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The Development of Flight Training Operation for Tanjung Laboh Airport

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Abstract: Flight training operations is very important to world of aviation today because it is one of the important criteria that drive the industry forward. Many people start to involve themselves into the world of aviation to become a professional pilot, but there are lack of number of flying school available here in Malaysia. Therefore this study will discuss on the planning and future development of flight training operation in LTTL. This airport will be used later to aid in the process of training purpose in order to produce the professional pilot amongst UTHM student in the future. This development will include the design of facilities and the procedure of operation for flight training purposes in LTTL. The regulation from the responsible authority which is CAAM and ICAO has been followed in order to make sure all the facilities is built by following the regulations and its specification, and the procedure of operation for flight training is followed the rules fixed by the authorities body. The design of facility is being proposed and design by using Solidwork 2017, it is design based on the requirement needed by LTTL. Facility which is being propose is runway, hangar, air traffic control tower and fuel storage store. For the procedure of operation, the procedure for take-off and landing is being developed by following the procedure for VFR aircraft since in LTTL all aircraft is using VFR. Besides that, the airspace for LTTL is also being developed by referring to Malaysia's airspace to identify allowable airspace for training area. The suggested length for runway is obtained based on MTOW of an aircraft. All of the design and procedure of operation is provided by following the regulation being set by authorities' body

Keywords: Flight, Training, Operation, Tanjung Laboh Airport, Runway

1. Introduction

This chapter will involve more on reading and choosing on some information for design of facility and procedure of operation for flight training purposes. These two things need specific regulation which is authorize by authority body in world of aviation which is International Civil Organization Aviation (ICAO) and Civil Aviation Authority of Malaysia (CAAM) in order to develop the flight training operation. There are few main facility need to be develop to the required standard for LTTL, it is:

i. Runaway
ii. Hangar
iii. Fuel storage
iv. Air Traffic Control

For the procedure of operation for the light training purposes, there are few procedure that had been developed by following the required standard for LTTL based on the reference from ICAO, Annex and CAAM. Those operation are:

i. Take off procedure
ii. Landing procedure
iii. Maximum Take Off Weight (MTOW)
iv. Airspace

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2. Introduction

2.1 Runway

In order to develop a runway, it will be directly related to its physical characteristics which is the number in orientation of runways. There are few important factor should be taken in this physical characteristic which is usability factor, as determined by the wind distribution. The number and orientation of runaways at and aerodrome should be such the usability factor of the aerodrome not less than 95% for the aeroplanes that the aerodrome is intended to serve. [1-4] As we know every aeroplane should be in normal circumstance during landing or take-off. The other physical characteristic is actual length of runways. For the primary runways the actual length of runway provided must meet the operational requirement of the airport which is refer to the type of aircraft will landing and take-off. It is important to know the take-off and landing requirement for each aircraft as shown in Table 1 that will use the runways to determine the length of runway should be provided and to make sure this operations can be conducted in both directions of the runway. For secondary runway it has similar requirement as primary runway except it must adequate with the aeroplane that will use it.

Table 1: Length Requirements – UUU Representative Aircraft [5]

Aircraft	Approximate Runway Required (feet)
Cessna 172Q Cutlass	1690
Piper PA-31-300 Navajo	1950
Piper PA-23 F Turbo Aztec	1980
Beechcraft 58 Baron	2101
Raytheon King Air C-90	2261
Eclipse 500 Micro Jet	2342
Cessna Caravan 208B	2840

Runway length assumes clearing a 50 foot obstacle in standard weather conditions.

2.2 Hangar

There are three important elements of design requirement which is hangar building, hangar areas and personnel. In a minimum requirement for hangar is its framing must be build up with the steel material. Most of the hangar is build up with steel as its frame. Then for the floor and ramp construction, the floor must be constructed and having a layer of concrete for 5 inch thickness.[5-10] The design and result of the test must bearing the seal by the registered architect or engineer before being submitted to the Airport Authority. For the door, it was suggested the Bi-fold door is very suitable to use because of their ease of operation. Approved swing out, overhead or sliding doors may be used. All pedestrian doors must be of pre-finished metal construction. To design the most optimum space and size of the hangar it is better to design the aircraft parking layout that are specific for one size and shape of aircraft only. There are several types of aircraft parking layout which are:

- Standard T-Hangar
- Nested T-Hangar
- Nested T-Hangar with Jet Pod, Modification
- Nested T-Hangar with the clear span end unit
- Individual Clear Span Hangar
- Consecutive Clear Span Hangar
- Back-To-Back Clear Span Consecutive Hangar

2.3 Fuel Storage

Fuel storage tank is one of the important facility needed in an airport, without this the fuel does not have any safe place to be stored. As we know fuel is very flammable substance and must be stored very carefully. There are few types of aircraft fuel such as Jet A-1 and Avgas which is expensive. Thus, it need a safe storage place. There are no comprehensive regulation regarding to the fuel storage, but there are still few special requirement for operating and maintenance considerations. The important requirement for fuel storage is, it shall surrounded by security barrier fence with lighting and utilize lock to discourage pifaferage, as well as sabotage. The fuel storage must be lock when it is unattended and uninspected to prevent from being stole. Every fuel storage in an airport shall have fire equipment, at least the minimum requirement must be meets. Minimum requirement fire equipment consist few handheld dry-powder extinguisher at convenient location or foam spray equipment. [11-14]

2.4 Air Traffic Control

In order to develop the new control tower, the heights of it is the first thing to be decide. To build the good control tower it must meet the required height, have ample space to ensure an optimum working environment, be energy sufficient and durable but all of this must at the moderate cost. Besides, if control towers is located at top of the terminal building, it will have problem with space when there are increase number of tower staffing and equipment. Next, it is better to separate control tower structure with the terminal building to fulfil operational purpose and get the best design. It height is sufficient to best meet ATC needs which is the height of the tower should be such that, at normal eye level (about 1.5 m above the floor of the tower cab) the controller is provided with the visual surveillance previously described. The higher the tower,

the more easily this optimum surveillance is attained, but at greater financial cost and with a greater likelihood of penetrating the obstacle limitation surfaces.[4] There are other ways to determine the tower height by using 'Determination of Eye Level'.

$$(e) = E\ (as) + D\tan(35\ min + G(s)) \qquad (2\text{-}1)$$

2.5 General Rules for Take-off and Landing Procedure

Take-off is the phase of flight in which aircraft goes from the ground to flying in the air. There are instruction provide in AIP which mention, ATC may specify any or all of the following items when issuing clearance to departing aircraft:

a. Turn after take-off
b. Track to make good before turning on to desire heading
c. Check the base and final flight paths to your runway or to any other conflicting runway from the taxiway hold short line.
d. Announce intentions on UNICOM, for example: Bravo Foxtrot traffic, Skyhawk 4321 taking runway 22, south departure.
e. Once airborne and clear of the local pattern you may switch frequencies to Approach, center, or Flight Service for additional services [15]

ATC may instruct an aircraft departing to leave a reporting point at a specified time or at a specified point or time. If these instructions cannot be fulfilled, the pilot-in-command shall notify ATC. [16-18]

Landing is the last part of a flight, where a flying aircraft returns to the ground. Based on AIP, there are mention about the landing instruction where on initial contact with the appropriate ATC unit, ATC clearance or control instructions for approaching an aerodrome or holding point will be issued to an arriving aircraft. The clearance specifies the clearance limit, route and flight level.[16] An Expected Approach Time is included if the arriving aircraft is expected to be held. For VFR aircraft to land it needs:

a. Check local weather if possible using AWOS or ASOS
b. Listen on the UNICOM to see what runway others are using.
c. If no one else is in the pattern, you should usually choose the runway that gives the best headwind and least cross wind component.
d. Announce your UNICOM frequency 6-10 NM pattern entry intensions from the airport. For all runways found in Airport / Facility Directories, follow pattern instructions. If not noted, LEFT traffic is used by all runways.
e. Be at traffic pattern altitude before entering the pattern itself, usually 2-3 miles from the airport if terrain allows.[15]

2.6 Maximum Take-Off Weight (MTOW) and Runway Length

Maximum Take-Off Weight (MTOW) is the maximum weight for an aircraft to take off due to structural or other limit. MTOW for an aircraft is usually defined by the manufacturer. It does not vary with changes in temperature, altitude or runway available and it value is fixed. But it help to develop a new runway by suggested a suitable length of runway need to be built. There are many type of small airplane with different value of MOTW and approach speed in this world. It can be categorized into few category which is:

2.6.1 Small Airplanes with Approach Speed of Less than 30 knots

Airplane with approach speed less than 30 knots is considered as ultra-light airplane. It recommended length for runway development is 92 meters at mean sea level.

2.6.2 Small Airplanes with Approach Speed of between 30 knots and 50 knots.

Airplane with approach speed in between 30 – 50 knots has a suggested runway length of 244 meters.

2.6.3 Small Airplanes with Approach Speed of 50 knots or more with MOTW of 5670kg or less

Airplane which has approach speed of 50 knots or more with MOTW of 5670 kg and below need to refer to few graph and categories in order to get it suggested runway length.

2.7 Airspace

2.7.1 Type of Airspace Area

In every airspace where will be a potential for aircraft operation it will have some place is being restricted temporarily or permanently. It is classified according to three types of areas defined by ICAO, it is:

a. Danger Area

A defined dimensional airspace within which aircraft hazardous activities may exist at specified times. This term is only used when the potential hazard to aircraft has not resulted in airspace being designated as restricted or prohibited. The effect of creating the hazard area is to warn aircraft operators or pilots that they need to assess the hazards associated with their responsibility for aircraft safety.

b. Prohibited Area

An airspace of defined dimensions, above a State's land areas or territorial waters, where aircraft flight is prohibited. This term is used only when an aircraft is not allowed to fly within the

designated airspace under any circumstances at any time.

c. Restricted Area

An airspace of defined dimensions above a State's land areas or territorial waters where aircraft flight is restricted under certain specified conditions. This term is used when the flight of an aircraft within the designated airspace is not strictly prohibited, but can only be fulfilled in specified condition. Thus, flight prohibition except at certain specified times leads to airspace being designated as a' restricted area' as would be prohibited except under certain meteorological conditions. Similarly, flight prohibition leads to the designation of a restricted area unless special permission has been obtained. However, flight conditions imposed as a result of applying rules on air or air traffic service practices or procedures (e.g. compliance with minimum safe heights or rules resulting from establishing controlled airspace) do not constitute conditions requiring designation as a restricted area.

2.7.2 Classification of Airspace

Air Traffic Services airspaces are classified and designated in accordance with follow the type of airspace, level of flight and it classification as shown in Table 2.

Table 2: Airspace Classification (AIP)

Airspace	Levels	Classification
FIR (Including ATS routes)	FL 460/ FL 250	A
ATS routes and TMAs	FL 250/ FL 150	A
	FL 150/ 10 000 FT ALT	B
	10 000 FT ALT/ LOWER LIMIT	C
CTRs and ATZs	UPPER LIMIT/ GND/ SEA	C
Uncontrolled Airspace	Below FL 250	G

3. Methodology

This chapter describes the methodology of the present study which includes a theoretical aspect of hangar, runway, air traffic control tower and fuel storage with the method of carrying out the design process. The objectives of this study is to determine the design requirement for LTTL facility, several literature reviews on books, journal and website had been analysed. After that, the design of the facility was designed by using CAD software. Next, the research flowchart can be used to explain on how the process of the research was done. It shows the process works from the beginning until the end of the research. It compromise some component from the problem statement, literature review, methodology, confirmation parameters, result, analysis, discussion and final conclusion of the research.

The design will be based on the requirement and specifications from authorities' body which is ICAO and annex. Besides, the design from other similar airport also been taken.

The requirements are set from reading on a literature review that summarize few journals, website and thesis that had been done before. From the reading, the requirements can be separate based on the type of facility which is runway, hangar, air traffic control tower and fuel storage.

The drawing process is carried out by using a SolidWorks software. The drawing of the facilities will be following all the requirements and the conformity of LTTL.

To design a hangar in SolidWorks firstly, we need to sketch the basic shape of the hangar which is rectangle and a triangle. Rectangle is for wall and triangle for the roof. Then, we put the dimension of each shape based on the propose design. After each shape has its dimension, extrude boss the shape to make it into 3D shape. Later, we use the shell button to make a whole at the rectangle shape for the inner space of the hangar. Lastly, we assemble both part by using mate where both shape will combine perfectly.

A site visit had been done to complete the study for this project. From the site visit few information had been obtained, it is:

a. The real situation of LTTL
b. The direction for aircraft to take-off and landing
c. Obstacles which can affect take-off and landing procedure
d. Marks can be used for aircraft to landing.

The direction for aircraft to take-off and landing were obtain by doing some observation, reading a map and direction by using compass. Then, all of the information obtained was recorded in a notepad to be used for the report writing.

4. Results

4.1 Runway

Based on the area LTTL occupied and the operation that will be operating at there which is Flight Training School it is suitable for it to have runway with length of 1200 meters and width of 20 meters. The type of aircraft used for the flight training is the main factor to determine the length and width of the runway.

There are many type of surface for the pavement of runways as stated in literature review, one of the surface is grass. Since, LTTL is used for training flight for student Professional Piloting in Aeronautical Engineering of University Tun Hussein Onn Malaysia so the most suitable surface is grass because it is the most soft surface besides than gravel. The other reason is due to the limitation of budget to develop this place

since it is rarely a flying school operated by its own without sharing its runway with commercial airport. So high amount of budget needed to develop this place.

4.2 Air Traffic Control Tower

Based on the LTTL runway, the design of ATC tower can be designed in order to control the airport traffic. There are three main part of ATC tower and three types of shaft as mention in literature review. For this airport the ATC will be design by using Non-functional shaft combine with the base building. The wall of this building will be built by using concrete and the windscreen of the cab will be used glass. The disadvantages for this design is large area is needed and the financial cost for design and construction is very high. However, it will give some benefit where the base building can become the classroom for Air Control Tower in future besides can become place to store any equipment.

The best placement for this facility is it must enables clear lines of sight, unimpaired by direct or indirect external light sources such as apron lights, car parking lights, surface traffic and street lights and reflective surfaces.[8]

Since this airport is still in development process its best to place this facility at the middle of runway, so the controllers can see the runways from end-to-end.

The most important thing in design ATC tower is its height, based on the equation (2-1), the calculation will be:

$$(e) = (as) + D\tan(35\ min + G(s))$$

$$(e) = (7) + 1000\tan(35\ min + (-2))$$
$$= 16.6\ m$$

4.3 Hangar

This hangar will be design for two purposes, for the storage of training aircraft and place for student of Aircraft Maintenance in Aeronautical Engineering Technology of UTHM to have their class and workshop. It will ease their studying process due time saving to move from class to workshop. It can be seen in Fig. 1

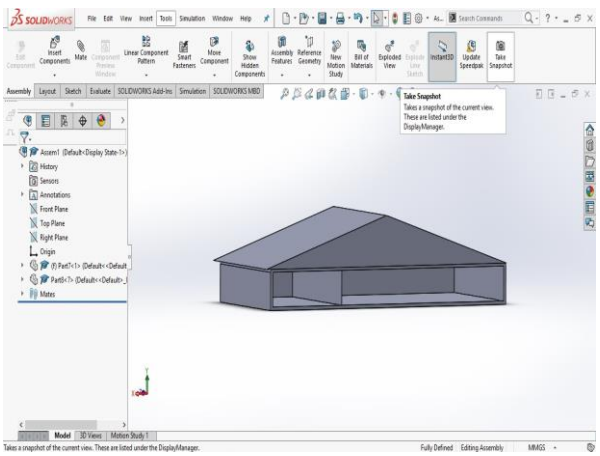

Fig. 1: Hangar Design

Hence, this hangar will be designed for two training aircraft, one non-operational aircraft by following specification and a classroom for maintenance student. The frame of the hangar will be build up by using steel because most of the training flight hangar used this material for their hangar's frame as mention in the literature review. Next, the floor and ramp will be built by using the concrete as it is the most suitable material. Then, Bi-fold door will be used for the hangar's door because it is suitable with our hangar specification and its operation is easy. This hangar will have two different layout which the design is choose from the literature review, the design is:

a. Training aircraft = Standard T-Hangar layout
b. Non-operating aircraft = Individual clear span hangar layout. It can be seen in Fig. 2 and Fig. 3.

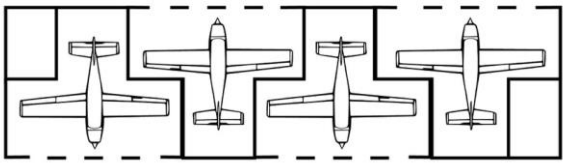

Fig. 2: Standard T-Hangar Layout

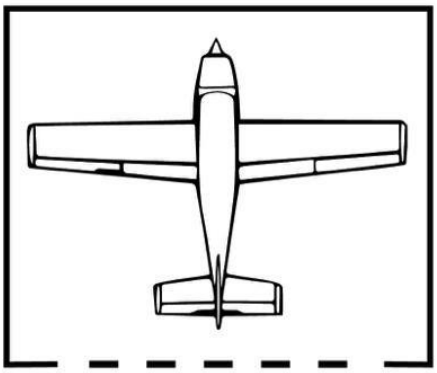

Fig. 3: Individual clear span hangar layout

4.4 Fuel Storage

For the small airport or military airport they not using fuel farm as their place to store their fuel. Most of this airport only use simple fuel storage looks like a simple building. This facility must have in every small airports like LTTL to make sure their fuel is safe in the storage. It is to prevent the fuel from being stolen or other incident that can cause big problem.

The wall and floor for this facility will be built by using concrete which is to keep the fuel in indoor environment and protected from rain. Next the door for this facility will be used roller shutter type because it is easy to be handed. The size of the facility is based on the number of fuel barrel being stored and fit for the forklift to move in and out from this facility. Then, it will have the good air ventilation system because the smell of the fuel can affect our health. Based on the tips in literature review, all of the tips will be implement to

this facility. Lastly, it will be locate near the taxiway to ease the process and movement of aircraft into the runway. The design can be refer in Fig. 4.

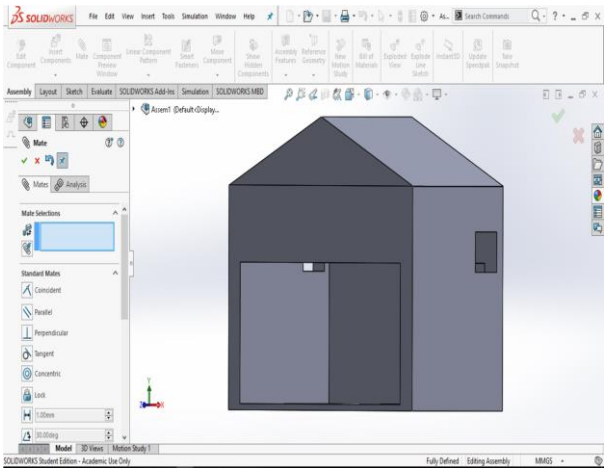

Fig. 4: Fuel Storage Design

4.5 Procedure of Operation

4.5.1 MTOW determine the runway length

To gain the suggested length for runway, it can be gain by refer to Table 3 and 4.

Table 3: Parameters for Runway Length Calculation

Temperature (mean day max hot month) Refer Fig. 5	33.73°C / 92.74°F
Elevation	23 FT

Table 4: Aircraft MTOW and Approach speed

AIRCRAFT	MTOW	APPROACH SPEED
Piper 180	975 kg	70 – 75 knots
Cessna Skyhawk	1157 kg	60 – 70 knots

DATE	LOWEST TEMPERATURE (°C)	HIGHEST TEMPERATURE (°C)
1 APRIL 2019	32	25
2 APRIL 2019	33	24
3 APRIL 2019	30	23
4 APRIL 2019	36	23
5 APRIL 2019	35	24
6 APRIL 2019	34	24
7 APRIL 2019	35	23
8 APRIL 2019	35	24
9 APRIL 2019	34	25
10 APRIL 2019	35	25
11 APRIL 2019	32	25
12 APRIL 2019	33	25
13 APRIL 2019	34	24
14 APRIL 2019	32	25
15 APRIL 2019	36	24
16APRIL 2019	35	25
17 APRIL 2019	35	25
18 APRIL 2019	35	25
19 APRIL 2019	36	25
20 APRIL 2019	32	24
21 APRIL 2019	35	24
22 APRIL 2019	33	25
23 APRIL 2019	35	25
24 APRIL 2019	33	25
25 APRIL 2019	34	25
26 APRIL 2019	30	25
27 APRIL 2019	30	24
28 APRIL 2019	35	24
29 APRIL 2019	34	24
30 APRIL 2019	34	24

Fig. 5: Temperature

Based on data obtain and Fig. 6, the suggested length for runway is:

i) Suggested Length based on Fig. 6: 944.84 m
ii) Jabatan Kejuruteraan Aeronautik Length: 800 m
iii) Proposed Runway Length: 1.2 km

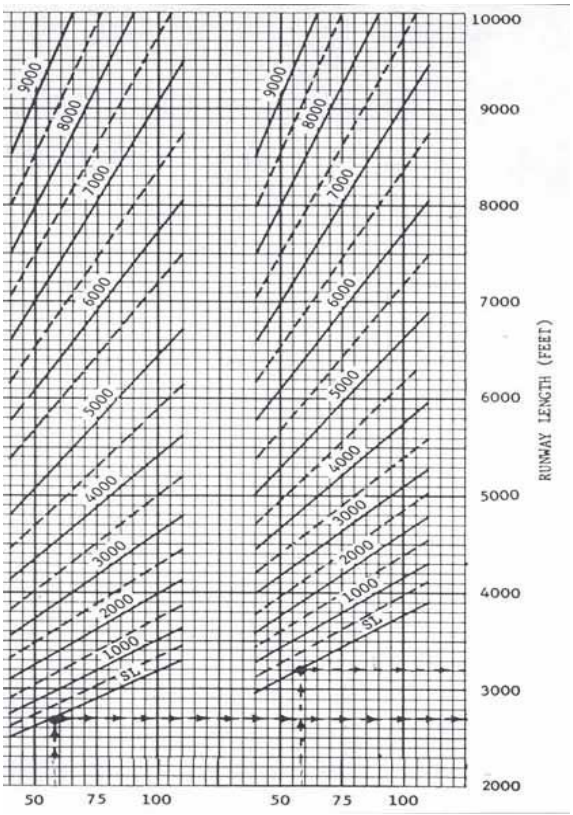

Fig. 6: Runway Length

4.5.2 Classification and Type of LTTL Airspace

Airspace : Uncontrolled Airspace
Classification : Class G

Uncontrolled airspace is there are no ATC service is not deemed necessary or does not provided for some practical reason. It has flight level below 250 FL and it is suitable with both aircraft being used. There are two class which is place under this type of airspace, it is Class G and Class F.

For Class G it is defined to have both type of flight which is IFR and VFR or either one. Where, IFR and VFR flights are permitted and receive flight information service if requested. It also suitable with LTTL since the aircraft is using VFR as their type of flight.

4.5.3 Proposed Training Area

Table 5: Training Area

Location	Latitude / Longitude
WMR 226	From N 1°56.66'E 103°17.02' to N 1°46.78'E 103°6.03' to N 2° 0.01'E 102°58.56' to N 2°1.99' E 103°12.24
WMR 224A	From N 01°46'08.61 E 102°56'36.0' along 3NM ARC centred on WMAB ARP (N 01°4'47.5' E 102°59'16.7) to N 01°47'48.4' E 102°59'16.7' then a straight line to N 01°47'48.4 E 103°04'50.4' then along 20NM Arc centred on AP NDB to N 02°00'00.00 E 102°58'30.0' then N 02°03'17.61 E 102°57'55.8' to N 02°09'00.0 E 102°46'12.0' to N 01°55'14.0 E 102°39'07.0' to N 01°46'08.6 E 102°56'36.0'
WMR 224B	A straight line from N 02°11'49.8 E 102°40'22.9' to N 02°25'31.2 E 102°53'04.4' to N 02°03'17.6 E 102°57'55.8' then to N 02°11'49.8 E 102°40'22.9'
WMR 240A	From N1°32.07' E103°21.86 to N1°17.33' E103°16.46 to N1°24.78' E102°53.64' to N1°44.04' E103°0.35 to N1°32.07' E103°21.86

4.5.4 Take Off and Landing Procedure

At LTTL, there are two ends on it runway which is label as Runway 14 and Runway 32. Both of this runway can be used for take-off and landing after having their training done which is located at WMR 240A, WMR224A, WMR 224B and WMR226. In order to perform both take-off and landing there are some procedure need to be followed. Since, only VFR aircraft will be operated at LTTL. The procedure will become more simple compare to procedure for aircraft which use IFR. The procedure is as follow:

Take-off Procedure:

a. Turn after take-off
b. Track to make good before turning on to desire heading
c. Check the base and final flight paths to your runway or to any other conflicting runway from the taxiway hold short line.
d. Announce intentions on UNICOM, for example: Bravo Foxtrot traffic, Skyhawk 4321 taking runway 14, North West departure.
e. Once airborne and clear of the local pattern you may switch frequencies to Approach, center, or Flight Service for additional services.

Landing Procedure:

a. Check local weather if possible using AWOS or ASOS
b. Listen on the UNICOM to see what runway others are using.

If no one else is in the pattern, you should usually choose the runway that gives the best headwind and least cross wind component.

4.5.5 Procedure to Enter Training Area WMR240A from Runway 32 and landing through Runway 14

Fig. 7: Routes

For take-off, pilot in charge should:

a. Check the base and final flight paths to your runway or to any other conflicting runway from the taxiway hold short line.
b. Announce intentions on UNICOM, for example: Bravo Foxtrot traffic, Skyhawk 4321 taking runway 32, south east departure.
c. Heading toward to 137° South East. In order to take-off from Runway 32.
d. Turn to right to enter training area WMR240A.

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e. Once airborne and clear of the local pattern you may switch frequencies to Approach, center, or Flight Service for additional services

For landing, pilot should:

a. Check local weather if possible using AWOS or ASOS
b. Listen on the UNICOM to see what runway others are using.
c. If no one else is in the pattern, you should usually choose the runway that gives the best headwind and least cross wind component
d. From training area WMR240A, heading to factory with green roof (use as marker) and make a U-turn to joining into Runway 14 for landing.

5. Conclusion

The objective of this project is to propose the design of flight facility and develop the procedure of operation for flight training purposes in LTTL. The design of flight training facility have been designed based on other similar small airport have in Malaysia and some study as mention in Chapter 2, besides following the requirement needed by LTTL. For the procedure of operation for light training purposes have been develop for four item only. It have been developed based on study from AIP and few ICAO document. The conclusions obtained are summarizes as follows:

a. All of the facility of flight training can be designed successfully by using Solidworks2017. The design of the hangar must suitable with the size of the aircraft being used. Next, the length of runway also must meet the requirement for aircraft to take off and landing.
b. The suggested length of runway can be determined by using Figure 2 17. Besides, some study of aircraft also needed. It is to know the runway length required by the aircraft to take off and landing without having any problem.
c. The height of ATC tower can obtained based on Equation 1. From the equation it involve the level of eye elevation, average of elevation and distance.
d. A study of ICAO Annex, AIP and CAAM document is strictly to be done in order to develop the procedure and propose facility design. It is because every single thing in aviation world must follow the regulation and law which have been mentioned.
e. There are few restricted airspace that cannot be used for training purposes. But there are some airspace that have their regulation for training aircraft to enter their airspace. All of this info can be obtained from Indoavis Nusantara airspace chart.
f. Therefore, a good and a very detailed study need to be done to develop an airport.

6. Recommendation

To develop training facility and procedure of operation for flight training, there are many aspect and regulation need to be study. A good study of ICAO documents, Annex and AIP is a must. Without a study from these document it is impossible to develop both training facility and procedure of operation that's followed the regulation provide by authorities body.

In future, the development of procedure of operation for flight training can be more focused on other procedure operation such as taxiing, holding and emergency precaution. Those procedure also important to be develop.

Besides that, other design of facility could be proposed if there is a better and more suitable design which can help in minimize the budget and give optimum usage.

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