



**BUILDING DEPARTMENT  
UNIVERSITI TEKNOLOGI MARA  
(PERAK)**

**ALUMINIUM FORMWORK (TAC SYSTEM)**

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(PERAK)**

APRIL 2014

This is to certified that this Industrial Practical Report is prepared

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**Entitled**

**Aluminium Formwork (Tac System)**

To accepted in partial fulfillment of the requirement for a Diploma in Building.

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**APRIL 2014**

**STUDENT'S DECLARATION**

I declare that this Industrial Practical Training Report has been done by me except its notice by my practical training in 5 month started 4 November 2013 until 23 March 2014 in MNM Sdn Bhd. This report is to be done as its one of the requirement of DBN307 and also requirement of Diploma in Building.

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Date : 25 March 2014

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## **LIST OF ABBREVIATIONS**

UiTM Universiti Teknologi MARA

BRC Bar Reinforcement Concrete

KKM Kementerian Kewangan Malaysia

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## **ABSTRACT**

Aluminum formwork technology is comprised of a total aluminum system that is designed and manufactured to the specific requirements of each project design. It can form all elements of a concrete structure, including architectural features, and is probably the most versatile modern construction system in use which is equally suited to high and low raise construction especially in the residential sector. Aluminum formwork is a versatile solution for forming concrete structures in a cost effective and efficient manner. Aluminum formwork is the best choice for both high and low-rise construction projects. It was found that the use of aluminum formwork system, superstructure construction is fast and efficient.

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## **LIST OF ABBREVIATIONS**

UiTM Universiti Teknologi MARA

BRC Bar Reinforcement Concrete

KKM Kementerian Kewangan Malaysia

## CHAPTER 1

### PREFACE

#### 1.1 Introduction

An aluminum formwork system was developed by W.J Malone. A Canadian engineer in the late 1970's as a system for construction low-cost housing units in the developing countries. The unit was to be of cast in place concrete with the bearing walls and formed with aluminums panels. To be erected by the hundreds using a repetitive design the system ensured a fast and economical method construction.

Using that fundamental concept 1200 unit was built in Egypt followed by 1500 unit in Iraq. The latter project was incredibly successful-setting records for speed and quality of construction at minimal costs. The aluminum formwork system has been used successfully in different countries like Egypt, Hong Kong, India, Iraq, Philippines, Seychelles, Singapore, South Korea, Taiwan, Thailand and Malaysia.

With the revival in the local construction industry, in particular that of low and low-medium cost houses, as well as massive demand for speedy social housing development in the countries in the Asian region and other parts of the world, TAC System Formwork Sdn Bhd foresees a tremendous growth potential in its business over the medium term. TAC System Formwork Sdn Bhd's strategy of market penetration to overseas will also mitigate any possible major downturn in the local construction industry. Below are some of the advantages of using aluminum formwork system as compared to conventional system seeing table 1.1a. Figure 1.1 shows that cost saving between aluminum system and conventional system.

## CASH FLOW COMPARISON

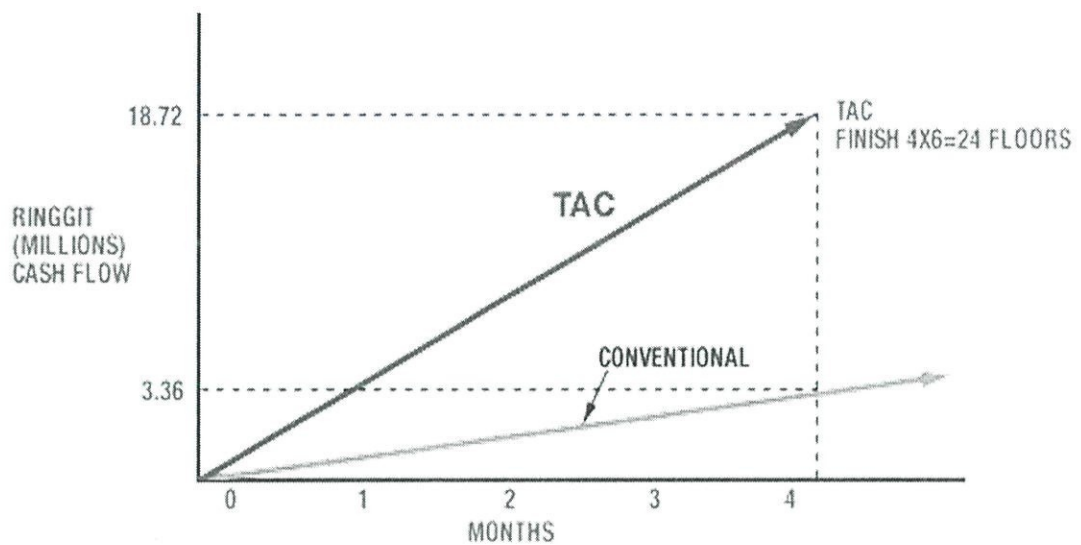


Figure 1.2: Graph of Cash Flow comparison between TAC system and Conventional system

Source: <http://www.tacsystemformwork.com/vs.html>

### 1.2 Objective

The objectives of the study are:

- i. To identify the advantages of using TAC system.
- ii. To document method of statement for construction of TAC system.
- iii. To document the difficulties in using TAC system.

### **1.3 Scope of study**

The scopes of study for the application of TAC system to Condominium Suasana Lumayan comprise the entire process of applying aluminium formwork according to its types, characteristic and function. It also involves the introduction for types of aluminium formwork and the advantages and disadvantages of the system.

The scope of study area will be limited to:

- i. Type of component TAC system that has been used in Suasana Lumayan Condominium.
- ii. Function of the aluminium formwork that been applied in Suasana Lumayan Condominium.
- iii. Step of installation aluminium formwork that been used at Suasana Lumayan Condominium.
- iv. Difficulties in installation that occur using this system.



## 1.4 Methods of Study

There are several ways that been used in gaining information to prepare this report. Some of the ways that been used are:-

1. Interview

An interview with aluminums supervisor Mr. Andrew on the advantages of using TAC formwork.

2. Internet

Internet is another way to get some information about TAC formwork and searching about the company of this formwork which is TAC System Formwork Sdn.Bhd.

3. References

References such as manual books, drawings and also journal were used as guidance on preparing this report. The information also been referred to the staff members or related person at the site especially the subcontractor for aluminum formwork.

## CHAPTER 2

### COMPANY BACKGROUND

#### 2.1 Introduction



Figure 2.1 MNM Construction Sdn Bhd logos

Pembinaan Mohamed Nazir Meraslam Sdn Bhd (MNM) was established and incorporated in November 1990. It started with telecommunication infrastructure and cable maintenance, repair and installation works.

Due to increased demand of their quality services, MNM registered itself with "Pusat Khidmat Kontraktor" under class (C) contractors. In the beginning, MNM was listed with Telekom Malaysia Berhad, Binariang Sdn Bhd and others. The scope of business was as telecommunication, TNB electrical infrastructure and Street Lighting Works.

Since the year 2000, MNM have expended their scope of business to involve with building works, civil engineering, electrical engineering, telecommunication, trading and general services. MNM registered under class (A) contractors with "Pusat Khidmat Kontraktor" under head and sub-head of civil engineering, building specialist and telecommunication works. MNM is also registered with KKM for trading and general



services thus offering customers full up-to-date quality services. MNM aim to exceed the strictest safety and quality code requirements while undertaking our projects with absolutely no short-cuts whatsoever.

The company comprises of experienced and qualified professional partners and associates, and is supported by diligent staffs, which have many years of proven track records in their respective job functions.

MNM has over the past years built up the track record of performance in the field electrical supervision and management and maintenance services and has a formidable list of clients, which is constantly growing. They have built a team comprising mainly of competent personnel to handle our growing business volume.

The many service and job undertaken by the company since its inception varies in size and kind. Most works/jobs were implemented and carried out successfully through the concerted efforts of all partners concerned. The electrical contracting and servicing ranges from high voltage (H.V.) and low voltage (L.V.) substations, housing estates, offices, shops, factories, hotels to multi-storey high-rise buildings. While the electrical supervision and management a service varies from industrial buildings, factories, condominiums, hotels, recreational outlets to high-rise buildings. MNM Khidmat Elektrik Sdn Bhd is licensed by the Suruhanjaya Tenaga Malaysia to carry out the following:-

- Supervision and competent control of electrical installations
- Testing, commissioning and maintenance of electrical installations up to 33 kV.

MNM offers comprehensive contracting and management services in electrical and electro-mechanical engineering to both the public and private sectors. Services offered are briefly as follows:-

**i. Electrical Supervision and Competent Control:**

- Factory and industrial buildings
- High rise buildings
- Condominiums
- Hotels
- Theme parks and recreational outlets
- Hospitals

**ii. Electrical Contracting and Management Services:**

- M&E engineering consultancy services
- Protection coordination studies of electrical systems
- On-line condition monitoring of electrical systems
- Power quality audits and energy management
- Electrical safety audit
- UPS and standby generators
- Lighting protection systems
- Lighting, power and electrical distribution systems in buildings.
- High masts and yard lighting systems
- High Voltage and Low Voltage electrical systems
- Transformer repair and oil purification
- Skilled manpower training

## 2.2 Organization chart

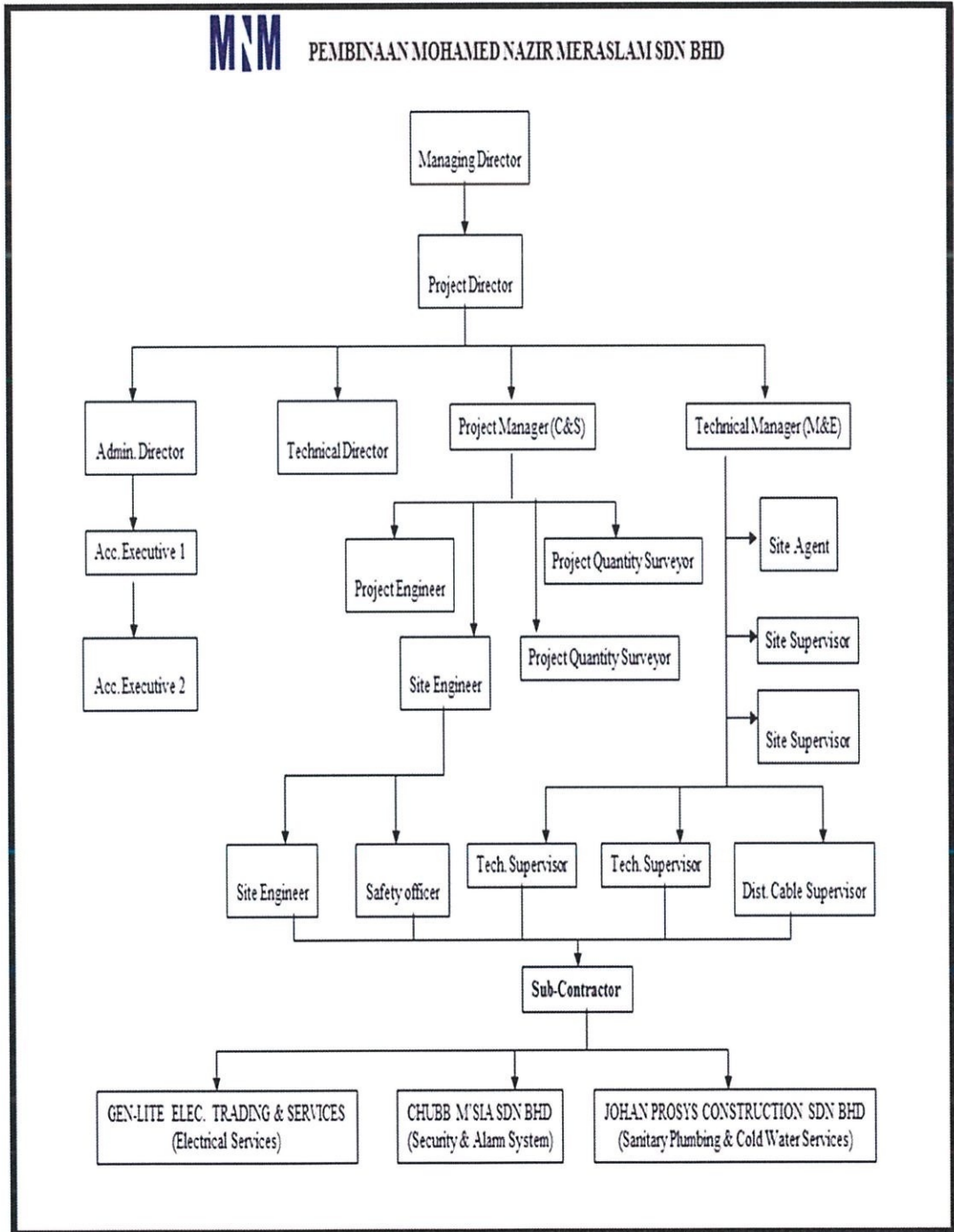


Figure 2.2: MNM organization chart

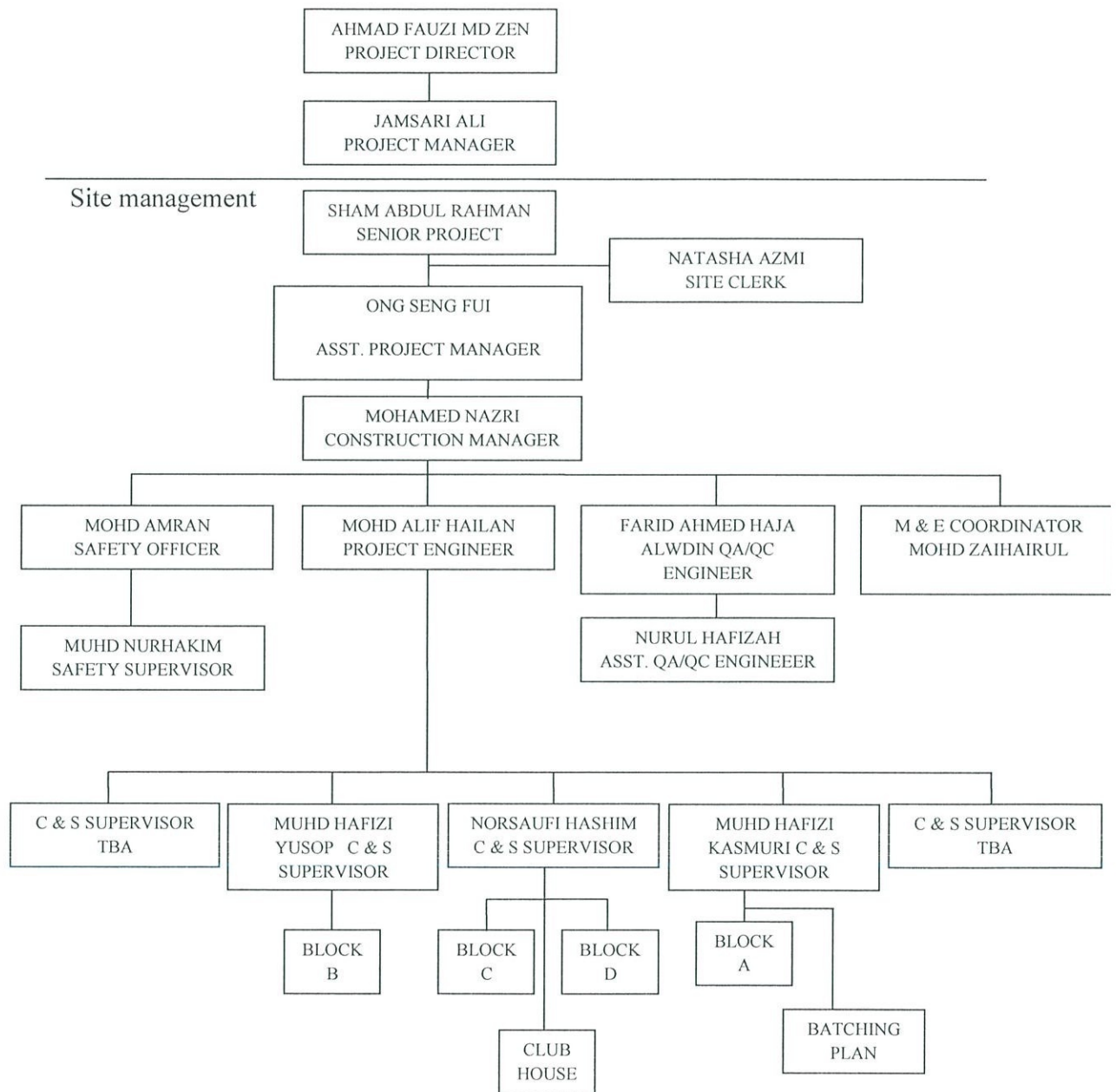


Figure 2.3: Site Organization Chart

Source: MNM catalogue, 2013

## **2.3 VISION AND MISSION**

### **2.3.1. Vision**

Vision of this company that, continual improvement in working techniques as well as looking for long term planning and seeking to diversify in new business sectors.

### **2.3.2. Mission**

Mission of the company is as follows:

- To provide effective client interaction and efficient project management for satisfactory project delivery.
- To achieve our goal of excellence we have put in place Quality Assurance by way of the implementation of the Integrated Management System (IMS) in our work.
- The IMS incorporates standards contain in ISO 9001:2008 Quality management System; OHSAS 18001:2007 Occupational Health and Safety management System and MS 1722:Part1:2005 Occupational Safety and health management System.



## 2.4 LIST OF PROJECT

### 2.4.1 Completed Projects

Table 2.1: List of completed project

| No | Project  | Owner/Main contractor                          | Contract Value (RM) | Scope of Work                                   | Contract Period         |
|----|--|--|---------------------|---|-------------------------|
| 1  | Sub-Contractor for Structural & Architectural Works for Mardi Station  | UEM Construction S/B                           | 16,744,315.48       | Maintenance                                     | 11/1/2008 - 11/6/2008   |
| 2  | Cadangan Membina dan Menyiapkan Sebuah Masjid Serta Kerja-Kerja Yang Berkaitan Secara Reka Dan Bina Di Atas Lot 5379 Taman Melawati, Mukim Hulu Kelang, Daerah Gombak, Selangor Darul Ehsan. | Majlis Agama Islam Selangor Darul Ehsan (MAIS) | 13,500,000.00       | Sub-structure, Superstructure & Ancillary Works | 15/09/2008 - 08/12/2009 |
| 3  | Electrified Double Track Project Between seremban And Gemas - Package 1 (KM 461.234 To KM 500.400) - SC/EDT/2009/27  | IJM Norwest joint Venture                      | 4,452,430.00        | Telecommunication Works                         | 12/01/2009 - 11/06/2009 |

Table 2.2: List of completed project (continue)

| No | Project  | Owner/Main contractor                 | Contract Value (RM) | Scope of Work            | Contract Period         |
|----|--|---------------------------------------|---------------------|--------------------------|-------------------------|
| 4  | Peraksanaan Projek Rangkaian Tempatan Secara Sistem JKH<br>No Kontrak : 3200000381                           | Telekom Malaysia Berhad               | 7,000,000.00        | Cabling & Manhole        | 12/2/2008 - 11/2/2010   |
| 5  | KLCC Lot 171 (Lot C) - W005/09   | Kejuruteraan KindenkosSdnBhd<br>Binta | 2,675,475.00        | TNB Infrastructure Works | 28/12/2009 - 2010       |
| 6  | Peraksanaan Projek Rangkaian Tempatan Telekom Malaysia Secara Jadual Kadar Harga.<br>No Kontrak : 3200000480 | Telekom Malaysia Berhad               | 10,000,000.00       | Cabling & Manhole        | 2009 - 2011             |
| 7  | High-Speed Broadband (HSBB) Project<br>No Kontrak : 3200000524   | Telekom Malaysia Berhad               | 34,470,000.00       | Fiber Cabling            | 01/07/2009 - 30/06/2012 |

## 2.4.2 Project in Progress

Table 2.3: List of current project

| No | Project   | Owner/Main contractor    | Contract Value (RM) | Scope of Work           | Contract Period         |
|----|---|--------------------------|---------------------|-------------------------|-------------------------|
| 1  | Mass Rapid Transit Lembah Kelang- Jajaran Sungai Buloh-Kajang Package V5-Construction and Completion Of Viaduct Guideway and Other Associated Works From Maluri Portal To Plaza Phoenix Station (Telecommunication Works From CH1,000 to CH2,800 (Package 1)  | IJM Construction Sdn Bhd | 30,600,000.00       | Telecommunication Works | 20/04/2012 - 2014       |
| 2  | Mass Rapid Transit Lembah Kelang- Jajaran Sungai Buloh-Kajang Package V5-Construction and Completion Of Viaduct Guideway and Other Associated Works From Maluri Portal To Plaza Phoenix Station (Telecommunication Works From CH2,800 to CH4,600 (Package II) | IJM Construction Sdn Bhd | 28,600,000.00       | Telecommunication Works | 20/04/2012 - 2014       |
| 3  | Contract For Network Dev. Project Via Schedule Of Rates (JKH) For Telekom Malaysia Bhd (Keaja-Keraja Tambahan)  | Telekom Malaysia Berhad  | 5,000,000.00        | Fiber Cabling           | 01/11/2013 - 31/10/2014 |



## CHAPTER 3

### CASE STUDY

#### 3.1 Introduction

In the early days, the job of formwork was carried out by the carpenter with available timber and nails as best as possible with the approach of rule of thumb. The formwork techniques have also developed side by side along with the growth in the development of concrete construction. With the technological advancement and introduction of new materials of formwork, more rational approach is being made in the design of formwork

Aluminum Formwork System is a new technology and it saves cost, time and improves the quality of construction. Aluminum Formwork is successfully used in Japan, Singapore, Malaysia and the Middle East for the construction which for low and high rises. Aluminum Formwork panels can be designed for any condition/component of building such as bay windows, stairs, balconies and special architectural features. This system is unique as all the components in a building, including slabs, floors, walls, columns, beams, staircases, balconies and window hood, are concrete and there is no need for block works or brick works. As all the periphery of resulting structure/component is concrete and at the same time we can control the concrete quality, the durability of the structure increases. It gives form finish, eliminates the need for external and internal plaster and the walls can be directly painted with a minimal skim coat, all these ultimately resulting in cost saving (Takalkar, 2009).

Ideally suited for small construction firms or smaller contract, these panels may be purchased or hired with a buying option. This means that an element formwork can be

formwork to be used to better effect for the important structural parts of the building (Hurst,1983)

Aluminum Formwork System is highly suited to load bearing wall construction whereas traditional formwork consisting of plywood and timber is not suitable to the high pressures of fresh concrete on the wall. The formwork gives the box or cellular design resulting in the walls giving support to the super structure in two directions. As a result, the structures are more resistant to earthquakes than the traditional RCC column and beam designs. As the Aluminum Formwork is lightweight, no tower cranes are required for the same unlike in tunnel framework. Due to simplicity of the assembly, only unskilled labors are required with minimal supervision (Takalkar, 2009).

### 3.2 Background of the project

Purpose to construct Suasana Lumayan 4 block apartment 23 floors (900 units) with 2 floors podium car park with includings:-

- i. Block A – 226 Units & Block C – 224 Units (Phase 1)
- ii. Block B – 226 Units & Block D – 224 Units (Phase 2)
- iii. Sebuah rumah kelab beserta kolam renang

At plot 15 and 16, Jalan Tasik Permaisuri 2, Bandar Tun Razak, Mukim Cheras, Wilayah Persekutuan Kuala Lumpur Untuk Dewan Bandaraya Kuala Lumpur dan Jv Danau Lumayan Sdn. Bhd. (**APPENDIC A, B and E**)

Table 3.1: Project information

|                                  |  |
|----------------------------------|--|
| Employer                         | Dewan bandaraya kuala lumpur<br>Jv danau lumayan sdn. Bhd. |
| Architect                        | Bbu architech  |
| Consultant engineer              | Jpc  |
| Infra structure engineer         | Jpc  |
| Mechanical & electrical engineer | Perunding metrik sdn. Bhd                                  |
| Quantity surveyor                | Tqs konsult  |
| Contractor                       | Pembinaan danau lumayan sdn bhd                            |
| Refereance                       | Dewan bandaraya kuala lumpur                               |
| Contract sum                     | Rm 150 000 000.00  |



Figure 3.1: Location of Suasana Lumayan

### 3.3 Case Study

#### 3.3.1 Advantages

TAC system was introduced into the market about 10 year ago and has been successful in gaining market acceptance from the local and overseas construction industry. Among the key success factors of this system are (<http://www.tacsystemformwork.com/system.htm>):-

##### i. Economy

The cost saving throughout the whole construction progress from defects rectification, machineries, additional conventional formwork cost, time etc. The cost saving on overall profit to the client can be increased be a factor of from 10 – 30% (i.e. one where there are more than 50 repeats of a typical layout).



## ii. Quality

The system does not require plastering as the off-the-form finish is only less than 3.5mm tolerance in deflection. Therefore the structure finishes only to be apply 6mm-8mm skim coat before other decoration application, this is a substantial cost-saving. In addition, all the structure are accurately dimensioned so that remedial work to correct inaccuracies are eliminated.

## iii. Speed

The system allow 100% of the building superstructure to be constructed or formed at the rate of 4days per floor as against the traditional approach which will at least consumed 10 to 15 days a floor. Even then, the letter can only do for columns, beam and slab only and the infill walls have to be built and plastered later. The vertical formwork such as wall & column to be struck after 12 hour of curing. The horizontal formwork such as slab & beam soffit to be struck after approx 36 hour (concrete strength achieving min. 10 N/mm<sup>2</sup>) and the props to be removed: - slab – 7 days, beam – 9 days

## iv. Durability

The system formwork panel can withstand pressure up to 45kN/m<sup>2</sup> and capable withstand min. 300 cycles (with proper handling & maintenance).

## v. Mono-casting

All building element such as walls, columns, beams, slab, lift shaft, walls, stairs, window hoods, parapets, balconies, and all other intricate decorative features will be form and cast in 1 casting.

## vi. Light weight

The system panel is easily handling & handheld product. The system is light-weight therefore all the TAC system product can be carried by hand without

using any lifting machinery installation, dismantling & transferring from floor to floor basis.

vii. Design to suite

The system is designed to suite all types building shapes from geometrical to irregular, from low-cost residential to high-end residential even from landed building to high-rise building.

viii. Safety

The system provides an inherent safety features in the use of prop will not need to be removed during the slab & beams soffit forms dismantling. Overlooking of re-propping in one of the commonest causes of fatal accident on building construction.

ix. Hazard

The construction site is free from hazardous such as waste material scattering, compacted working space, nail and timber waste due using of exist formwork system (timber formwork) & access (due to scaffold support, table form etc.)

x. Independence from Scarcity of Skilled Tradesmen

The TAC System eliminates the need for skilled plasterers as noted above, but it also eliminates the need for skilled carpenters and brick layers. Projects have often been seriously delayed because of the unavailability of these skilled trades.

xi. Scaffolding

The need to carry the cost of scaffolding for the construction of the structure is eliminated, as the TAC System provides its own work platform brackets, which ascend the building as it being constructed. There is the added advantage that the infrastructure can now precede in parallel with the building construction, as the contractor has unimpeded access to the base of the building.

### 3.3.2 TAC Installation

#### Typical and standard component of aluminum formwork

Normally the component use in this system includes:

##### A. Wall Formwork Component

1. Wall Panel
2. Corner Joint
3. External Angle
4. Wall Heel
5. Kicker
6. Kicker Corner

##### B. Slab Formwork Component

1. Prop
2. Slab Panel
3. Slab Corner
4. Slab Joint
5. Link Beam
6. Link Head

##### C. Typical Formworks Accessories

1. Pin
2. Wedge
3. External working platform
4. Wall strut
5. Adjustable base jack







Figure 3.3: Example of Wall Panel



Figure 3.4: Example of Slab Panel



Figure 3.5: Example of Props (Slab)

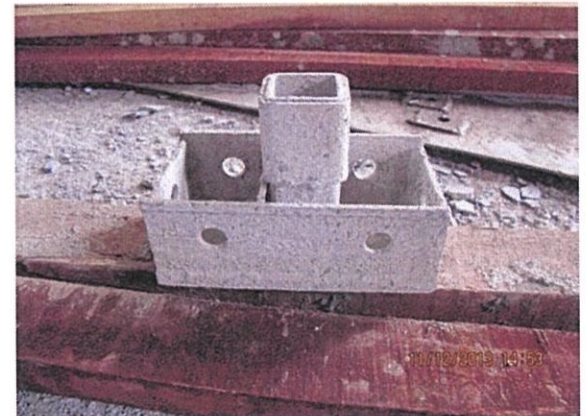


Figure 3.6: Example of Link Head (Slab)



Figure 3.7: Example of Stair



Figure 3.8: Example of Wall



Figure 3.9: Examples of Slab Corner Joint



Figure 3.10: Example of Wedge (accessory)



### A. Installation of the aluminum formwork (wall)

The diagram showing the formwork installation for walls. The wall panel install after the BRC completed install, then after wall panel install, wall ties will be use to tie the wall panel and also to avoid the concrete leak during concreting work. Wall hell is use to close or to tie the bottom of the wall panel.

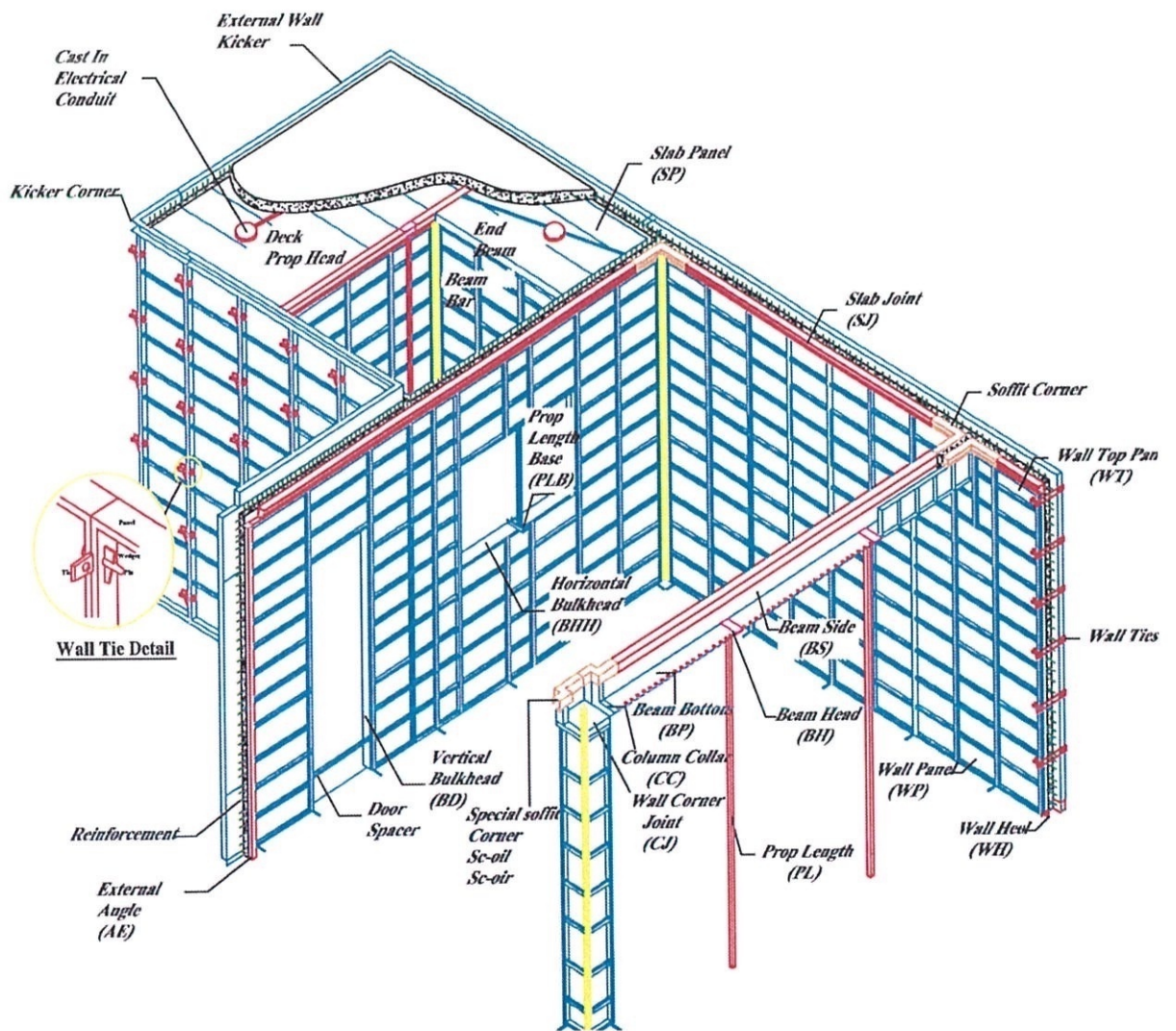


Figure 3.11: Overview of the TAC system component

(TAC System Manual, 2012)

# FORMWORK INSTALLATION SEQUENCE 1 WALL FORMWORK INSTALLATION

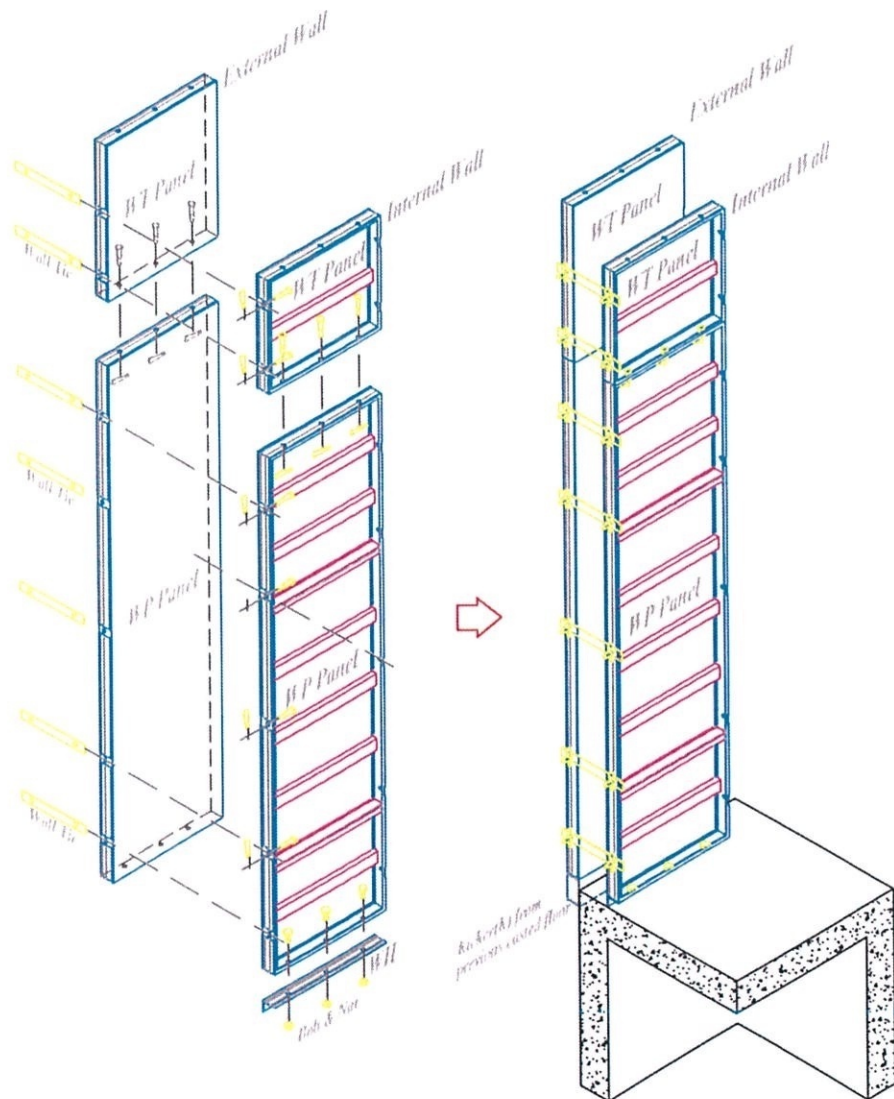


Figure 3.12: Wall installation sequence 1

(TAC System Manual, 2012)

For more detailed, wall panel for internal wall must be set up. Next after the setting up for internal wall panel complete, the external wall panel follows up. Must be cleared that the wall ties must install to make sure that the panel is strong enough and to avoid leaked of concrete during concreting work



# FORMWORK INSTALLATION SEQUENCE 2 WALL FORMWORK INSTALLATION

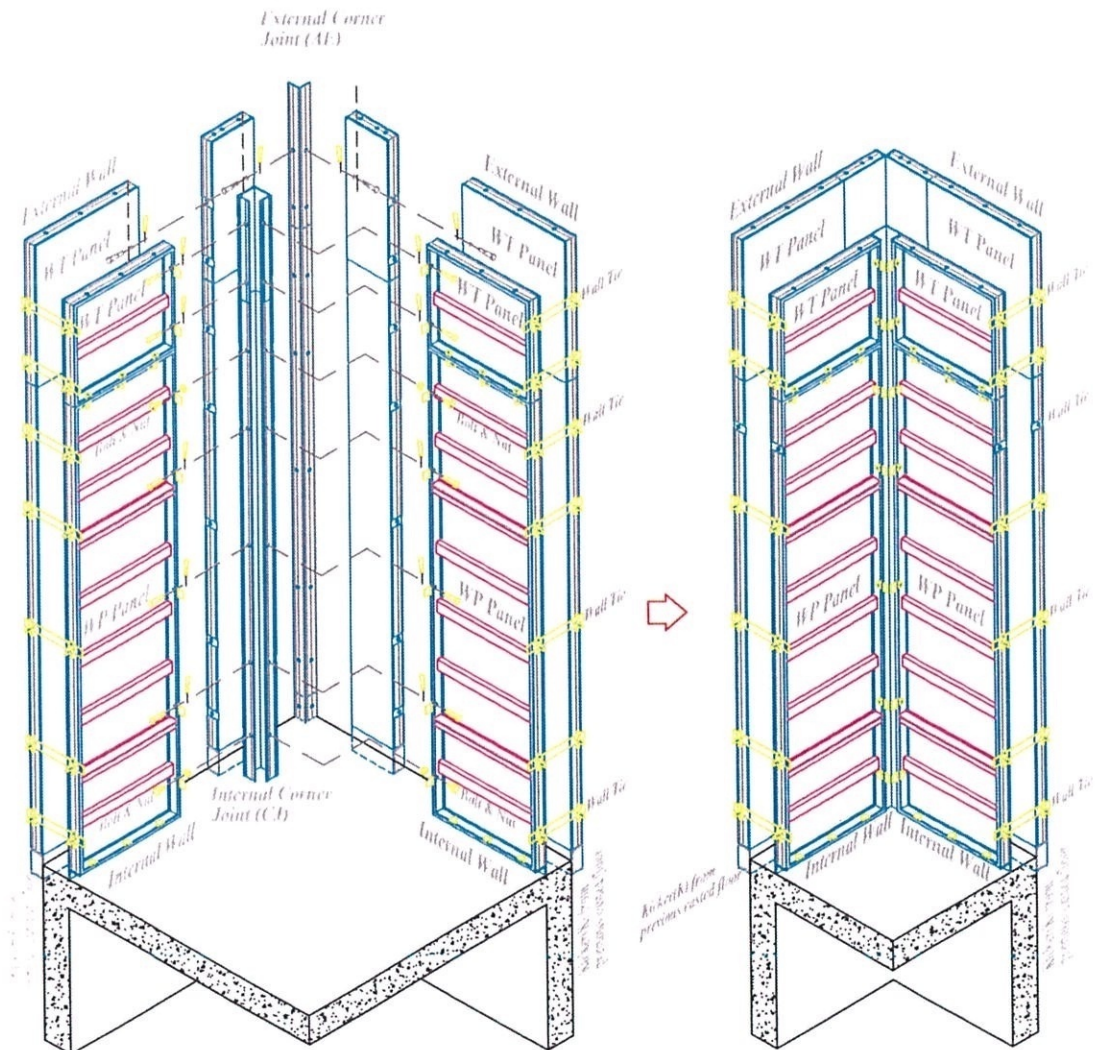


Figure 3.13: Wall installation sequence 2

(TAC System Manual, 2012)

The figure 3.13 shows the sequence of installation wall panel at Corner Joint (CJ).



Figure 3.14: Example of Wall Panel installation



Figure 3.15: Wall Panel installation



Figure 3.16: Wall installation (cont'd)



Figure 3.17: Installation Wedge and Pin



Figure 3.18: Examples Pin and Wedge position



## B. Installation of the aluminum formwork (slab)

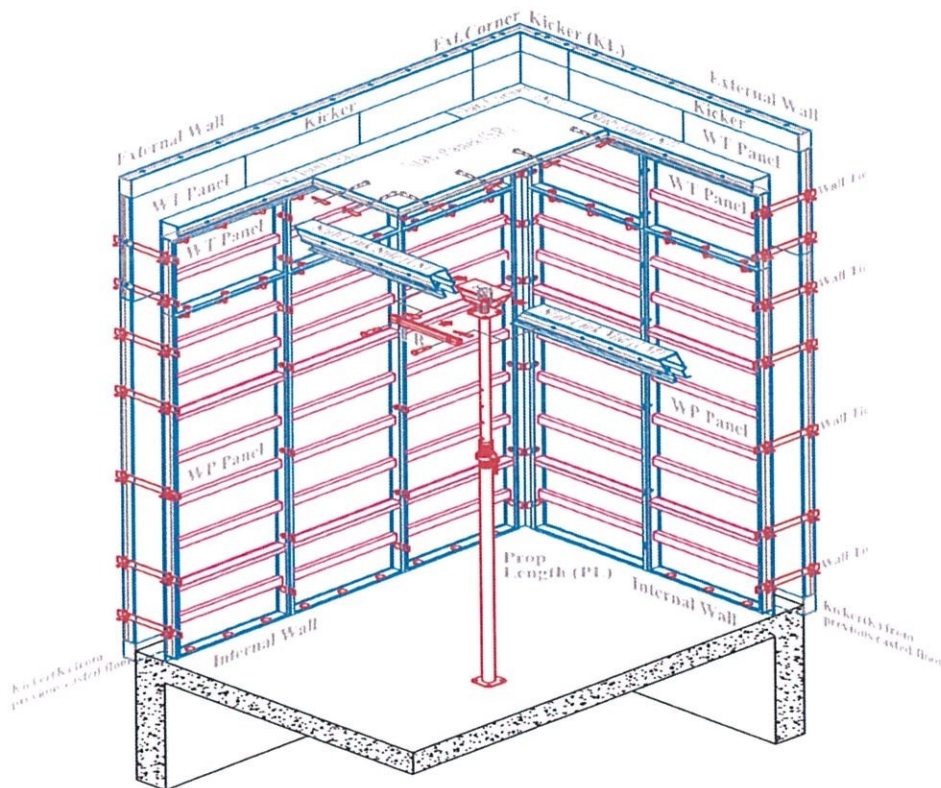


Figure 3.19: sequence installation of slab panel

(TAC System Manual, 2012)

For installation of the slab too wall. Firstly slab panel must be installing at corner and ties it with pin and wedge. Then continue install the slab joint to join other panel. Prop is used to support the slab panel and tie it within the slab joint. Tie it with wedge and pin. The distance between prop to other prop for install is within 5 meters to 10 meters (2 meter recommendation for fully strength).



Figure 3.20: Slab Panel are lifting up



Figure 3.21: Installation of the Slab Panel





Figure 3.22: Slab Panel installation (cont'd)

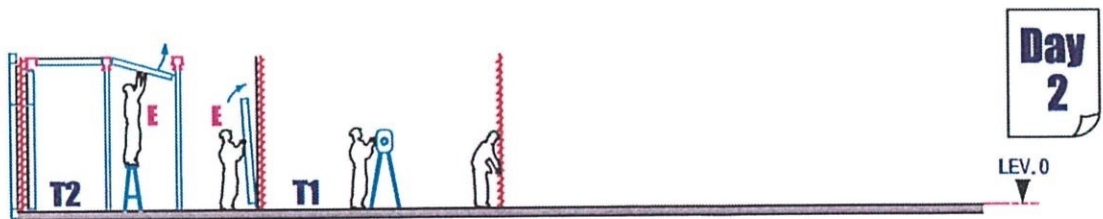


Figure 3.23: Installation of Slab Panel (cont'd)

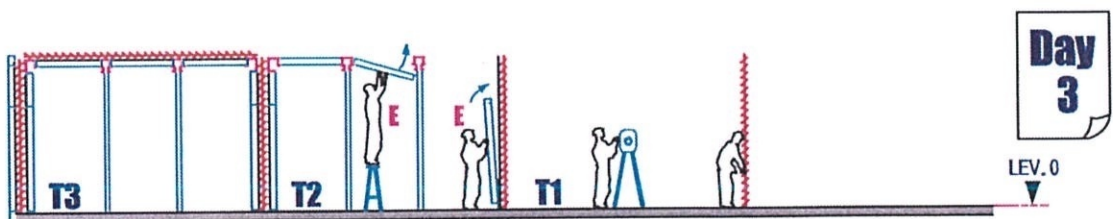
### C. Construction Sequence



1. The first step of installation aluminium formwork is setting up the level at T1. Its is because to get the alignment and verticality of the formwork. Level of the formwork can be done by levelling. After get the right pointm, so that installation of rebar and mechanical and electrical (M&E) can proceed.

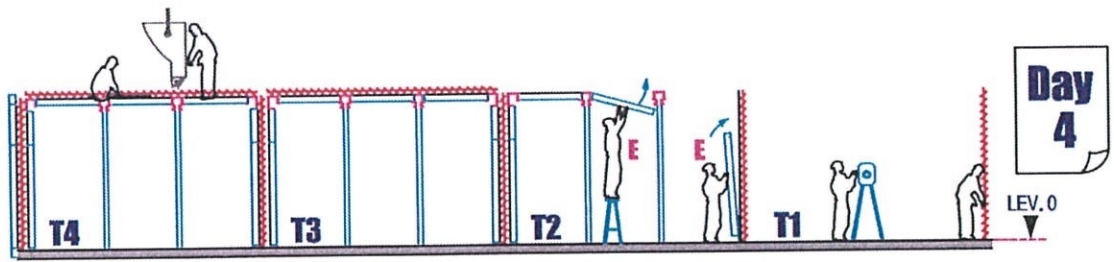


2. After get the right level, and then the area will proceed with installation of formwork starting installing wall or column panel and continuous with slab panel for next level. The next area is also doing the 1<sup>st</sup> step which levelling, installation of rebar and M&E.

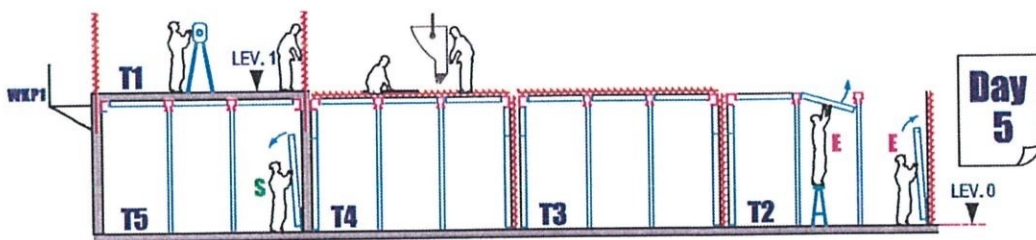


3. Days 3 is continue the step before whre the area 3 is do the levelling, install rebar, and M&E. Area 2 continue with wall/column panel and slab panel. And area 1 is install the props as the additional strenght as it will receive the weight of the concrete.

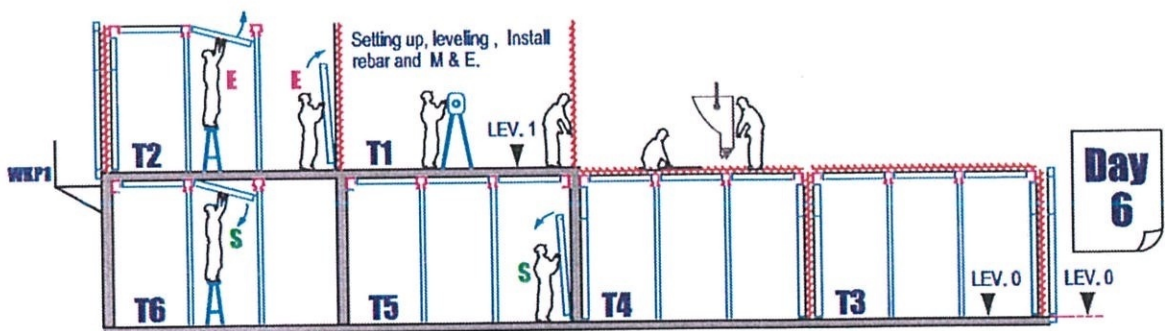




4. Days 4 will proceed of concreting work at area 1. The concreting work will fill at wall/column panel and slab panel (liftcore, staircase if have too). Area 4 , 3 and 2 is repeated previous step.



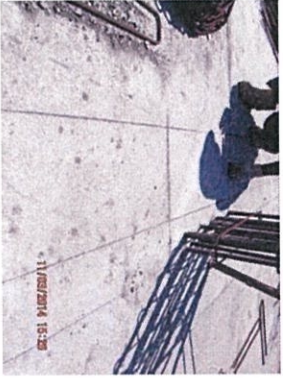

5. Days 5 the aluminium formwork can be uninstalled at area 1 an lift up the formwork to the area 1 at next floor (upper floor). The concrete are strong enough but the props cant be uninstalled as it act to support the strenght of the concrete. Area 2 upper floor is proceed with concreting work.


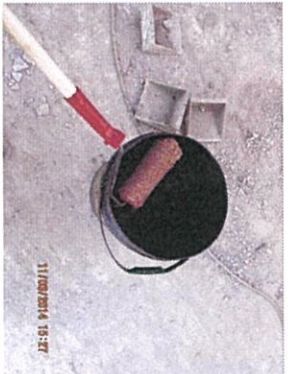


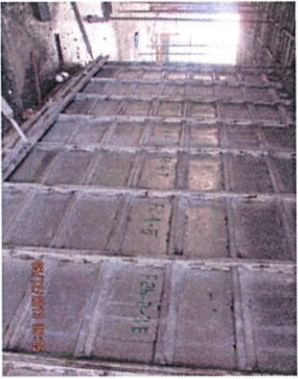
6. Day 6 is repeat all step and continous till last floor of the building.





### 3.3.3 Method statement of installation TAC system


| NO | TYPE OF WORK                             | METHOD STATEMENT  | FIGURE   | LABOUR                  | EQUIPMENT                   | DURATION |
|----|--|---|--|-------------------------|-----------------------------|----------|
| 1  | Installation of wall panel (setting out) | Assume that the alignment and offset 300mm for formwork are done and BRC for wall are completely installed. |  <p>Figure 3.24: BRC for wall completely installed with offset line.</p>  <p>Figure 3.25: Offset line as alignment wall panel</p> | 2 semi-skilled workers. | BRC for wall<br>Offset line | 1 hour   |

| NO | TYPE OF WORK   | METHOD STATEMENT   | FIGURE  | LABOUR              | EQUIPMENT                  | DURATION |
|----|--|--|---|---------------------|----------------------------|----------|
| 2  | Installation of wall panel<br>(oil/grease apply to face of wall panel) | Oil/greases must to be applying at the surface of formwork as it to avoid the concrete from stick and harden with the formwork during concreting work. Oil/grease applying just one layer. |  <p>Figure 3.26: Worker apply oil/grease to wall panel</p>  <p>Figure 3.27: Oil and roller</p> | 1 unskilled worker. | Oil/Grease<br>Roller Brush | ½ hour   |

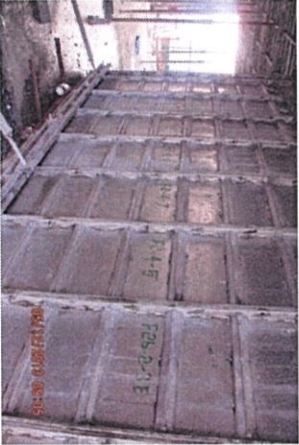
| NO | TYPE OF WORK   | METHOD STATEMENT  | FIGURE  | LABOUR                 | EQUIPMENT  | DURATION |
|----|--|---|---|------------------------|------------|----------|
| 3  | Installation of wall panel (wall panel and wall joint install) | Lifting up wall panel and combined it with next panel. Make sure that the panel are correctly installed and must accurate with the offset. Wall joint is to be installed next to wall panel and wall joint act to hold between to wall panel. |  <p data-bbox="810 1003 896 1303">Figure 3.18: Wall panel installation</p> | 2 semi-skilled workers | Wall panel | ½ hour   |


| NO | TYPE OF WORK                                     | METHOD STATEMENT  | FIGURE  | LABOUR           | EQUIPMENT              | DURATION |
|----|--|---|---|------------------|------------------------|----------|
| 4  | Installation of wall panel (pin and wedge apply) | After all wall panel are lifting up, the panel must to apply pin and wedge to lock and tie the panel. Make sure that the panel are tie tightly and no void. It is because to avoid the leakage of the concrete during concreting work. By using steel bar, lock the panel at the hole and wedge are inserting. Insert the wedge by using hammer and pin it. |  <p>Figure 3.29: Pin and wedge installation</p>  <p>Figure 3.30: Pin and wedge</p> | 2 Skilled worker | Pin<br>Wedge<br>Hammer | 1 hour   |


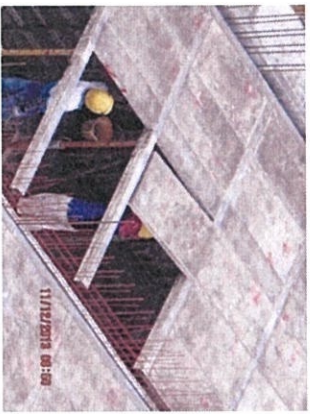


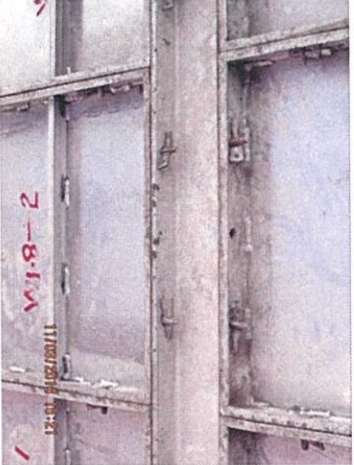
| NO | TYPE OF WORK                                | METHOD STATEMENT  | FIGURE  | LABOUR                    | EQUIPMENT      | DURATION   |
|----|---|---|---|---------------------------|----------------|------------|
| 5  | Installation of wall panel (wall tie/knife) | After wall completely lock, then wall tie apply. Wall tie are install between wall panel and wall joint. Wall tie functional as to separate between wall panel and wall joint. Its to avoid concrete harden and stick to these panel. |  <p data-bbox="715 853 804 1400">Figure 3.31: Wall knife install at wall panel</p> | 1 skilled worker<br>Semi- | Wall tie/knife | 40 minutes |





| NO | TYPE OF WORK                                      | METHOD STATEMENT  | FIGURE  | LABOUR           | EQUIPMENT                        | DURATION |
|----|---|---|---|------------------|----------------------------------|----------|
| 6  | Installation of wall panel (prop and wall welled) | After the panel is complete install, next prop and wall welled is to be applied. Wall welled and prop are installing at the bottom area of the panel. This is because during concreting work, the higher load and pressure is accumulating at the bottom of the formwork. So that the higher additional strength is to b applied at this area. Wall welled must be locking first and follow by the prop. Prop must be drill first and install a rebar to hold the prop at the floor/ground. |  <p data-bbox="820 987 895 1352">Figure 3.32: Example of wall welled and prop position</p> | 3 skilled worker | Wall welled<br>Prop<br>Rebar Y16 | 1 hour   |


| NO | TYPE OF WORK                                    | METHOD STATEMENT  | FIGURE  | LABOUR            | EQUIPMENT  | DURATION |
|----|---|---|---|-------------------|------------|----------|
| 7  | Installation of slab panel (slab joint install) | Slab joint must be installed between wall panels. Slab joint must to come first and follow by slab panel. |  <p data-bbox="730 853 762 1384">Figure 3.33: Slab joint installation method</p> | 2 skilled workers | Slab joint | ½ hour   |


| NO | TYPE OF WORK                                      | METHOD STATEMENT   | FIGURE   | LABOUR             | EQUIPMENT                                | DURATION |
|----|---|--|--|--------------------|--|----------|
| 8  | Installation of slab panel (slab panel installed) | Slab panel are lifting up and combined with slab joint. Slab panel must install correctly as it will form a slab for next floor. Ensure that the slab panel already applies with oil/grease. |  <p>Figure 3.34: Slab panel being install</p> | 2 skilled workers. | Slab panel<br>Oil/grease<br>Roller brush | 1 hour   |
|    |   |  |  <p>Figure 3.35: Slab panel installation</p>   |                    |  |          |


| NO | TYPE OF WORK                                     | METHOD STATEMENT   | FIGURE   | LABOUR            | EQUIPMENT              | DURATION |
|----|--|--|--|-------------------|------------------------|----------|
| 9  | Installation of slab panel (pin and wedge apply) | After pin and wedge are done lifting up and combined it, then slab panel are tie together with slab joint by using wedge and pin. Penetrate the wedge by hammer. |  <p data-bbox="770 954 804 1301">Figure 3.36: Pin and wedge</p> | 2 Skilled workers | Pin<br>Wedge<br>Hammer | 1 hour   |




| NO | TYPE OF WORK                              | METHOD STATEMENT   | FIGURE  | LABOUR              | EQUIPMENT           | DURATION |
|----|---|--|---|---------------------|---------------------|----------|
| 10 | Installation of slab panel (prop install) | Prop is to be installed after all slab panels completely install. Prop install at below slab panel and it's to give additional strength to slab for shear all force and weight of concrete. Prop also act as temporary column and its transfer the load to the slab before it. |  <p>Figure 3.37: Prop installation for slab</p>  <p>Figure 3.38: Prop installation at slab joint</p> | 2 unskilled workers | Prop sets<br>Hammer | 1½ hour  |


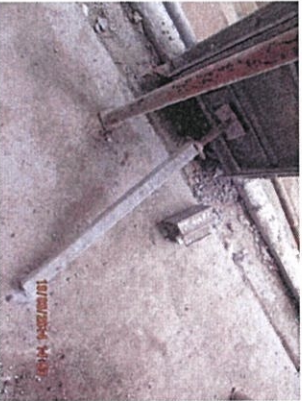
| NO | TYPE OF WORK                               | METHOD STATEMENT   | FIGURE  | LABOUR                | EQUIPMENT                      | DURATION |
|----|--|--|---|-----------------------|--------------------------------|----------|
| 11 | Installation of column panel (setting out) | Assume that all starter-bar is completely tied and offsets line 300mm are applied. |  <p data-bbox="836 1003 906 1346">Figure 3.39: Setting out for columns panel</p> | 1 semi-skilled worker | Offset thread Rebar for column | ½ hour   |

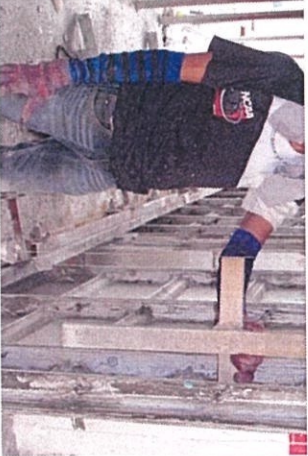
| NO | TYPE OF WORK                                    | METHOD STATEMENT   | FIGURE   | LABOUR             | EQUIPMENT                  | DURATION |
|----|---|--|--|--------------------|----------------------------|----------|
| 12 | Installation of column panel (oil/grease apply) | Oil/grease is to be applying first at surface of the column panel before start tie. Oil/grease is to avoid concrete harden together with column panel. |  <p data-bbox="805 1030 893 1422">Figure 3.40: Oil/Grease is apply by worker</p> | 1 unskilled worker | Oil/grease<br>Roller brush | ½ hour   |

| NO | TYPE OF WORK  | METHOD STATEMENT  | FIGURE   | LABOUR            | EQUIPMENT    | DURATION |
|----|---|---|--|-------------------|--------------|----------|
| 13 | Installation of column panel (column panel install) | Column panel is lifting up to the rebar of column and close it together before pin and wedge apply. |  <p data-bbox="518 974 555 1422">Figure 3.41 : Column panel installed</p> | 2 skilled workers | Column panel | ½ hour   |



| NO | TYPE OF WORK                                       | METHOD STATEMENT   | FIGURE   | LABOUR            | EQUIPMENT              | DURATION |
|----|--|--|--|-------------------|------------------------|----------|
| 14 | Installation of column panel (pin and wedge apply) | Pin and wedge are applied by using hammer after column panel completely install. Make sure that pin and wedge is tie together with column panel tightly to avoid from panel break, or concrete leakage during concreting work. |  <p data-bbox="715 936 785 1393">Figure 3.42: Pin and wedge apply to column panel</p> | 2 skilled workers | Pin<br>Wedge<br>Hammer | ½ hour   |

| NO | TYPE OF WORK  | METHOD STATEMENT  | FIGURE  | LABOUR            | EQUIPMENT/<br>MACHINERIES               | DURATION |
|----|---|---|---|-------------------|---|----------|
| 15 | Installation of column panel (prop and column welled install) | Column panel that already completely is to install prop and welled for column to avoid panel break and to give additional straight to panel. It's same as wall prop and welled. |  <p>Figure 3.43: Example of prop installed at column</p>  <p>Figure 3.44: Example of prop to be installed at column panel (cont'd)</p> | 2 skilled workers | Prop sets<br>Column welled<br>Rebar Y16 | ½ hour   |

| NO | TYPE OF WORK                      | METHOD STATEMENT  | FIGURE   | LABOUR             | EQUIPMENT         | DURATION                            |
|----|-----------------------------------|---|--|--------------------|-------------------|-------------------------------------|
| 16 | Inspection (checking verticality) | After wall and column formwork are completely done, next inspection for verticality of the formwork. This is importance as its will form a stronger structure after concreting work done. Using verticality ruler, inspection will work as its hang it at the top of formwork and the threat with plumb bob will determine whether its tally or not to the mark at verticality ruler. |  <p data-bbox="758 952 790 1321">Figure 3.45: Verticality check</p> | 1 unskilled worker | Verticality ruler | Until all formwork done inspection. |

### 3.3.4 Problem and solution

#### 1. Verticality of the formwork

To ensure the formwork is right to the alignment which verticality, after the formwork completely install, some test should be done which call verticality test. This test is used plumb bob which tie at top of formwork. Take reading from the top to middle and bottom formwork to determine if the formwork is not alignment. Refer **APPENDIX C**.

#### 2. Leakage of the concrete

Leakage of the concrete during concreting work is because the tie of the formwork. The worker must ensure that all the pin and wedge is tie tightly to avoid the concrete leakage. Wall welled and prop at the bottom of the formwork also must been tie tightly to avoid concrete leak. Refer **APPENDIX D**.

#### 3. Its fix and can't be change

This formwork system is fix because it's already be designed at factory and cant be change at construction stage. So make sure all the designed and plan is right and checked before sent to manufacture design.



## **CHAPTER 4**

### **CONCLUSION & RECOMMENDATION**

From the study it is concluded that this TAC system is better than our urban system which is use timber system where it's not environmental. These aluminium formworks have more advantages than disadvantages as compared to conventional system, and method of the installation and also workability of this formwork. There are many advantages using aluminium formwork as compared to conventional formwork for example cost saving, less skilled worker needed, and less hazard. The TAC system must install tightly and carefully to ensure all connection are tie in order to avoid concrete leakages. Installations of this TAC system are not difficult as compared to conventional system where this system only use specific component such as wall, column, slab and accessory.

## REFERENCE

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TAC System Manual

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# APPENDICES



**APPENDIX A: Suasana Lumayan Project View**





APPENDIX B: Project information board

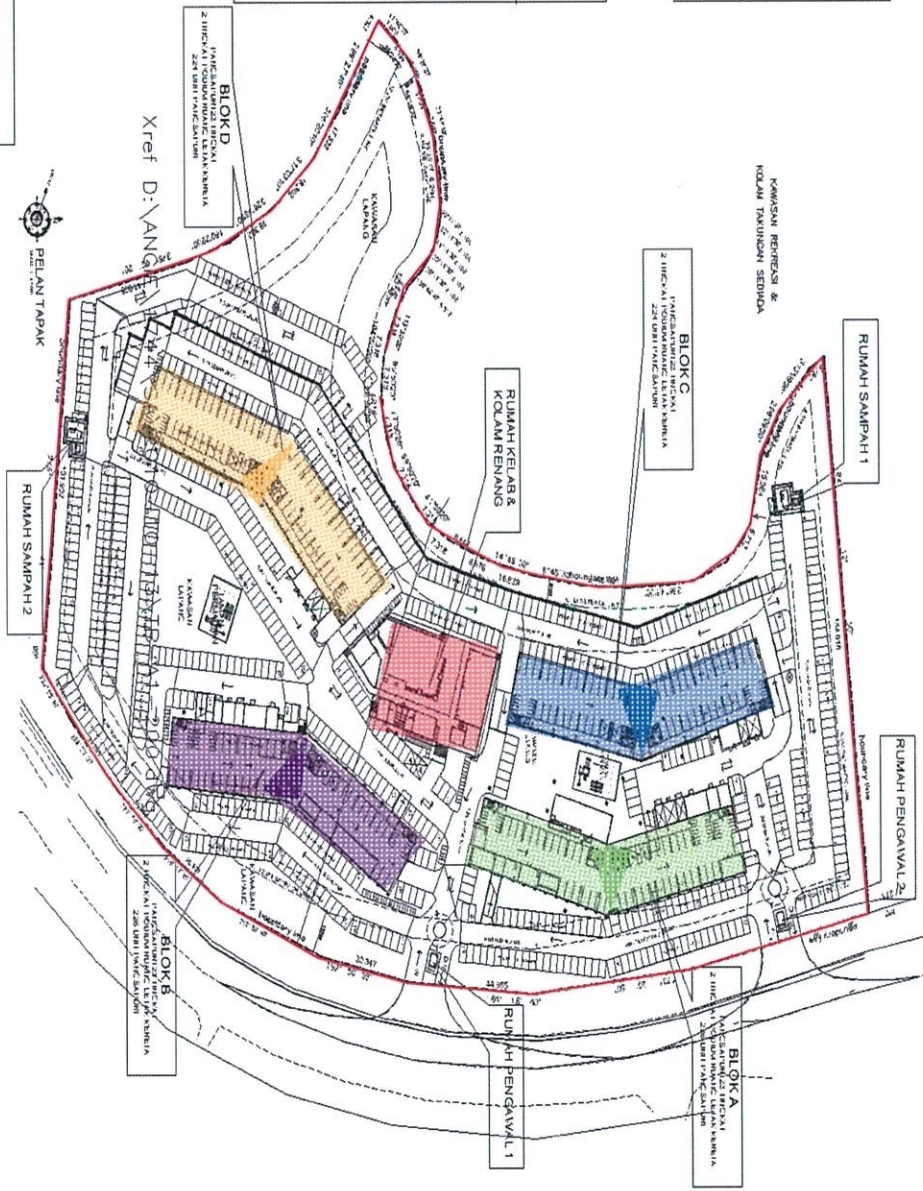
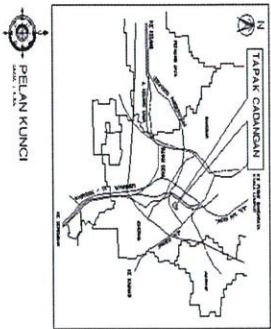




**APPENDIX C:** Example of the verticality method



**APPENDIX D:** Wall Joint at bottom of the Wall Panel



| Legend |               |
|--------|---------------|
|        | Block A       |
|        | Block B       |
|        | Block C       |
|        | Block D       |
|        | Club House    |
|        | Site boundary |

APPENDIX E: Site Layout of Suasana Lumayan