Study on Sky Brightness and Length of Shadow To Determine The Early Time of Dhuha Prayer

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ABSTRACT--- *Time of prayers have been explained very general in the Qur'an and so thoroughly in the Sunnah to facilitate Muslim to perform prayers. The main purpose of this study was to determine the brightness of the sky and length of shadows during the early time of Dhuha. Based on Islamic law, the time of Dhuha begins when the sun is rising about a spear's length and lasting until the sun transited, but it was encouraged to perform it during the sun is high and hot. On average, the initial time of Dhuha was estimated at 28 minutes after sunrise by The Department of Islamic Development Malaysia. Cermin Beach, Tanjung Tuan, Port Dickson, Negeri Sembilan was chosen as the location because there is a clear eastern horizon and the sun is easily visible with naked eye as it rises. The results of the study found that when the length of shadows was more than 4 times of the stick's and the altitude of the sun exceeding 6°, ensured that is the beginning of Dhuha prayer time. However, the determination of the brightness of the sky can be categorized as instances clear sky and overcast sky based on the physical differences at that time.*

Keywords--- Sky brightness, length of shadows, altitude, *Dhuha* time

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1. INTRODUCTION

Prayer is an obligation that has been prescribed for us by the Islamic law. Therefore, prayers that performed outside the time will not be counted because one of the requirements for a valid prayer is prayer at the specific time period. Therefore, it is an obligation for Muslims to know the beginning and ending of prayer time. Allah s.w.t command :

> *"And when you have completed the prayer, remember Allah s.w.t standing, sitting or lying on your sides. But when you become secure, reestablish (regular) prayer. Indeed, prayer has been decreed upon the believers a decree of specified times."*

The time of prayers has been described in the Qur'an in general and explained in detail by Prophet Muhammad p.b.u.h. Therefore, the integration between the interpretations of the jurists about prayer times should used astronomy application so that scientific method is employed on prayer time's calculation. Hence, it is easily understood and performed properly by Muslims.

Dhuha prayer is the prayer that is performed during Dhuha hours, when the sun rises about a spear's length until the sun is in the middle of the sky (*istiwa'*). The beginning of Dhuha hours is when the sun height from the eastern horizon about a spear length until it transits or on the observer meridian (Abdul Rahman al-Jazari, 2011).

Other opinion stated, Dhuha time began as the sun was rising the day getting hotter and baby camel while sitting down will feel the heat. It will stand-up and walk away. Dhuha time end when the sun reaches its meridian or transit, but encouraged to delay it until the sun has rises high and the day has became hot (Muhammad as-Sayyid Sabiq, 2009).

However, based on the method of calculation, Dhuha hours are calculated as the time of Sunrise plus one-third time difference of Sunrise and Subuh. On average, the Dhuha prayer time is around 28 minutes after Sunrise (Astronomy Research Unit, The Department of Islamic Development Malaysia, 2001).

Date   : 25th March 2013
Subuh Time   : 5.58 a.m
Sunrise Time : 7.14 a.m

Dhuha Time   : Sunrise Time + ⅓ (SunriseTime-Subuh Time)
        : 7° 14' 37'' + ⅓ (7° 14' 37''- 5° 58' 8'')
        : 7° 14' 37'' + ⅓ (1° 16' 29'')
        : 7° 14' 37'' + 0° 25' 29.67''
        : 7° 40' 6.67''

Dhuha Time : 7.40 a.m

Figure 1: Example for the calculation of Dhuha time.

Figure 1 shows the calculation of Dhuha time based on the method that provided by The Department of Islamic Development Malaysia. By this calculation, the Dhuha time on 25th March 2013 was on 7.40 a.m as the time of Sunrise plus one-third time difference of Sunrise and Subuh.

2. INSTRUMENTATION AND METHODS

In this study, we focused on measuring sky brightness and length of shadow through observation of the sun that was carried out at Cermin Beach, Tanjung Tuan, Port Dickson, Negeri Sembilan (101° 51.522'E). Cermin Beach, Tanjung Tuan was chosen because of clear eastern horizon and the sun is easily visible with naked eye as it rises. Thus, the basic instrument used to obtain the data is light meter, sticks, moonC software, DSLR (*Digital Single-Lens Reflex Camera)* and a digital clock.

Sky brightness data, length of the shadow and the altitude of the sun were recorded within one-hour period after the beginning of Sunrise. Light sensor on light meter was pointed towards the sky to obtain sky brightness data and retrieve the length of shadow data by the reading on the value measured on the stick's shadow.

We have chosen the best data on 25th March 2013 as the reference to estimate the sky brightness, length of shadow and sun altitude value for positive reported data in the literature from 23rd January 2013 to 20th April 2013.

3.   RESULT AND DISCUSSIONS

Length of shadow and sky brightness on 25th March 2013

Date   : 25th March 2013   Subuh Time   : 5.58 am
Day   : Monday   Syuruk Time : 7.14 am
Location   : Cermin Beach, Tanjung Tuan   Sky   : Bright
Latitude   : 2° 24.854'N
Longitude   : 101° 51.522'E

OBSERVATION TIME (± 1 SECOND)	LENGTH OF SHADOW (± 0.5 CM)			SKY BRIGHTNESS (LUX)	ALTITUDE (°)
	5 CM	7 CM	9 CM		
7.15	-	-	-	200	-0.258
7.16	-	-	-	300	-0.049
7.17	-	-	-	400	0.161
7.18	-	-	-	400	0.374
7.19	-	-	-	500	0.590
7.20	-	-	-	500	0.808
7.21	-	-	-	600	1.030
7.22	-	-	-	600	1.254
7.23	-	-	-	700	1.481
7.24	-	-	-	800	1.710
7.25	-	-	-	900	1.941
7.26	-	-	-	1 000	2.174
7.27	-	-	-	1 100	2.408
7.28	-	-	-	1 300	2.644
7.29	-	-	-	1 400	2.881
7.30	-	-	-	1 400	3.119
7.31	-	-	-	1 600	3.358
7.32	-	-	-	1 800	3.598
7.33	-	-	-	2 000	3.839
7.34	-	-	-	2 300	4.080
7.35	-	-	-	2 600	4.322
7.36	-	-	-	2 900	4.565
7.37	-	-	-	3 300	4.808
7.38	-	-	-	3 700	5.052
7.39	23	31	37	4 000	5.296
7.40**	**23**	**31**	**37**	**4 400**	**5.540**
7.41	22	30	36	4 800	5.785
7.42	22	30	36	5 200	6.030
7.43	22	30	36	5 600	6.275
7.44	21	29	35	6 000	6.521
7.45	21	29	35	6 400	6.767
7.46	21	29	35	6 800	7.013
7.47	20	28	35	7 400	7.259
7.48	20	28	35	7 800	7.506
7.49	20	28	34	8 300	7.752
7.50	19	27	33	8 800	7.999
7.51	19	26	33	9 200	8.246
7.52	19	25	32	9 900	8.493

7.53	**18**	**25**	**31**	**10 400**	**8.740**
7.54	**18**	**24**	**31**	**11 100**	**8.988**
7.55	**18**	**24**	**31**	**11 400**	**9.235**
7.56	**17**	**24**	**30**	**12 000**	**9.482**
7.57	**17**	**23**	**30**	**12 700**	**9.730**
7.58	**16**	**23**	**29**	**13 400**	**9.978**
7.59	**16**	**22**	**29**	**14 000**	**10.226**
8.00	**15**	**22**	**28**	**14 800**	**10.474**
8.01	**15**	**22**	**28**	**15 500**	**10.722**
8.02	**15**	**21**	**27**	**16 100**	**10.970**
8.03	**15**	**21**	**27**	**16 400**	**11.218**
8.04	**15**	**21**	**27**	**17 000**	**11.466**
8.05	**14**	**21**	**26**	**17 600**	**11.714**
8.06	**14**	**20**	**26**	**18 100**	**11.962**
8.07	**14**	**20**	**25**	**18 700**	**12.211**
8.08	**14**	**20**	**25**	**19 100**	**12.459**
8.09	**14**	**20**	**24**	**19 400**	**12.708**
8.10	**14**	**19**	**24**	**19 900**	**12.956**
8.11	**13**	**19**	**24**	**20 500**	**13.205**
8.12	**13**	**19**	**24**	**21 000**	**13.453**
8.13	**13**	**18**	**23**	**21 200**	**13.702**
8.14	**13**	**18**	**23**	**21 500**	**13.951**

**Dhuha Time = Syuruk Time + 1/3 (Syuruk Time – Subuh Time)
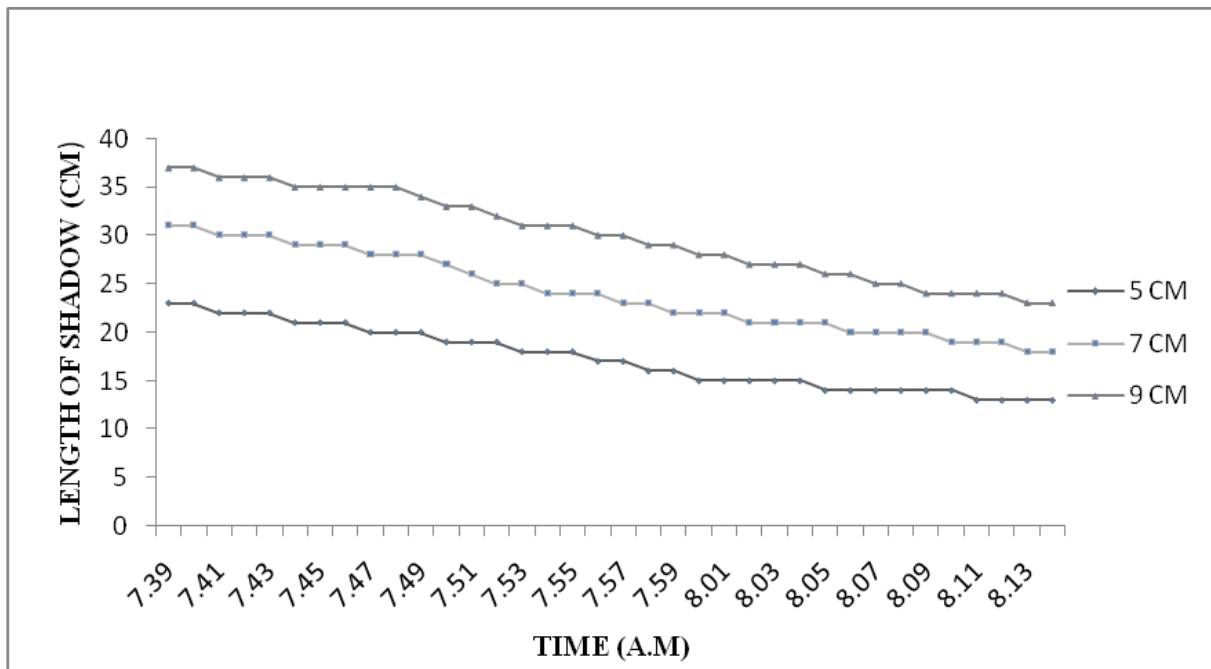

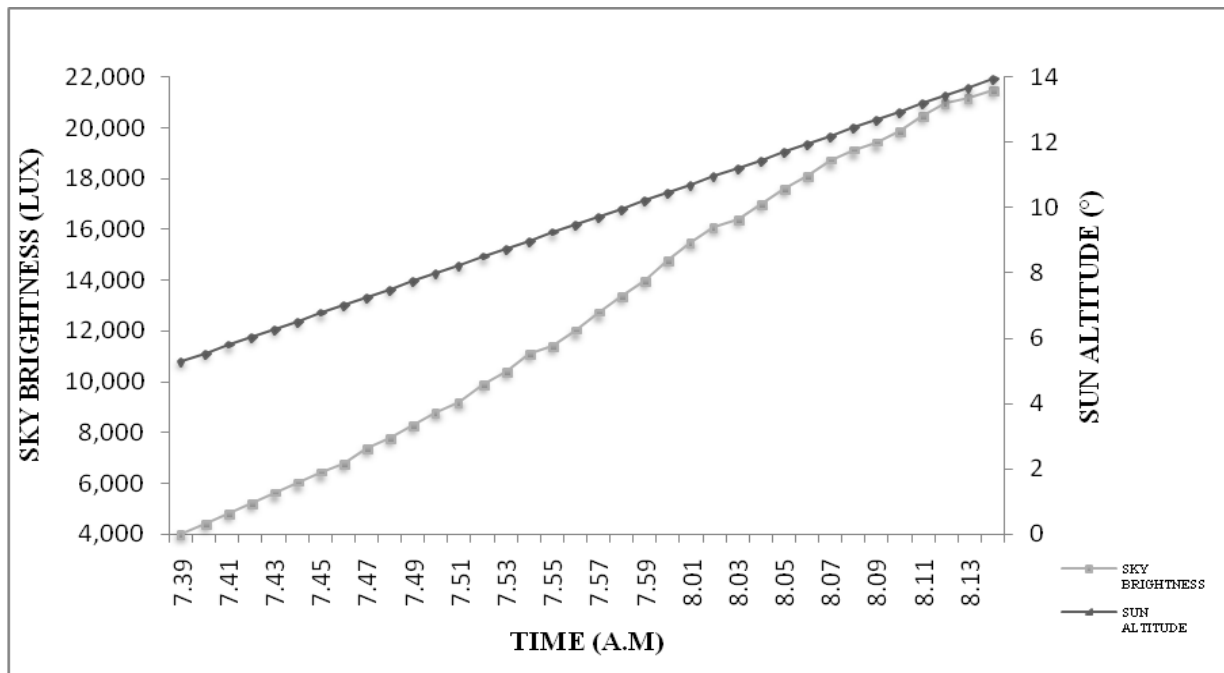Figure 2: Time versus length of shadow on 25th March 2013.

Figure 3: Time versus sky brightness and sun altitude on 25th March 2013.

Figure 2 and Figure 3 shows the observational data taken on 25th March 2013. The beginning of Sunrise time was 7.14 a.m. However, no data could be analysed from 7.14 a.m. until 7.38 am because there were some constraints such as cloudy and overcast that could affect the data obtained. The length of shadow, sky brightness and sun altitude data were collected starting from 7.39 a.m. and ends at 8.14 a.m. The data were collected within 30 minutes after Dhuha time to analyze the changing of length of shadow on 3 sticks. The differences in the length of shadow depend on the length of the sticks that were used 5cm, 7cm and 9cm.

Figure 2 shows the time versus length of shadow on 25th March 2013. Generally, as the time increases the length of shadow become shorter. During 7.39 a.m. to 8.14 a.m., the reading of shadow for 5 cm stick was in range of 13cm to 23cm. Meanwhile, the length of the shadow for 7cm stick was in range of 18cm to 31cm and the reading of the length of shadow for 9cm stick was between 23cm to 37cm. The shape of three curves is consistent with each other. The length of shadow also gives shorter reading as the sun moves higher above the horizon.

Figure 3 shows the time versus sky brightness and sun altitude on 25th March 2013. In general, the sky brightness and the sun altitude increase when the time increases as well as the sun moves higher above the horizon. The sky brightness during that period recorded by light meter was 4000 lux to 21500 lux. The altitude of the sun during that period was observed in the ranged from 5.29° to 13.95°.

Based on the calculation and formula that was provided by The Department of Islamic Development Malaysia, the beginning of Dhuha time on 25th March 2013 (Monday) was on 7.40 a.m. The brightness during the beginning of Dhuha time was 4400 lux and the altitude of the sun was 5.54°. The reading of the length of shadow during Dhuha time for the three sticks 5 cm, 7 cm and 9 cm were 23 cm, 31 cm and 37 cm respectively. Meanwhile, based on Islamic perspective, the time of Dhuha begin when the sun is rising about a spear's length. The interpretation on a spear's length with the length of shadow shows that the differences in length of shadows depend on the length of the sticks.

4. CONCLUSION

The location that was chosen for data acquisition was a good location because there were clear eastern horizon and the sunrise could be seen with naked eye. Thus, it facilitates the researchar to obtain the sky brightness data directly from the sun.

Climatic factors also influence the process of data acquisition. Cloudy and overcast conditions caused no data could be recorded. The clear sky and cloudless conditions were needed when the observations were being carried out.

However, there were some constraints that could affect the process of obtaining data of shadow. The variety of light scattering caused the length of shadow was irregular and not uniform. Thus, the reading for shadow length for each stick will incurred as estimation of error ±0.5 cm.

The variation in thickness of the cloud also caused the stick to produce blurred shadow images. This causes difficulty in measuring and determining accurately the true shadow length.

The altitude of the sun showed the range between 5.51° to 5.67° during the beginning of the Dhuha time. Based on the data obtained, it can be concluded that when the length of shadows of the sun was more than 4 times of the stick and the sun altitude exceeding 6°, it was confirmed that Dhuha prayer time has begun.

Based on the calculation, Dhuha time began around 25 to 27 minutes after Sunrise with an estimation error of ±1 minute. These calculations seem in agreement with the formula that Dhuha prayer time has begun 28 minutes after Sunrise as provided by The Department of Islamic Development Malaysia.

5. REFERENCES

1. Al-Imam Abdullah Wahab, *Wa Arudh Al-Fiqhiyyah Fi al-Ibadah*, Dar al-Kutub al-Ilmiah, Beirut, 2007.
2. Astronomy Research Unit, The Department of Islamic Development Malaysia, *"Astronomy Guide Syariah Rules"*, The Department of Islamic Development Malaysia, Kuala Lumpur, 2001.
3. Baharrudin Zainal, *"Determination of The Prayer Times",* In Falak Syar'I Conference, 2004.
4. Danial Musyaih, '*Ilm al-Falak Dalil Li at-Ta'allum az-Dzati*, Makabah al-'Ubaikan, Saudi 'Arabia, 2003.
5. Evan, David S., *Observation In Modern Astronomy*, The English University Press Ltd, London, 1968.
6. Gerald S. Ferman, Jade Levin, *Social Science Research*, John Wiley and Sons, USA, 1975.
7. Ilyas, M., *Astronomy Of Islamic Times For The 21ˢᵗ Century*, Mansell, London, 1989.
8. Kennedy, E.S., *Studies In The Islamic Exact Sciences*, American University, Beirut, 1983.
9. Mohd Yusoff, *A Complete Guide To Sunnah Solat*, Perniagaan Jahabersa, Johor Baharu, 2009.
10. Muhammad as-Sayyid Sabiq, Fiqh Sunnah (Volume 1). Translation: Nor Hasanuddin, Aisyah Saipuddin, Al-Hidayah Publication, Kuala Lumpur, 2009.
11. Selangor Mufti Department, *Determination and Calculation Methods of Prayer Times*, Shah Alam, Selangor, 2005.
12. Susiknan Azhari, *Discovery of Treasury in Islam and Modern Science*, Suara Muhammadiyah, Yogyakarta, 2007.
13. Wahbah al-Zuhayli, *Fatawa al-Asri Fi al-Ibadah Wa al-Muamalat*, Darul Khair, Damsyik, 2005.
14. Wahbah al-Zuhayli, *Fiqh al-Islami Wa Adillatuhu*, Volume 2, Darul Fikr, Damsyik, 1989.
15. Yahya Shamiy, *'Ilm al-Falak*, Dar al-Fikr al-'Arabiy, Beirut, 1997.