



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

**AUTOCLAVED AERATED CONCRETE (AAC) BLOCKS FOR WALL
ELEMENT AT PEJABAT KESIHATAN DAERAH JELI, KELANTAN.**

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(PERAK)**

DECEMBER 2019

It is recommended that this practical training report provided

by

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entitled

**Autoclaved Aerated Concrete (AAC) Blocks For Wall Element at Pejabat Kesihatan
Daerah Jeli, Kelantan.**

be accepted in partial fulfillment of the requirements for obtaining the Diploma In Building.

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DECEMBER 2019

STUDENT'S DECLARATION

I hereby declare that this report is my own work, except for extract and summaries for which the original references are stated herein, prepared during a practical training session that I underwent at NH Aries SDN BHD for a duration of 20 weeks starting from 5 August 2019 and ended on 20 December 2019. It is submitted as one of the prerequisite requirements of BGN307 and accepted as a partial fulfillment of the requirements for obtaining the Diploma in Building.

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Thank you very much.

ABSTRACT

A good choice material is important especially when it comes to construction industry. A good material used will lead to a strong, high quality, durable, eco-friendly and thermal resistant product such as application of wall that will need to be strong and steady. Hence, this report will discuss mainly about the advantages of material that has been used nowadays which is Autoclaved Aerated Concrete (AAC) that were applied to the construction project under NH Aries SDN BHD titled as “Construction of Pejabat Kesihatan Daerah Jeli, Kelantan”. The objectives of this report are to analyse the product material and machineries involved, to observe the laying of Autoclaved Aerated Concrete (AAC) blocks and to determine the advantages of AAC blocks used in the construction industry. For the conclusion of this report, it will explain about the reasons why most of construction nowadays prefer to use these blocks and the solutions of the problems faced during installation.

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CHAPTER 1.0

INTRODUCTION

The Autoclaved Aerated Concrete (AAC) material was developed in 1924 in Sweden. It has become one of the most used building materials in Europe and is rapidly growing in many other countries around the world. AAC is produced from the common materials such as lime, sand, cement and water, and a small amount of rising agent. After mixing and moulding, it is then autoclaved under heat and pressure to create its unique properties.

AAC has excellent thermal insulation and acoustic absorption properties. AAC is fire and pest resistant, and is economically and environmentally superior to the more traditional structural building materials such as concrete, wood, brick and stone. At the point when AAC is blended and cast in structures, a few compound responses occur that give AAC its light weight (20% of the heaviness of cement) and warm properties. Aluminium powder responds with calcium hydroxide and water to release hydrogen. Toward the end of the frothing procedure, the hydrogen escapes into the air and is supplanted with air.

AAC blocks are unique and an excellent type of building material due to its super heat, fire and sound resistance, lightweight and offers ultimate workability, flexibility and durability. Its main ingredients include sand, water, quicklime, cement and gypsum. The chemical reaction due to the aluminium paste provides AAC its distinct porous structure, lightness, and insulation properties, completely different compared to other lightweight concrete materials. When the forms are removed from the material, it is solid but still soft. It is then cut into either blocks or panels, and placed in an autoclave chamber for 12 hours. During this steam pressure hardening process, when the temperature reaches 190° Celsius (374° Fahrenheit) and the pressure reaches 8 to 12 bars, quartz sand reacts with calcium hydroxide to form calcium silicate hydrate, which gives AAC its high strength and other unique properties. Because of the relatively low temperature used AAC blocks are not considered fired brick but a lightweight concrete masonry unit. After the autoclaving process, the material is ready for immediate use on the construction site. Depending on its density, up to 80% of the volume of an AAC block is air. AAC's low density also accounts for its low structural compression strength. It can carry loads of up to approximately 50% of the compressive strength of regular concrete. AAC offers incredible opportunities to increase building quality and at the same time reduce costs at the

construction site. AAC is produced out of a mix of quartz sand and/or pulverized fly ash (PFA), lime, cement, gypsum, water and aluminium and is hardened by steam-curing in autoclaves. As a result of its excellent properties, AAC is used in many building constructions, for example in residential homes, commercial and industrial buildings, schools, hospitals, hotels and many other applications. AAC contains 60% to 85% air by volume.

Autoclaved Aerated Concrete is a lightweight, load-bearing, high-insulating, durable building product, produced in a wide range of sizes and strengths. Hence, AAC blocks is lightweight and compare to the red bricks AAC blocks are three times lighter.

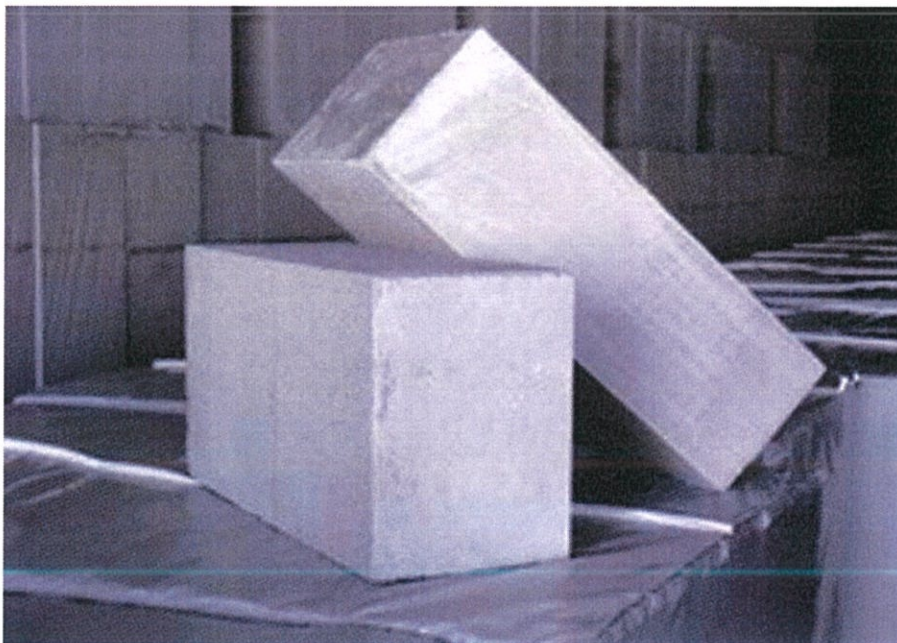


Figure 1.1 AAC blocks

1.1 Objectives of the Report

For this report, the objective are:

1.1.1 To study the product of Autoclaved Aerated Concrete (AAC) blocks.

1.1.2 To observe the laying of the Autoclaved Aerated Concrete (AAC) blocks.

1.1.3 To determine the advantages of Autoclaved Aerated Concrete (AAC) blocks.

1.2 Background and Scope of study

The construction of Pejabat Kesihatan Daerah (PKD) Jeli under NH Aries SDN BHD began on May 2018. This project was implemented through the design and build concept, where the appointed contractor was responsible for the design and construction of the project. It consists of 6 buildings which are the PKD Office, a store, a management block, a Tenaga Nasional Berhad (TNB) substation, a security post and a disposal house with other facilities. The site is surrounded with other government building which are the Agriculture office and RISDA office. This report is about the material used during the construction process and the topic chosen is Autoclaved Aerated Concrete (AAC) blocks installation. The reasons why this construction project decided to apply AAC blocks is because of its advantages and use of modern technologies. Since this construction is to build a health department building, the use of AAC block is clinically safe and fire resistant. The material itself has the characteristic of non-toxic since there are no source of toxic gases or other toxic substance in it. It is known that the AAC blocks installation for this project will take approximately 3 months per building or block. The process includes the layout of wall lines, start the levelling bed, set the first corner block, and others. The location of this case study is shown in the *Figure 1.2.1* below.

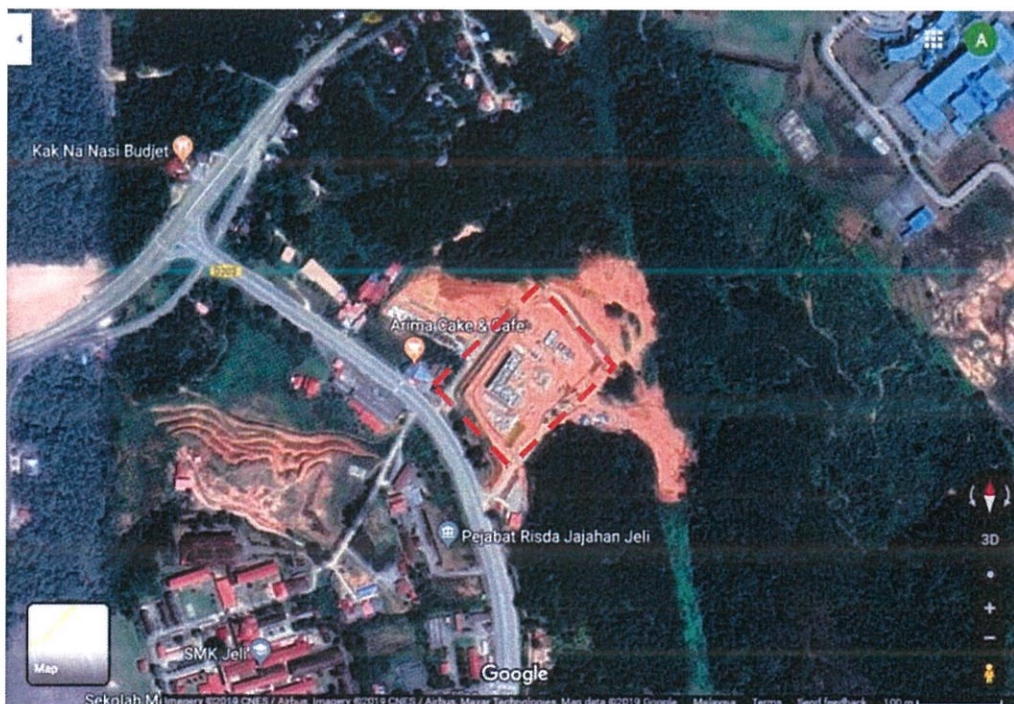


Figure 1.2 Location of new Pejabat Kesihatan Daerah Jeli, Kelantan on map

1.3 Research methods

Methods study is the process of subjecting work to systematic, critical scrutiny to make it more effective and more efficient. It is one of the key to achieve productivity improvement. There are three (3) methods of study that has been used to collect the information from all the parties involved in the project. The method of study that was used is observation, interviews and document reviews.

1.3.1 Primary Method

1. Observation

There was a lot of information and knowledge that were obtained from the observation method. The information obtained is about the construction material, Autoclaved Aerated Concrete (AAC) blocks and the process of the installation. During the period of observation, although only the substructure work was ongoing, the writer can still learn and collect the full information and knowledge through documents and pictures as references. The first aspect to observes is about the material used for the wall. The project parties involved chose Autoclaved Aerated Concrete (AAC) blocks as the construction material to be used. It is because of the good benefit of the material itself. AAC blocks is lightweight compare to the red bricks, AAC blocks are three times lighter. Some characteristic of AAC Blocks are high resistance to water penetration and earth quack resistance. So, the best option of blocks they chose is of course, AAC Blocks due to the quality.

2. Interview

Interviews are most effective for qualitative research. They help to explain, better understand, and explore research subjects such as opinions, behaviour, experiences, phenomenon and etc. Interview questions are usually open-ended questions so that it will be so much easier for the writer to collect the data.

Most of information gained was from the interview sessions. The topic of the interview was mostly about AAC blocks and the problems occur at the construction site. The location of the interview usually happens at the office. The person in-charge for being questioned is Ms. Nor Zahiriah binti Zakeri, the construction manager and Mr. Nor Shidki bin Ali as the site supervisor. The interview usually takes about 30 minutes.

1.3.2 Secondary Method

1. Document Review

A document is a written, drawn, presented, or memorialized representation of thought. In the past, the word was usually used to denote a written proof, useful as evidence of a truth or fact. During the practical, document is very important and useful to collect information and gain knowledge. All the important information recorded into the paper is also consider as documents. However, during the practical session, the writer only gets the chance to read and understand a few documents due to private and confidential of the company. These are a few of the documents received from my consultant and supervisor as report references :

1. Monthly site progress report.
2. Company profile.
3. CCC form.
4. Minute of site meeting.
5. Drawing and plan.

CHAPTER 2.0 COMPANY BACKGROUND

2.1 Introduction of Company

NH Aries SDN BHD is a construction company in Tanah Merah district, Kelantan. The main office and headquarters of the company is located at Tanah Merah itself which is PT 1897-A Tingkat Bawah, Bandar Baru Bukit Bunga, 17510 Tanah Merah, Kelantan. The company was established at the end of December 2006 and started with a small project involved. Initially, the staff of the company consist of their own family members and relatives. The idea of having a construction company was due to the passion towards construction field and industry. It was all started with obtain a business license, G1 contractor license from CIDB, and now the company even managed to get the G7 contractor license from CIDB.

The current project is Construction of Pejabat Kesihatan Daerah Jeli, Kelantan. The duration of the project is 88 weeks which will end approximately on 13 May 2020. The cost of the project is around RM 16 million including all material and facilities.

Company location of NH Aries SDN BHD



Figure 2.1 Location of NH Aries SDN BHD on map

2.1.1 Mission & Vision

1. Vision

To create local opportunity, growth and impact in every community and residential area around Kelantan.

2. Mission

Providing a good service to develop and deliver more facilities and buildings in order to enhance the development in Kelantan.

2.1.2 Objectives of the NH Aries SDN BHD Company

1. Ensure that office administration management is efficient in administration, finance, services and employment.
2. Provide a good quality of hospitality and service to the clients.
3. Promotes more job opportunity to the unemployed.
4. Ensure that all administrative affairs and control of the financial provisions entrusted used in the proper manner and in compliance with the provisions of construction industry law.

2.1.3 Other Related Information

1. Hold G7 contractor license of Lembaga Pembangunan Industri Pembinaan Malaysia (CIDB)
2. 100% Bumiputra Contractor and Sijil Perolehan Kerja Kerajaan.

2.2 Organization Chart of NH Aries Company

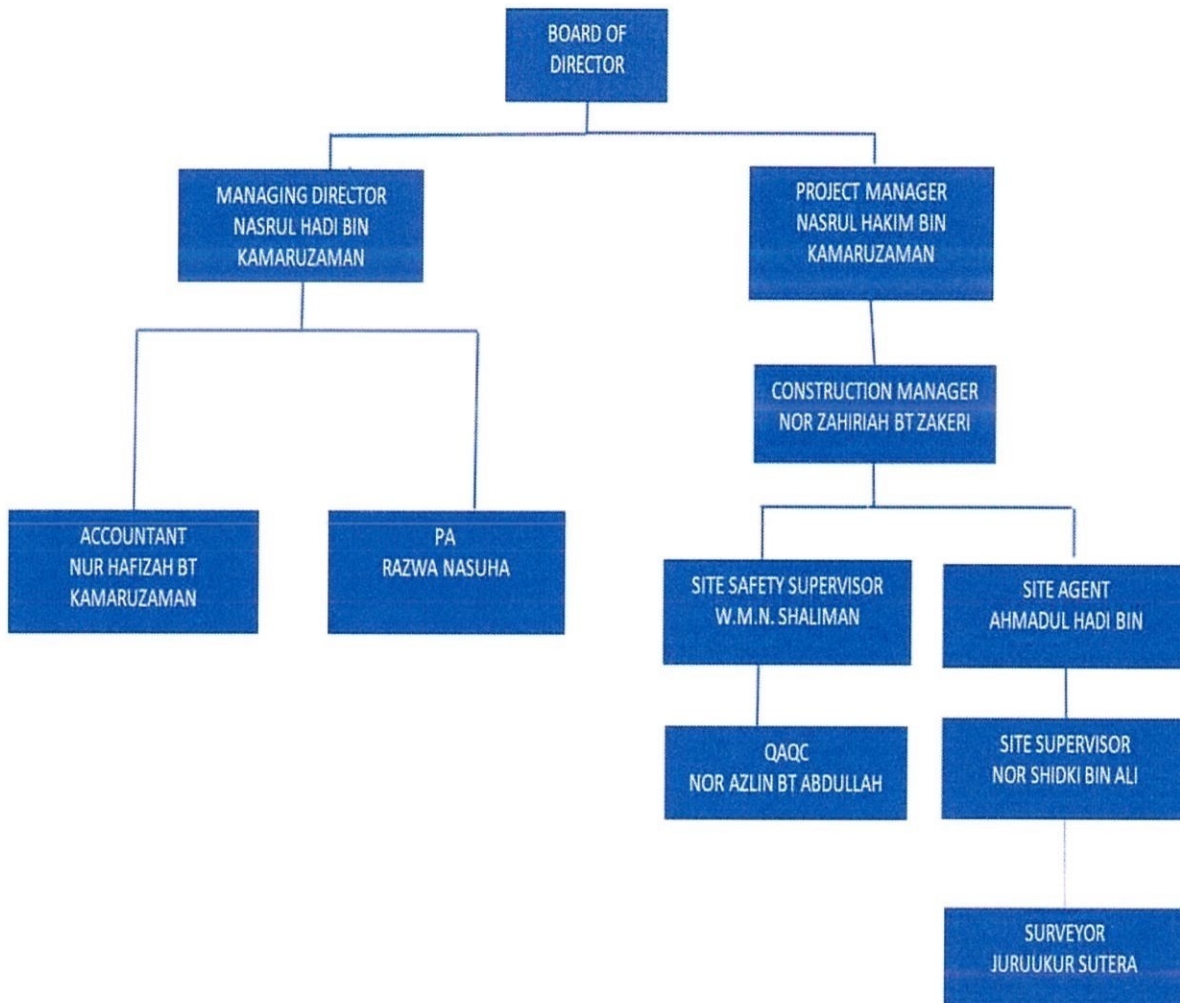


Chart 2.1 Organization chart of NH Aries SDN BHD

2.3 List of completed projects since 2016, 2017 and 2018

This list of projects was taken for 3 years from 2016, 2017 and 2018. This project list involved huge and small projects around Kelantan and Selangor.

2016	2017	2018
Proposal to build a single floor of library building and other related works in Kg. Gemang, Jeli, Kelantan.	Proposal to build and upgrading lot shops near Pasar Jeli, Majlis Daerah Jeli (MDJ) Jeli, Kelantan. (March 2017)	Proposal to upgrade and repair the tourist facilities of CIQ Bukit Bunga entrance door, Tanah Merah, Kelantan. (February 2018)
Proposal to upgrading and repairing works of Masjid Bandar Jeli, Kelantan.	Proposal to build and upgrading dewan MDJ (Dewan Belora), Majlis Daerah Jeli, Kelantan. (March 2017)	Proposal to build and do upgrading and repairing work of Masjid Besar Ayer Lanas, Jeli Kelantan. (April 2018)
-	Proposal to build and upgrading work of Masjid Batu 11, Tanah Merah, Kelantan. (July 2017)	Proposal to upgrading and repairing work of Sekolah Menengah Sri Murni, Hulu Langat, Selangor. (April 2018)

Table 2.1 List of completed project

Ongoing project:

“Construction of Pejabat Kesihatan Daerah (PKD) Jeli, Kelantan.” (May 2018)

CHAPTER 3

CASE STUDY

(AAC BLOCKS MATERIAL USED IN THE CONSTRUCTION OF PEJABAT KESIHATAN DAERAH JELI, KELANTAN)

PROJECT BACKGROUND

The project “Construction of Pejabat Kesihatan Daerah (PKD) Jeli, Kelantan consist of a main building and 5 others building (support block). The other building are the Management Block, Tenaga Nasional Berhad (TNB) substation, Store, Security Post and Disposal House. This project started on May 2018 at Jalan Pekeliling, Bandar Jeli, Kelantan. The main contractor is NH Aries SDN. BHD. Kementerian Kesihatan Malaysia (KKM) is the client and Jabatan Kerja Raya (JKR) as the consultant. The cost of this project is approximately around RM 15,993,459.14. The duration of project took 88 weeks and is still in progress. This project applied the Industrialised Building System (IBS) for framed structure and first floor slab of the main building. However, AAC blocks were also used for the non-bearing wall of the construction project.

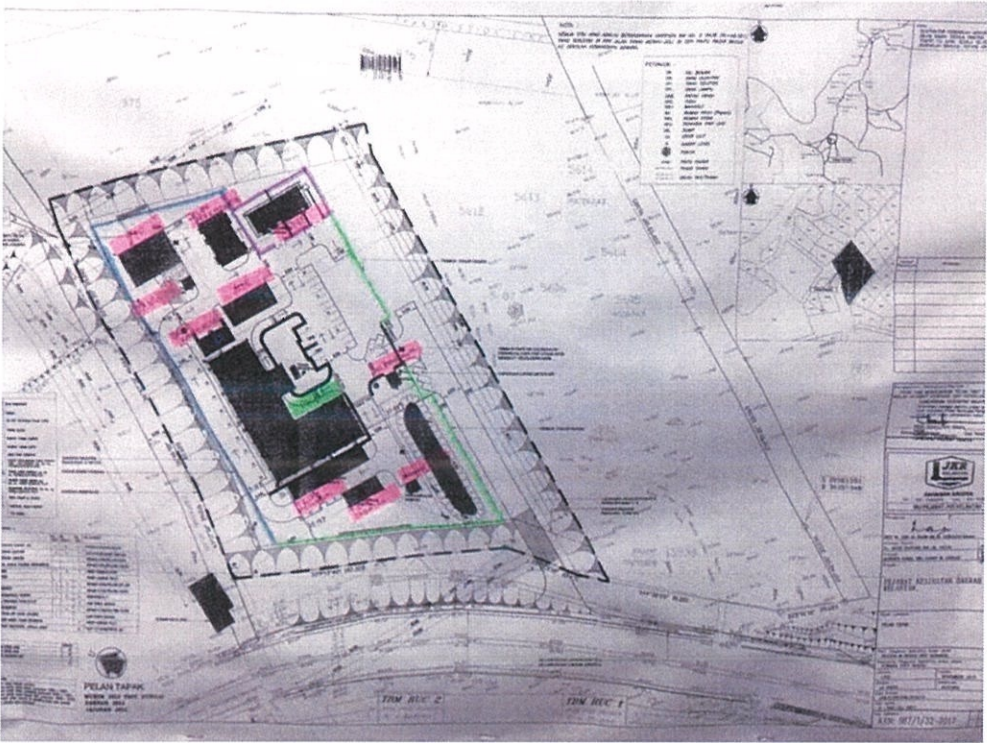


Figure 3.1 Site plan of Pejabat Kesihatan Daerah (PKD) Jeli, Kelantan

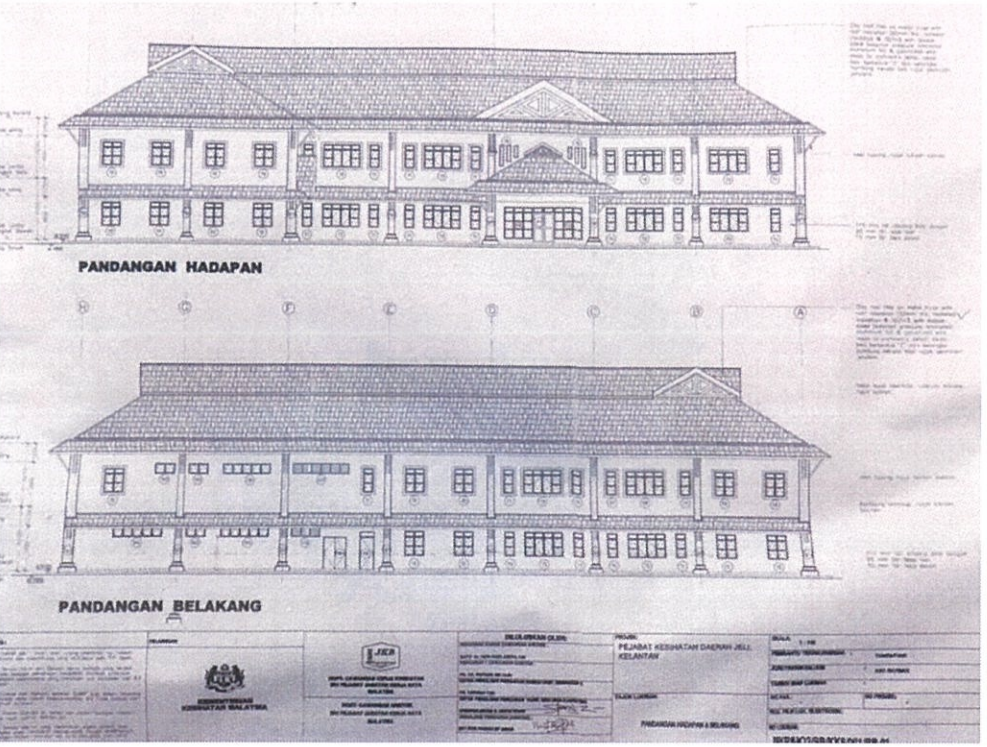


Figure 3.2 Front and rear view of PKD Building

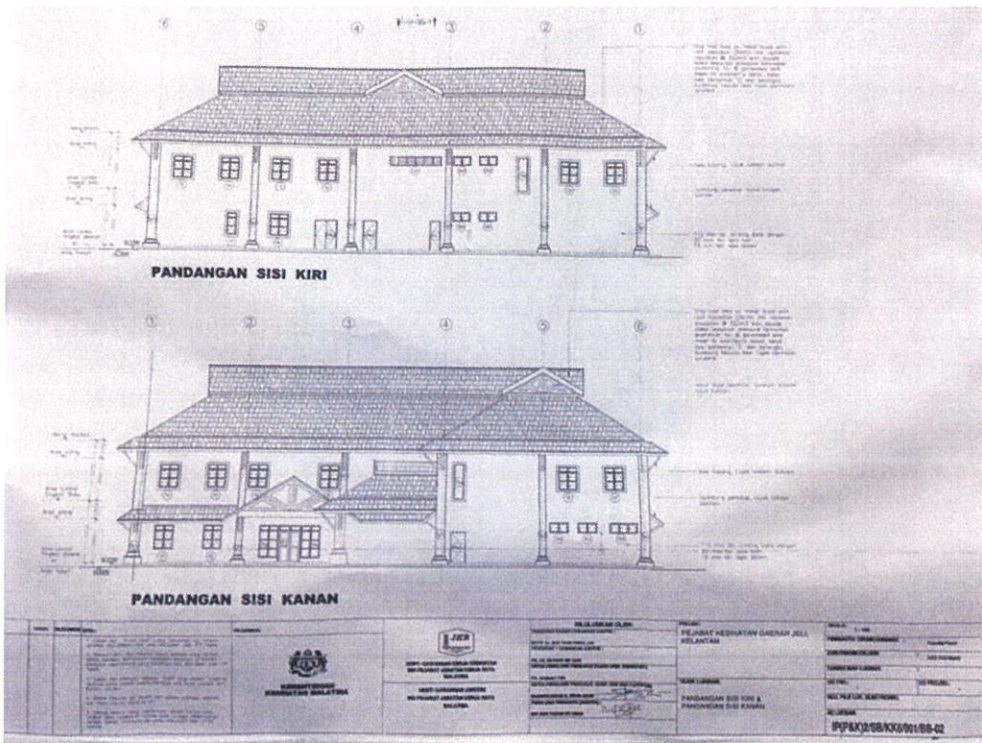


Figure 3.3 Left and right view of PKD Building



Figure 3.4 Framed structure of Industrialised Building System (IBS)

3.1 Product supplier and summary of Autoclaved Aerated Concrete (AAC) Block.

The Autoclaved Aerated Concrete (AAC) block's brand used in this construction site is STARKEN. Starken offers a wide range of cost effective AAC Block solutions for various types of wall applications. They are typically used in the construction of internal and external walls as well as in the construction of fire-rated walls such as party, compartment and separating walls.



Figure 3.6 Workers installing AAC blocks



*Figure 3.7 Main building of Pejabat Kesihatan Daerah Jeli,
Kelantan*

PRODUCT SUPPLIER, SUMMARY, TYPES AND SIZES

1)



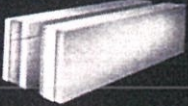
Product	Length x Height (mm)	Thickness (mm)	General Usage
Standard Block • CoolPro3™ • DuraPro5™ • StrongPro7™ 	600 x 200	50, 75, 100, 125, 150, 175, 200, 225, 250, 300	All blocks are applicable for infill walls. Only block thickness 125mm & above are suitable for use as load-bearing walls.
Jumbo Block & Jumbo Block EZ • CoolPro3™ • DuraPro5™ 	600 x 400, 600 x 600, 600 x 1200	100, 125, 150, 200 * Jumbo Block EZ only available in thickness 150 & 200mm	All blocks are applicable for infill walls & load-bearing walls.
Interlocking Block • CoolPro3™ • DuraPro5™ 	600 x 200	150, 200	All blocks are applicable for infill walls & load-bearing walls.

Figure 3.8 Product summary of Standard Block

Standard Block

Applications:

- General internal & external walls
- Party, compartment & separating walls
- Acoustic & fire-rated walls

Working dimension (Length x Height (mm))

Blocks are available in 600 x 200

Starken Standard Blocks offer a fast, convenient and versatile solution for most walling requirement. Each block is equivalent to 7 pieces of common brick.

Starken AAC blocks are easy to work with and can be cut to size with a tungsten carbide-tipped handsaw. This allows maximum flexibility and minimizes wastage.

2)

Packaging				
Length x Height (mm)	Thickness (mm)	Quantity per pallet	Coverage per pallet	
			m ²	m ³
600 x 200	50	360	43.2	2.2
	75	240	28.8	2.2
	100	180	21.6	2.2
	125	144	17.3	2.2
	150	120	14.4	2.2
	175	96	11.5	2
	200	84	10.1	2
	225	72	8.6	1.9
	250	72	8.6	2.2
	300	60	7.2	2.2

Length x Height (mm)	Thickness (mm)	Weights (kg)		
		CoolPro3™	DuraPro5™	StrongPro7™
600 x 200	50	4	5	5.5
	75	6	7.5	8.2
	100	8	10	10.9
	125	10	12.5	13.7
	150	12	15	16.4
	175	14	17.5	19.1
	200	16	20	21.8
	225	17.8	22.5	24.6
	250	20	25	27.3
	300	24	30	32.8

Figure 3.9 Product summary of Jumbo Block / Jumbo Block

Jumbo Block / Jumbo Block EZ

Applications:

- General internal & external walls
- Party, compartment & separating walls
- Acoustic & fire-rated walls

Working dimension (Length x Height (mm)):

Blocks are available in 600 x 400, 600 x 600, 600 x 1200

Starken Jumbo Blocks are specially manufactured up to 6 times larger than standard blocks. Construction output will significantly improve due to the block size, coupled with ease of assembly as blocks can easily be aligned. Jumbo Block EZ is equipped with hand-hold notch at both ends to facilitate handling.

3)

Packaging						
Length x Height (mm)	Thickness (mm)	Quantity per pallet	Coverage per pallet		Weights (kg)	
			m ²	m ³	CoolPro3™	DuraPro5™
600 x 400	100	90	21.6	2.2	15.8	20
	125	72	17.3	2.2	19.8	25
	150	80	19.2	2.9	23.8	30
	200	42	10.1	2	31.7	40
600 x 600	100	60	21.6	2.2	23.8	30
	125	48	17.3	2.2	29.7	37.5
	150	40	14.4	2.2	35.6	45
	200	28	10.1	2	47.5	60
600 x 1200	75	40	28.8	2.2	37.8	45.4
	100	30	21.6	2.2	50.4	60.5

Figure 3.10 Product summary of Interlocking Block

Interlocking Block

Applications:

- General internal & external walls
- Party, compartment & separating walls
- Acoustic & fire-rated walls

Working dimension (Length x Height (mm))

Blocks are available in 600 x 200

Construction gets easier and neater with the introduction of Starken Interlocking Blocks. Blocks edges are profiled with tongue and grove interlocking joint system that does not only make wall construction much easier but also produce a more stable wall.

However, this construction project only uses AAC Blocks in 2 sizes which are 100 x 600 x 200 and 225 x 600 x 200. This decision has been made with the discussion and agreements of parties involved in this project as material types, sizes, and quantity affect the cost of the whole project.

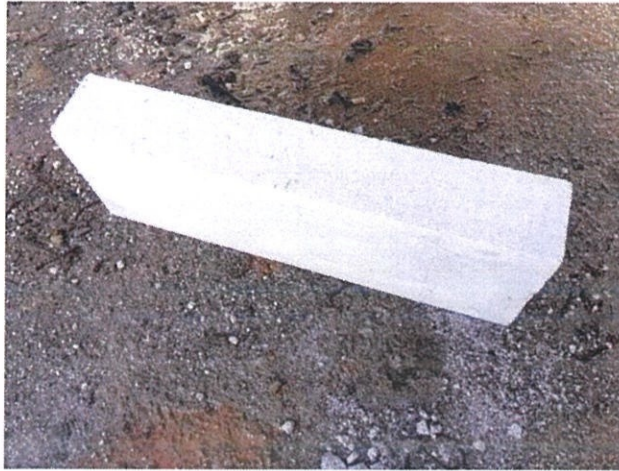


Figure 3.11 AAC block with size 100 x 600 x 200



Figure 3.12 AAC block with size 225 x 600 x 200

This project uses AAC blocks with the size of 100 x 600 x 200 more than 225 x 600 x 200. As evidence, these are the pictures of those building involved with the two sizes of the AAC Blocks.



Figure 3.13 Main building of PKD

This is the main block of the project which is the office. It consists of 225 x 600 x 200 size AAC blocks. Used at the AHU room and vault room because of the private and confidential stuff.



Figure 3.14 Store building

This is the store building of the health department project. It uses 100 x 600 x 200 size AAC blocks for the whole building. 80% of the work has been done and is still in progress.









Figure 3.15 TNB room

This is Tenaga Nasional Berhad (TNB) substation. The TNB substation is specially made with 100% of 225 x 600 x 200 size AAC blocks. This is because the TNB substation has a transformer and is exposed to high voltage.

3.2 Installation of the Autoclaved Aerated Concrete (AAC) Block.

Basic components and accessories for installation:

NO.	COMPONENTS	DIAGRAM
1.	Aac Blocks	
2.	Fiber Mesh (Fiber Glass Reinforcing Tape)	
3.	Thin Bed Adhesive	

4.	Skim Coat Finish	
5.	Skim Coat Base	
6.	Render	


7.	ST 2 (Column/Soffit Tie)	
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Table 3.1 Basic components and accessories for installation

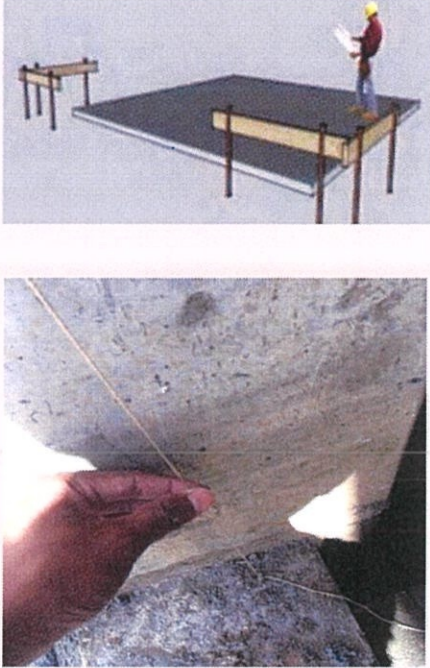

Basic installation tools:

NO	COMPONENTS	DIAGRAMS
	<p>Notched trowels (100mm, 125mm, 150mm & 200mm)</p>	 <p>Notched trowels available in: 100mm, 125mm, 150mm & 200mm.</p>
	<p>Tungsten Carbide Tipped Saw</p>	
	<p>Hand Drill</p>	
	<p>Standard Masonry Trowel</p>	

	Rubber Mallet	
	Spirit Level	

Table 3.2 Basic installation tools

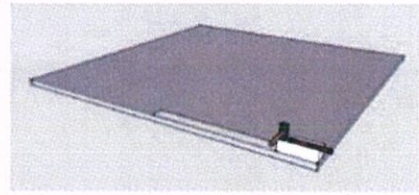
Block Installation Guidelines

STEP	PROCEDURE	DIAGRAM
1	Lay out wall lines on building slab by control lines	 <p>The diagram for Step 1 consists of two images. The top image is a 3D perspective view of a rectangular building slab supported by a wooden formwork structure. A worker in a red shirt and yellow hard hat stands on the slab, holding a string line. The string line is stretched across the slab to define the wall lines. The bottom image is a close-up photograph of a person's hand holding a string line against a rough concrete surface, demonstrating how to lay out the wall lines.</p>
2	Full width ½' deep sand-cement mortar joint using a masonry trowel is placed at the highest corner of the slab.	 <p>The diagram for Step 2 consists of two images. The top image is a 3D perspective view of a rectangular building slab supported by a wooden formwork structure. A worker is standing on the slab, and the mortar joint is visible at the corner. The bottom image is a close-up photograph of a masonry trowel being used to apply mortar to a block. The trowel is held at an angle, and the mortar is being spread across the top surface of the block.</p>

3

The first corner block in the sand-cement mortar is set and adjust the joint as needed.

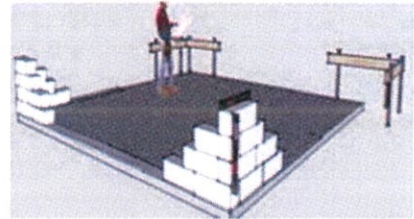
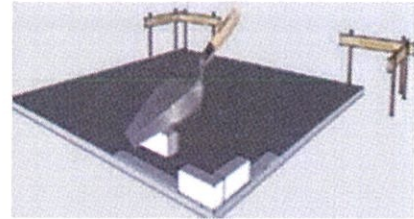
Lower and raised the block is done by tapping down with a rubber mallet or by adding additional mortar beneath to achieve the required height.



4

The second corner block is set up and adding thin-bed mortar to the head joint with the ¼ inch notched trowel.

Repeat for the other corners.





<p>5</p>	<p>After setting up the corners, remaining wall is built up with the proper measure so that no space is left between the blocks. An overlapping of the block is done with the center of other blocks. After every 5;6 level of blocks, a lintel has to be made with just two 6-8 mm iron rod and a propret measurement has to be done to get the wall completely horizontal.</p> <p>Next, Lintel is applied as required.</p>	 
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Table 3.3 Block Installation Guidelines

3.3 Advantages of Autoclaved Aerated Concrete (AAC) Block.

There are many advantages of Autoclaved Aerated Concrete (AAC) Block:

1. Fire Resistant – More superior than traditional masonry for products with fire resistant up to 4 hours for a nominal block thickness of 100 mm.
2. Cost-effective – Speed and ease of installation result in cost savings compared to traditional masonry construction.
3. Impact Resistant – Wall erected using 100 mm thick AAC products is classified as “Severe Duty” grade and able to withstand impact loads potentially resulting from rough usage.
4. Good Workability – AAC Block can be easily sawn, cut, carved, nailed or drilled using ordinary hands tools.
5. Thermal Comfort and Energy Saving – AAC Block’s excellent thermal insulation properties result in improved comfort level and saves heating and cooling costs.
6. Lightweight – AAC Block density is about one-fifth of that of normal concrete blocks, making it easily handled.
7. Water Resistant – AAC Block contains millions of closed microscopic cells which strongly resist moisture from passing through.
8. Eco-friendly – AAC Block to help reduce at least 30% of environmental waste, decrease 50% of greenhouse radiation and over 60% integrated energy on the surface of brick.
9. Dimensional Accuracy – Blocks are manufactured under factory environment using state-of-the art modern machineries resulting in products with tighter dimensional tolerances.
10. Durable – History of usage dated more than 50 years protecting building envelopes and remain durable even under extreme weather conditions.

Cost-saving Benefits

1. Save up to 25% of Foundation Cost
-25% less foundation required

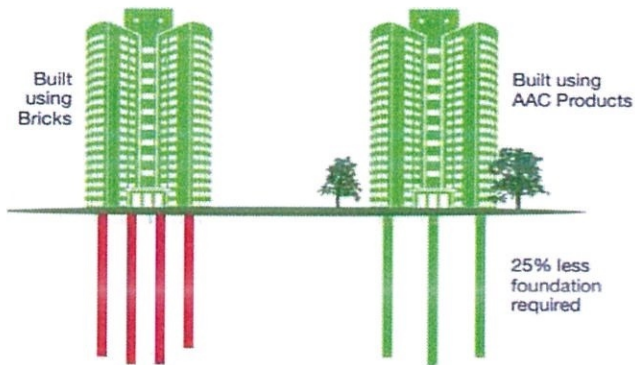


Figure 3.16 Cost-saving benefits

2. Wall Installation speed
-Speed than brick

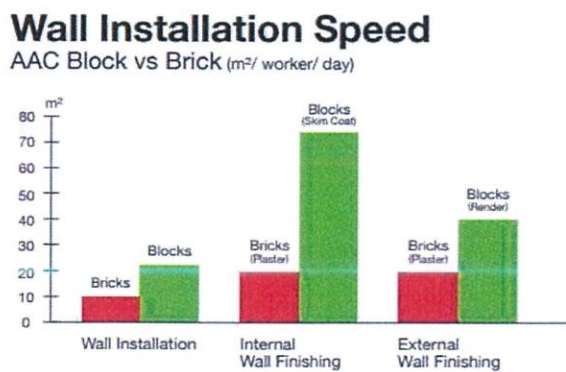


Figure 3.17 Wall installation speed chart

3. Thermal Control
-Heat Insulation 6 times superior than clay brick

CHAPTER 4.0

CONCLUSION

There are several types and sizes of AAC blocks in the market, such as Standard Block, Jumbo Block/Jumbo Block FZ and Interlocking Block. The ingredient is different between the types of blocks. The functions are also different between the types of AAC blocks. The types and size of blocks is chosen according to the necessity and economy of the project.

The laying of AAC blocks starts from doing the lay out wall lines on building slab to complete the procedure. The stability, durable of the wall and good workability are needed during the plastering work as it is very important to maintain the quality. Distributor also shared the information regarding the laying of blocks activities in the catalogue.

As many knows, AAC Blocks have many advantages than other blocks, such as fire resistant, good workability, water resistant and eco-friendly. Other than that, the advantages of AAC Blocks can reduce risk of damage wall, saving the cost for wall element and easy the workers to installing the blocks.

The parties involved in the project named “Construction of Pejabat Kesihatan Daerah (PKD) Jeli, Kelantan” chose the AAC Blocks for wall element. This is due to the use of AAC blocks will speed up the installation process. The quality of wall element will also increase because of the AAC blocks application.

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APPENDIX

AAC Block Wall Corners

- For Wall Without Horizontal RC Stiffener

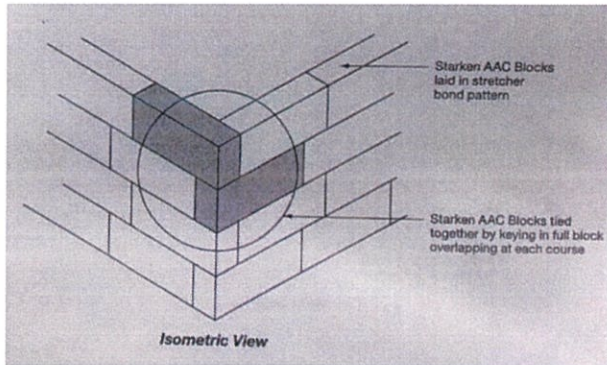


Figure 4.1 AAC block wall corners

AAC Block Wall to Block Wall Junction

- For Wall Without Horizontal RC Stiffener

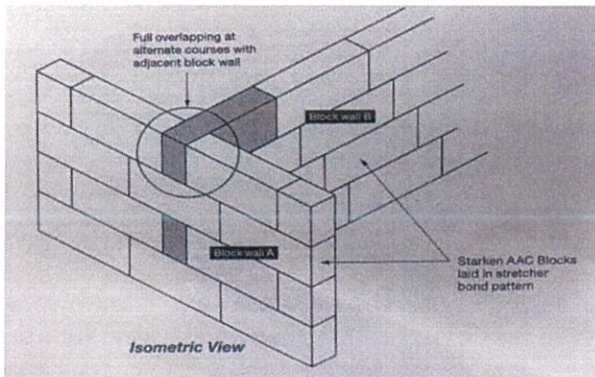


Figure 4.2 AAC block wall to block wall junction

AAC Block Wall & Other Masonry Wall Junction

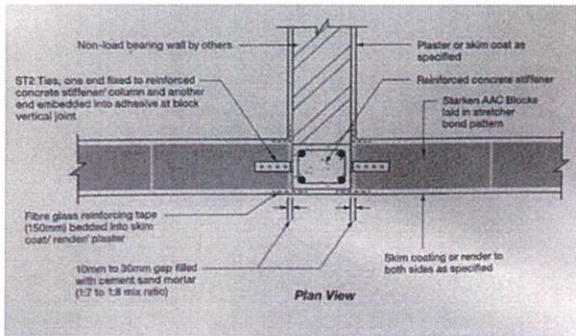


Figure 4.3 AAC block wall & other masonry wall junction

AAC Block Wall & Loadbearing Wall

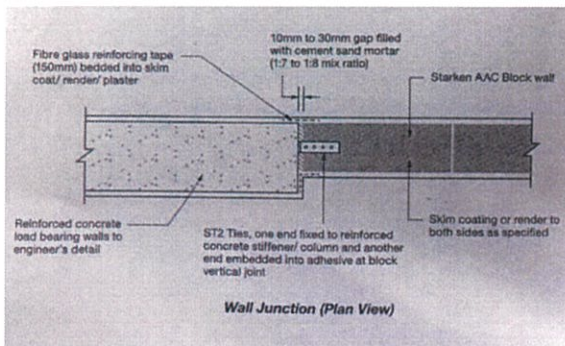


Figure 4.4 AAC block wall & loadbearing wall