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ASSESSMENT ITEM COVER SHEET

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ARBE3100 Construction Technology 3

Assignment 2 - Public Commercial Building

Due - 05/06/2009

Jonathan Langille - 3023329

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1.1 Project Outline

The development is a two story commercial development with a basement for car parking, plant and storage areas for Cook Retailers. The basement construction has been detailed in a previous report entitled Assignment 1 - Basement Construction. This report will deal with the superstructure and cladding of the above ground elements of the design.

There are several key considerations to be made in the selection of materials based on the client's requests and limitations put forward by the site. These considerations are:

- The building should project the image of a successful professional company.
- Materials should be long lasting and low maintenance.
- Retail outlets for the development will include at least one major retailer with a number of smaller retailers occupying the remaining floor space.
- The site purchased for the development is a green field site with no adjacent buildings.
- All access to the site if from Capitol Crescent, as all public utilities and services are located within Capitol Crescent.

(Source: *Memo from Cook Retailers*, Course Outline)

1.2 Introduction

In the context of a commercial development further consideration should be made with the selection of materials for suitability of use. In addition to the client's requests:

- The materials should be cost effective.
- The design should be adaptable for future growth on the site.
- The materials should maximize rentable floor space for investment return.

In light of these criteria for selection I will discuss the merits of between three different types of superstructure construction and a relevant cladding solution. Methods discussed in this report will be Steel Frame Construction with Precast Concrete In-Fill, Steel Frame Construction with Sandwich Panel Cladding, Precast Concrete with Tilt-Up Construction and Precast Concrete Frame Construction with Pre-Cast Concrete Wall Panels.

1.3 Steel Frame Construction with Precast Concrete In-Fill

Using a steel frame as the primary load bearing element of the structure provides the development with a lot of design flexibility in terms of the wall paneling. This would provide the client with a wide variety of options to really achieve the successful professional look that they desire.

The primary advantage of this system is the economy of the construction schedule. This system uses primarily pre-built elements which can be assembled on site. This allows the production of the materials for the super structure alongside the construction of the foundation elements. The elements can then be delivered and erected in accordance to a predetermined construction schedule minimizing construction time and interim financial costs.

When compared to other construction methods the spanning distance of steel frames can be used to create more efficient use of space in the design. This would create a less congested work site during construction and allow more rentable floor area to be used for investment return.

1.4 Steel Frame Construction with Sandwich Panel Cladding

As with the previous construction method the use of a steel frame as the primary load bearing element allows the design team with a variety of options for the layout and look of the external envelope of the building. The use of steel framing is also a very long lasting material in terms of resistance to rot, mould, termite and insect infestation.

The primary advantage of this method is the use of the sandwich panel cladding which allows for design flexibility during the initial construction of the site as well as for future growth. The engineered wall panels can also be adapted for specific performance criteria as per the client's requirements.

This would allow the building to be purpose built to satisfy any number of performance criteria (e.g. Fire Safety, Indoor Air Quality and Thermal Performance). The production of these panels and the steel frame, as with the previous method of construction can be easily worked into a tight construction schedule.

1.5 Precast Concrete Panels with Tilt-Up Construction

There a many construction companies that specializes in this form of construction and the turn-around from laying the foundation to finalizing the construction is very competitive to the same size development using steel frame. The design flexibility in terms of openings and wall finishes is also on par with that out steel framed buildings.

There are also many cost advantages to be had with tilt-up construction. The price of the materials is less than most methods as tilt-up eliminates the need for vertical forming and scaffolding and the price of the concrete is easier to control as there are less variables in the concrete mix.

Using appropriate concrete design the running costs of the building can be reduced due to the thermal performance of tilt-up buildings against comparable construction methods. Maintenance costs are also lower as concrete is a durable material which requires little to no maintenance over its lifespan.

1.6 Precast Concrete Frame Construction with Precast Concrete Wall Panels

As with the previous construction method the primary advantage of concrete construction is the cost involved. The use of a concrete frame as the primary load bearing element generally gives the design advantages in floor-to-floor heights and services adaptability and integration.

The concrete frame can be combined with the use of pre-cast concrete wall panels to produce a building that performs well acoustically, thermally and in terms of net lettable area. These inherent values are enhanced by lower running costs of concrete buildings due to their performance criteria.

Another inherent advantage for concrete construction is the production of a semi-internal area and safe working platform during the construction process. This allows for services and other trades to begin work earlier in the construction program minimizing lead-in costs on the installation of services.

2.1 Cost Comparison

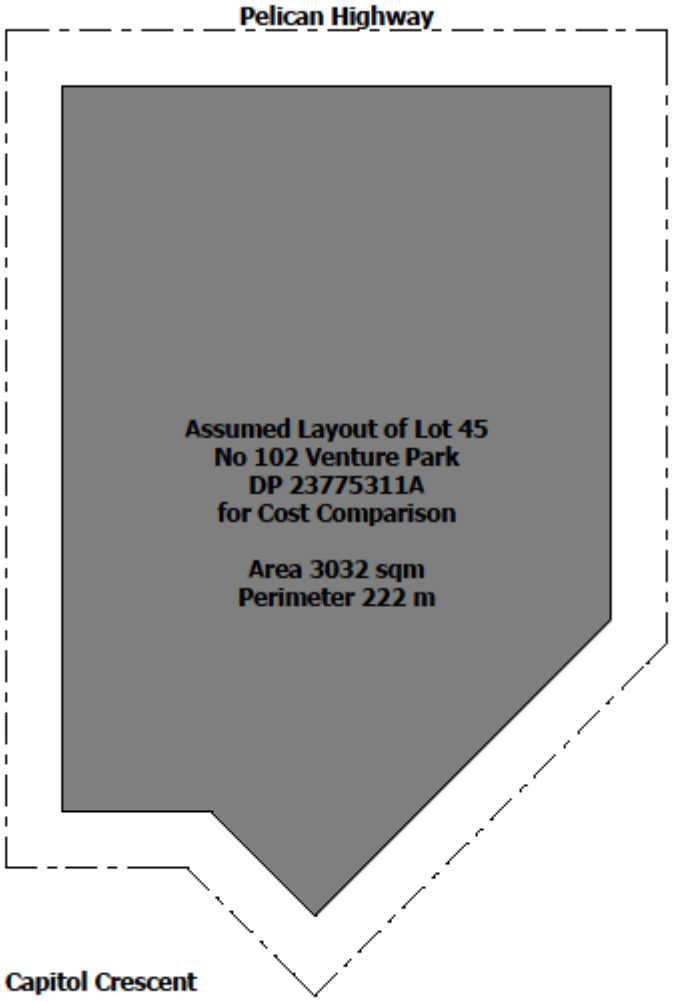

Figure 1: Assumed Layout for Cost Comparison

For cost comparison I have made a few assumptions as to the layout of the final development to accurately portray the differences in price between the different construction methods. Each cost is associated with a 2 story building with a story height of 3 meters. The assumed layout is represented by Figure 1. The estimated cost only deals with the cost of the superstructure and additional cladding without taking into account fit out or services.

Method	Material Cost	Total
Steel Frame Construction with Precast Concrete In-Fill	≈$100000 for Frame ≈$232320 for Cladding	≈$332320
Steel Frame Construction with Sandwich Panel Cladding	≈$100000 for Frame ≈$160160 for Cladding	≈$260160
Precast Concrete with Tilt-Up Construction	≈$239360 for Panels	≈$239360
Precast Concrete Frame Construction with Precast Concrete Wall Panels	≈$150000 for Frame ≈$232320 for Cladding	≈$382320

Figure 2: Estimated Cost Comparison (Source: *Rawlinson's Construction Guide*, 2008)

These values are not to be used at the final estimate when and should be revised to include labour and fit out as the project progresses.

2.2 Recommendation

It is my opinion that this project should employ Steel Frame Construction with Sandwich Panel Cladding for the following reasons:

- Compared to the other methods analysed it provides a cost effective solution while still maintaining suitability for purpose.
- In regards to the climate and environment of Australia the use of Steel Framing and Composite panels allows for controlled Indoor Environment Quality without risk of termite damage.
- Using the correct joining and fixing of the panels to the frame will provide a low maintenance option for the development while allowing for future growth should the project demand it.

3.1 Construction Sequence

The following is a construction sequence detailing the method of construction from foundation to fit out. As most components are prefabricated the stages of construction are:

- Foundation and Basement Construction
- Floor Slab Construction for Ground Level
- Steel Frame Delivery and Assembly
- Floor Slab Construction for Upper Level
- Wall Cladding Delivery and Assembly
- Roof Cladding Delivery and Assembly
- Services Installation
- Fit Out of Rentable Areas

3.2 Foundation and Basement Construction

Refer to Assignment 1: Basement Construction for Details

3.3 Floor Slab Construction for Ground Level

The finished floor level must be established over the basement area to provide a safe working platform for the erection of the steel frame and subsequent construction.

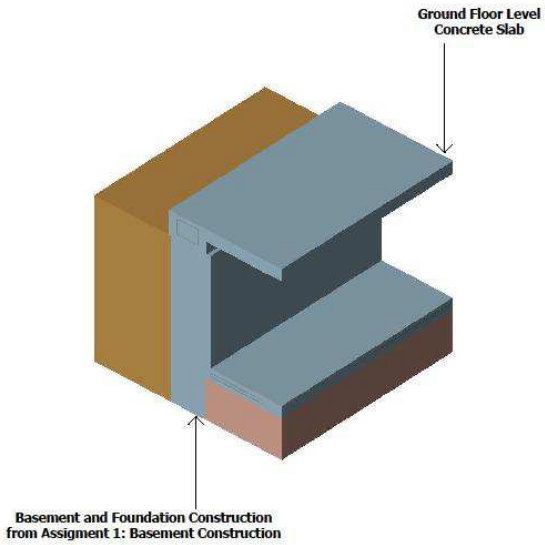

Figure 2: Floor Slab

3.4 Steel Frame Delivery and Assembly

The steel frame can be delivered to site and with minimal work required can be finished and erected to form the skeleton of the building.

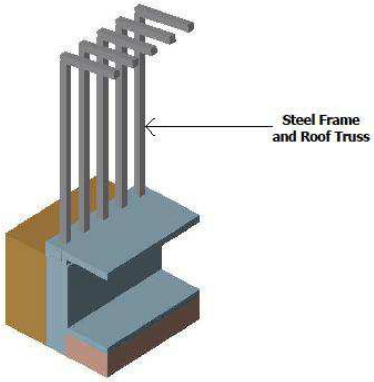

Figure 3: Steel Frame

3.5 Floor Slab Construction for Upper Level

The floor slabs can then be constructed using traditional table forms with can then be removed once the concrete has reach sufficient strength.

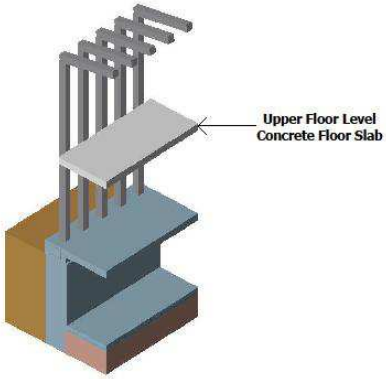

Figure 4: Upper Floor Slab

3.6 Wall Cladding Delivery and Assembly

The prefabricated wall panels are then delivered and craned into position and affixed to the steel frame according to supplier's specifications. Any required weather proofing can be done during or after the panels have been fixed into place.

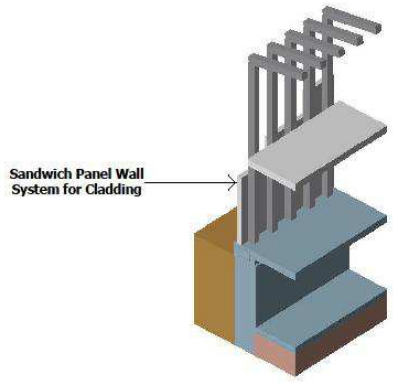

Figure 5: Wall Cladding

3.7 Roof Cladding Delivery and Assembly

The prefabricated roof panels are then delivered and craned into position and affixed to the steel frame according to the supplier's specifications. Any required weather proofing can be done during or after the panels have been fixed into place.

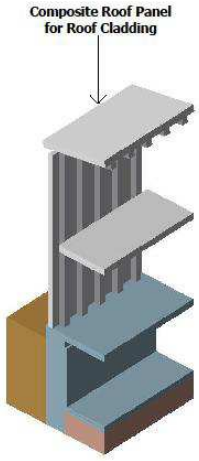

Figure 6: Roof Cladding

3.8 Services Installation and Internal Finishing

The building is now fitted with all services such as Air Conditioning, Electrical Wiring and any other required services for the operation of the building. Internal finishes are also completed during this stage of the construction sequence.

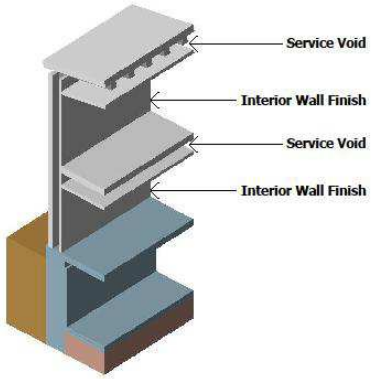

Figure 7: Service Installation

3.9 Fit Out of Rentable Areas

The individual fit out of the rentable areas can now commence as the building is nearing completion.

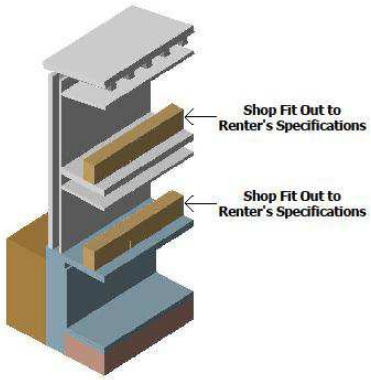

Figure 8: Shop Fit Out

3.10 Cladding Detail

The fixing of the sandwich panel cladding to the primary structure should be done as per supplier's specifications. Figure BLAH is an example of the joinery required for fixing and weather proofing the external skin of the building.

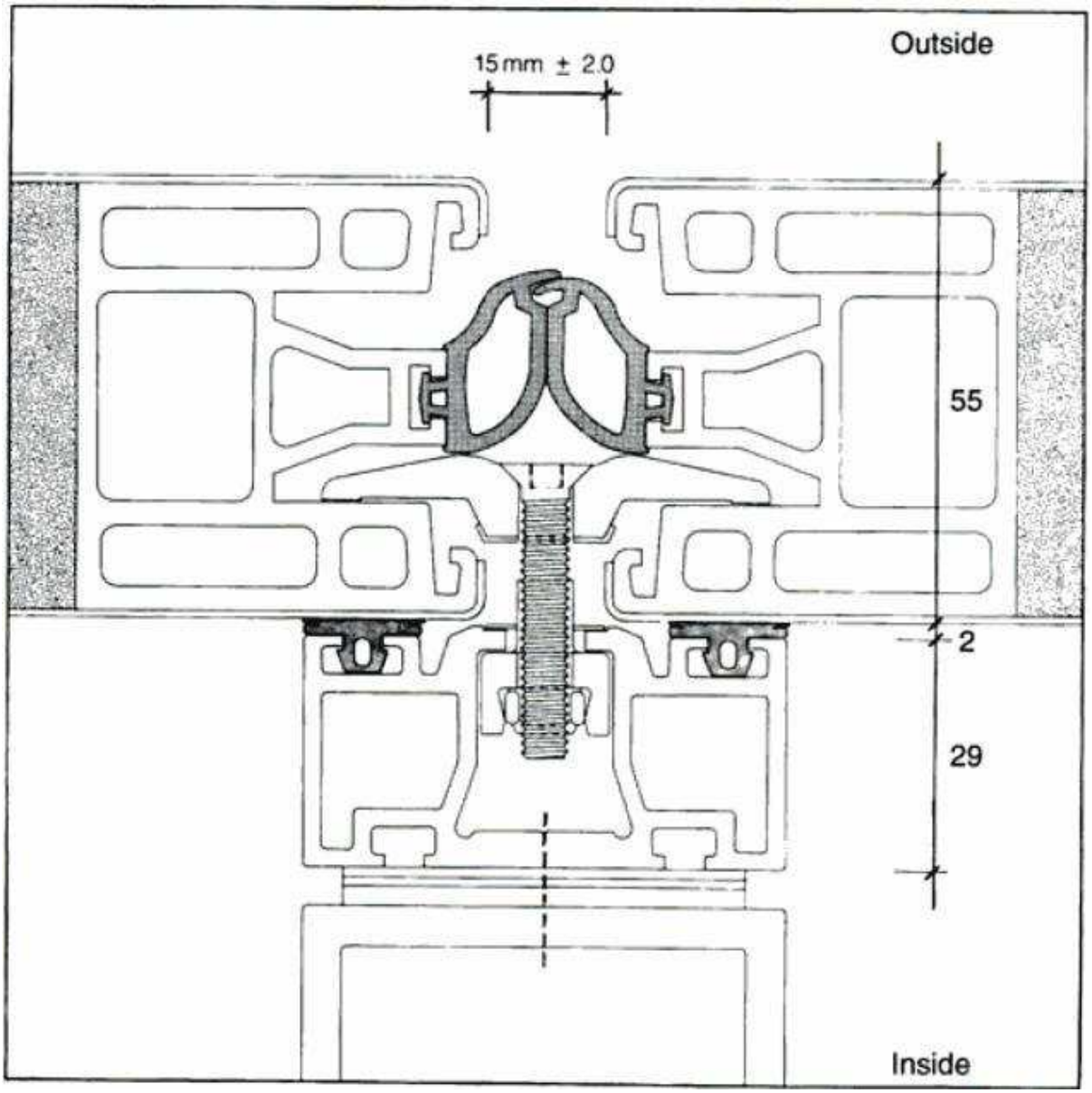

Figure 9: Typical Joint Detail (Source: Figure 8.2 Page 191, J.M. Davies, *Lightweight Sandwich Construction*, 2001)

4.1 Reflective Statement

This report contains discussion on four different options for the primary structure and cladding for the development at Venture Park. These construction methods were Steel Frame Construction with Precast Concrete In-Fill, Steel Frame Construction with Sandwich Panel Cladding, Precast Concrete with Tilt-Up Construction and Precast Concrete Frame Construction with Precast Concrete Wall Panels. The advantages of each type of construction are detailed in sections 1.3 to 1.6 on pages 2 and 3 for this report.

There is a tabular cost comparison the typical cost of each type of construction in section 2.1 on page 4 to be used as a guide for selection. My personal recommendation for the development, for the use of Steel Frame Construction with Sandwich Panel Cladding, is in section 2.2 on page 4 of this report.

The step by step explanation of the construction sequence is detailed in section 3.1 to3.9 of the report on pages 6 through 9. A typical detail on the joins between the external wall cladding is in section 3.10 on page 10.

Resources used as guides for this report are in section 4.2 on page 11 and 12. These resources were used as a basis for the analysis of each construction alternative.

4.2 Resources

Peter Ward, Assignment Brief, *ARBE3100 Construction Technology 3 Course Outline 2009*, University of Newcastle 2009

Rawlinson's Construction Cost Consultants and Quantity Surveyors, *Rawlinson's Construction Cost Guide 2008*, Rawlhouse 2008

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The Concrete Centre, *Concrete Frame Construction*, http://www.sustainableconcrete.org.uk/main.asp?page=123, The Concrete Centre, 2007

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National Ready Mix Concrete Association, *Commercial Construction Concrete Buildings: Design for Tilt-Up and ICF (Insulated Concrete Forms)*, http://www.concretebuildings.org/, Nation Ready Mix Concrete Association, 2009