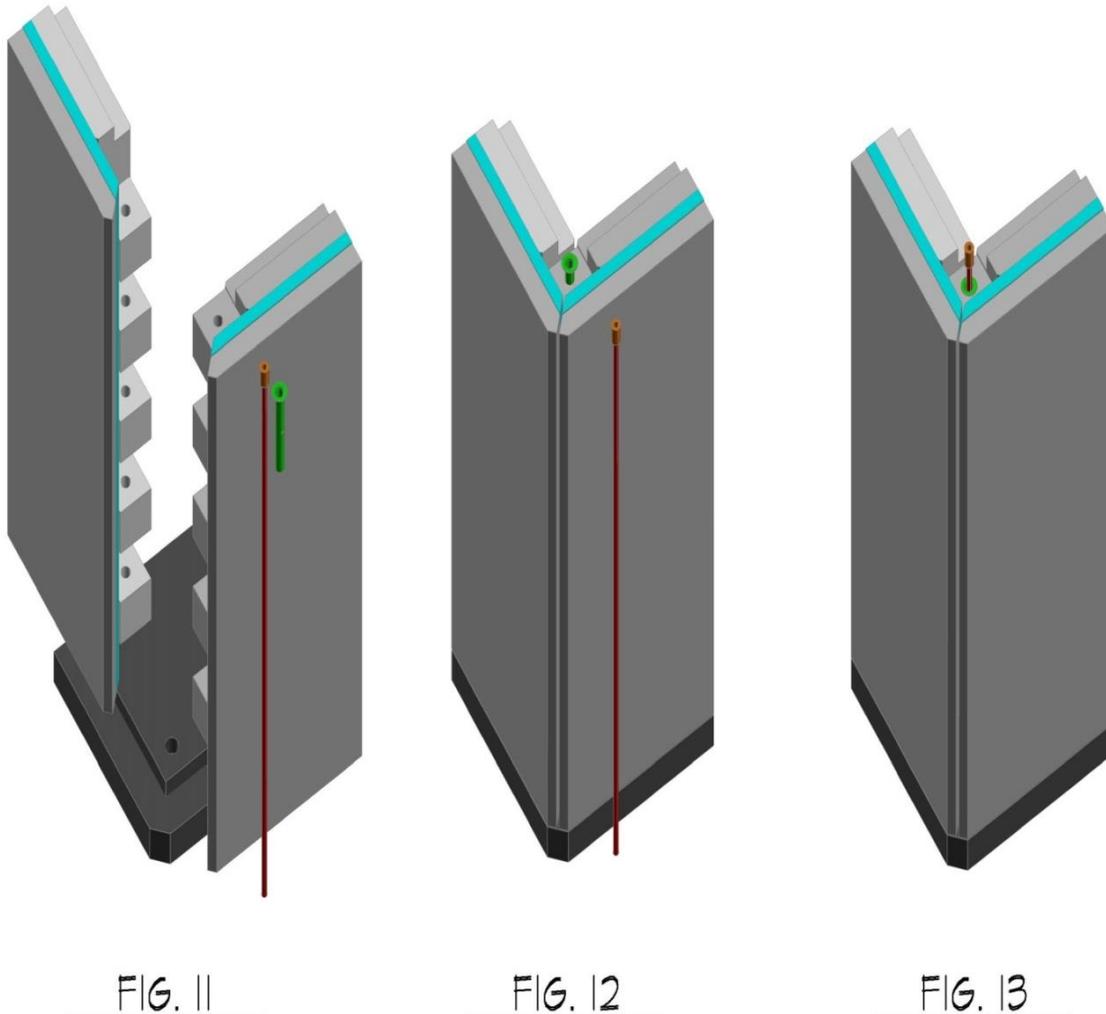
1. Precast parts with the threaded rod connectivity of steel.
2. Bolted semi-rigid moment joints vs. pinned joints used in conventional precast systems.
3. Modular dimension that allows parts to be interchangeable. Eliminates custom design and manufacture of each part.
4. 10+ percent less materials - concrete and steel
5. 50-70% less labour for Space Frame
6. Fast assembly - site work erection vs. construction
7. Captures quality and labour efficiency in factory setting
8. Excellent build-ability - speed, safety & cleanliness
9. Eliminates waste
10. Environmentally compliant - Sustainable
11. Flexible - villas to towers

## Dubai Silicon Oasis Residential Apartments



## The 6D-BUILDTECH Wall System

The 6D-BuildTech Wall System employs a basic finger joint pattern (Fig. 2) that enables the construction of joints to connect to intersecting wall blocks at the ends or along the length of a wall. A pair of walls is immediately stable once a joining pin has been installed.



### **6D-BuildTech Wall System finger joint connection.**

Door and window openings can be precast into each block, and reinforcing steel to resist the stresses that develop around each opening is engineered in response to the calculated loads in a proposed assembly. Electrical conduit and other service features such as plumbing and air conditioning routing can be cast into the basic wall and floor panel components.

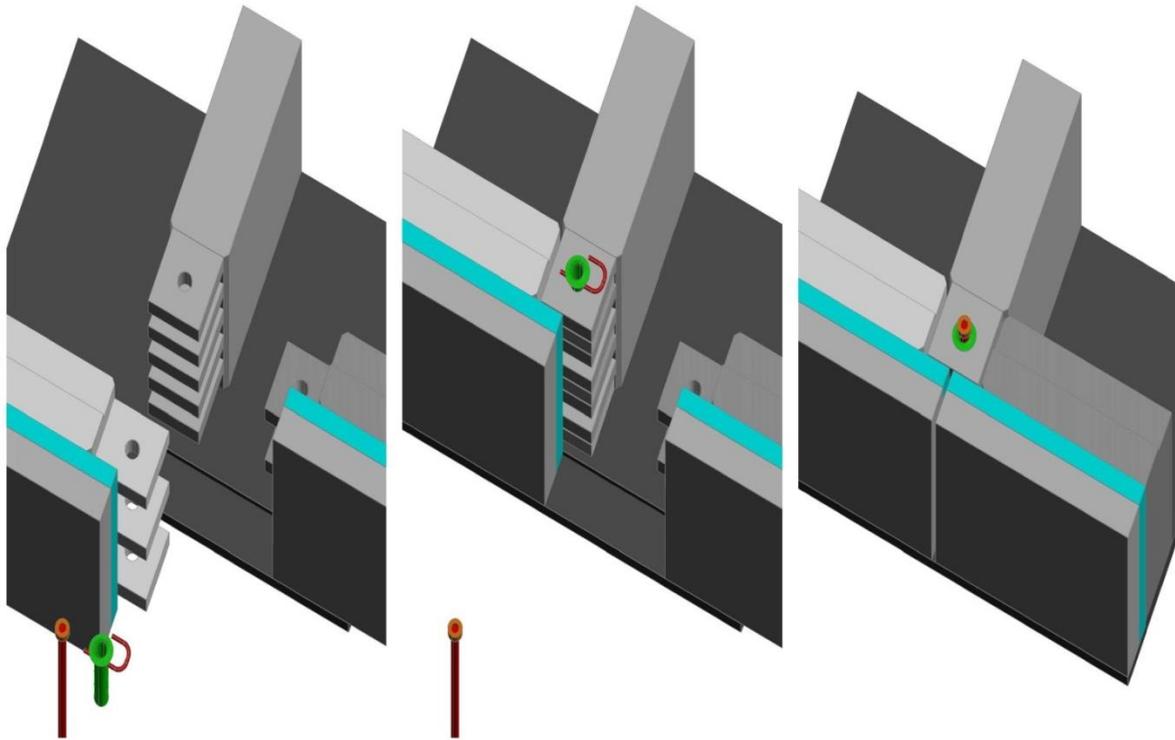


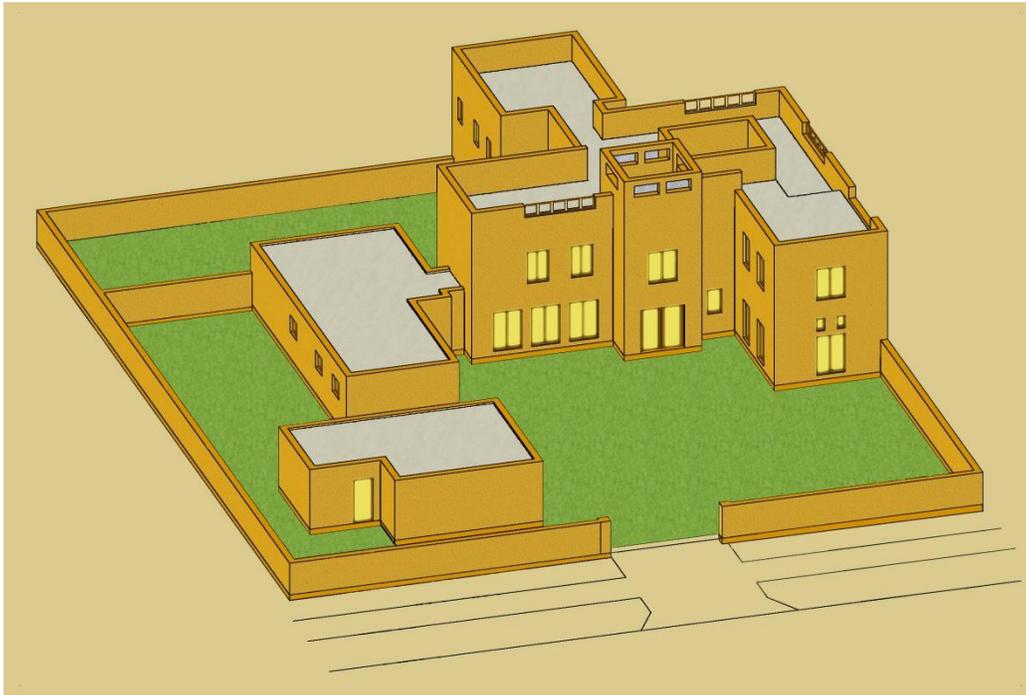
FIG. 23

FIG. 24

FIG. 25

**6D-BuildTech Wall System continuous insulation at wall panel joint.**

6D-BuildTech Wall System allows for continuous insulation coverage eliminating thermal bridges present in other insulated precast wall systems on the market.



6D-BuildTech Wall System Villa

**6D-BuildTech Wall System advantages include:**

- Finger joint stability during assembly
- Continuous insulation
- Less materials - concrete and steel (10-15% cost savings)
- 50-70% less labor
- Fast assembly – 80-90% faster than CIS construction
- Eliminate shoring and drastically reduce on site formwork
- Captures quality and labor efficiency in factory setting
- Excellent build-ability – speed, safety & cleanliness
- Eliminates waste
- Environmentally compliant – Sustainable
- Flexible – villas and townhouses up to 4 stories
- MEP conduits can be added at manufacturing stage
- Seismic zone performance
- Resist typhoon wind loads

## **6D-BUILDTECH® – A Unique Value Proposition**

This system delivers a unique value proposition to real estate owners and developers, as well as participating building design and construction partners.

### **Value Proposition for Owners/Developers**

A building constructed with 6D-BuildTech delivers more value to the owner/developer than any other construction method available today. The important value characteristics are:

- **Shortest time from concept to revenue** – The 6D-BuildTech system reduces project time from concept to occupancy by 30-60%. This is accomplished through streamlining design and replacing on-site construction with rapid assembly. On commercial properties, this means the revenue ramp starts much earlier and return on investment is realized sooner.
- **Lowest building life cycle cost** – With mechanical, electrical and plumbing (MEP) in pre-engineered crawl space or chase areas, MEP maintenance costs are minimized. When the unrivaled durability of reinforced concrete (e.g., resistance to fire, wind, hail, insects, water, decay, etc.) is combined with integral coloration and surface textures in the blocks, maintenance of a 6D-BuildTech building can be the lowest in the industry.
- **Green building** – from designed-in water collection, to elimination of building waste associated with traditional building systems, to elimination of toxic materials at the building site, to minimizing site disruption for foundations, 6D-BuildTech delivers the highest quality construction with the least environmental impact.
- **Expansion and reconfiguration of buildings** – With 6D-BuildTech, buildings can be designed and constructed to allow expansion or reconfiguration without demolition. Structures can be designed so they can be disassembled, blocks added, and the building reassembled to meet the changing needs of the owners.

### **Value Proposition for Construction Industry Partners**

6D-BuildTech offers design and construction professionals (e.g., contractors, architects, engineers, etc.) the opportunity to grow revenue and improve

profits while delivering more value to their Owner/Developer clients. The important value characteristics for construction industry partners are:

- **Reduced financing costs** – The 6D-BuildTech system reduces financial risk in new building construction by reducing the time from breaking ground to occupancy. This reduces financing costs and helps manage project risk.
- **Increased profit from construction projects** – the cost per M<sup>2</sup> of finished 6D-BuildTech construction can be significantly lower than conventional construction of similar quality. This is possible through lower labor costs associated with assembly of manufactured blocks versus on-site construction.
- **Flexible design and engineering** – 6D-BuildTech can be configured in an infinite number of layouts to match the site both structurally and architecturally. Architects and engineers can involve clients in rapid prototyping of concepts to get the best ultimate result.
- **Capture more revenue with total solution approach** – this unique building system allows a construction partner to capture a much larger portion of the total building revenue. By using the 6D-BuildTech system for framing, roofs, floors, etc., construction partners can eliminate much of the need for specialty contractors.
- **Building on irregular terrain** – 6D-BuildTech does not require a traditional slab on grade foundation. Using a unique pier and beam system, structures can be built on steep or uneven terrain. This offers the lowest possible cost for construction around lakes, canyons, mountains, coastlines and other challenging building sites. Engineers and architects can offer a great value proposition to clients who want to develop the most challenging sites.

## Services

The industry does not typically buy precast concrete superstructures as a stand-alone item, normally buildings are purchased on a “turn-key” basis where the building is delivered on a completed basis. The precast concrete portion of building solutions are generally sold on a delivered and installed basis, so delivery and installation is usually sold with the product. So 6D-BuildTech provides delivery and installation services along with its products.

Some full-service contractor’s like to do their own installation, so 6D-BuildTech buildings systems can also be sold on an ex-factory basis and installed by the main contractors.

**Technical** due diligence included review of design and engineering of an example G+17 office building, with 4 levels of underground parking, that was constructed using cast-in-situ concrete for comparison basis. Review of

the design and engineering of the selected building was conducted by Waterman International Ltd. (UK) and Cansult Maunsell Ltd. (Hong Kong).

**Financial** review of the 6D-BuildTech economic and proforma forecasting model was conducted by Ernst and Young (UAE). That same model was used in generating the proforma forecasts in this business plan.

## **Intellectual Property**

6D-BuildTech is a proprietary building system currently covered by multiple pending patents. It is anticipated that these pending patent applications will be divided into several patents with claims related to various aspects of the technology. Additional patent filings are expected as the planned development of complementary technology continues.

The claims made in current pending applications are being subdivided and amended in an ongoing process.

Specifically, the following patent applications are currently pending:

1. 6D-BuildTech – US Patent Application number: 20040134152 (Method and Apparatus for Precast and Framed Block Element Construction); PCT Patent Application number: PCT/US 03/31929 claiming a priority date of October 8, 2002. The PCT application number is WO 2004/033810 A3. The European Patent Office application number is 03776251.5.
2. Method and System for Prefabricated Construction – US Patent Application number: 60/467,410; PCT Patent Application number: PCT/US 04/13775 claiming a priority date of May 2, 2003.
3. Application USPTO 60/659,963 – Method and apparatus for precast and framed block element construction
4. Method and Apparatus for Precast Wall and Floor Block System – GCC Patent Application number: 2008/10845 claiming a priority date of May 17, 2008.

## **Support Services – Business Operations**

- Commercial - Processes for Defining Project Specific Components, Procurement and Vendor Selection, Awarding Contracts and Managing Contracted Work
- Purchasing / Accounts Payable
- Sales / Accounts Receivable
- Accounting

- Human Resources
- IT
- Engineering
- Manufacturing – Inventory Control
- QA/QC
- Safety
- Transport and Logistics
- Erection