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EXPERIMENTAL STUDY ON DAMAGE PATTERN CAUSED ON MALAYSIAN MADE HOLLOW BLOCKS BY GUNS OF DIFFERENT CALIBERS

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ABSTRACT

Firearm and ballistics in an important area in forensic investigation. Among three ballistics, terminal ballistics plays a vital role in to solve the mystery in crime scenes. The present experimental study is aimed to study the damage pattern caused on Malaysian made hollow blocks by using various firearm. For the experimental study, firearms viz. 0.38 revolver, 9mm sub-machine gun, 9 mm semi auto pistol, 5.56 mm rifle and 7.62 mm rifle were used with varying ranges. The shooting experiment was conducted at Sungai Buloh shooting range by trained firearms experts, Polis Di Raja Malaysia, Bukit Aman. Kuala Lumpur. The entry and exit damages were analyzed and the result of the investigation provided promising result in determining the type of firearm and other useful information. The entry damages are found to be comparatively smaller than the exit damages in the hollow blocks. The long arms caused more damages on the hollow blocks comparatively than hand arms.

Key words: Forensic science, firearms, damages, Malaysian hollow blocks

INTRODUCTION

Ballistics is the science that studies the motion of projectiles. While projectile may refer to anything that is forcefully moved through the air such as bullet or rocket. Scientists skilled in forensic ballistics analyse evidence from the use of firearms and bullets in crimes. (Sue, 2008). The firearm's surfaces (firing pin/striker, breach, barrel, etc.) that contact the softer cartridge case and bullet contain random, unique, microscopic irregularities that make it different from other firearms - even those of the exact same model. These differences can be used to identify or eliminate a weapon as being used in a crime, if a cartridge case or bullet is recovered at the crime scene. The ability to objectify ballistic evidence is a challenge faced by the firearms examiners around the world (Noor Hafzalinda, 2016). During investigative proceedings of incidents involving the use of firearms, forensic expertise can provide key elements for the court to reach an opinion. Researchers have conducted studies on examination of entry and exit wounds on tissues and bones to evaluative issues associated with firearms and cause of death in suspicious death cases (Laurent *et al.,* 2007*;* Druid, 1997; Xiaoun *et al.,* 2015; Hargarten *et al*., 1996).

The analysis on the perforation of the bullet is also importance as at some crime scenes, bullets or their castings cannot be found with bullet damage and holes the only evidence available to determine firearm type and firing position. Many studies have been conducted about the evaluation and reconstruction of fired bullet paths delivered in indoor scenes (Haag & Lucien, 2006; Trahin, 1987; Bunch *et al.,* 1998). Typically, the shooting environment for such training is achieved by the construction of temporary walls, artificial matrices, or other simulated surfaces so that shots of known origin can be safely delivered and the properties

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studied while on an active shooting range (Noedel, 2010). Many studies have been conducted on the evaluation and reconstruction of fired bullet paths delivered in indoor scenes (Haag, 2012; Haag, 2015; Bunch *et al.,* 1998). Experimental studies were conducted on borosilicate glass (Forde *et al*., 2010) wood boards, metal sheets (Nattapontangtawee *et al*., 2015) and composite structures (Razali *et al*., 2014). Hollow block is building material used to make walls, pavements and other elements of masonry construction. A fragmented steel casing impacting on hollow concrete masonry would be coming from irregular directions. It is because the fragments would be penetrated through the front surface and also may be from the reverse surface and some hole's size might be created during penetration (Bogosian *et al.,* 2008). The present study is aimed to examine the pattern of damages caused on Malaysian made hollow blocks of differ brands by guns of different calibres.

METHODOLOGY

The present experimental study used two different brands of Malaysian made concrete hollow blocks manufactured by Multi Usage Holdings Berhad (MUHB) and Seng Sun Sdn Bhd (SSSB) as targets since crime scene involved buildings and residential structures. In Malaysia concrete hollow blocks are used for the construction. The hollow blocks used have three holes with size of 100mm x 190mm x 390mm made by MUHB and 90mm x 190mm x 390mm made by SSSB. Guns of different calibers (0.38 revolver, 9mm semi auto pistol at 15m range, 5.56 mm rifle and 7.62mm rifle at 30m range) with varying range of fire were used for the firing experiment. The shooting experiment was conducted at Sungai Buloh shooting range by trained firearms experts, Ballistics division, Polis Di Raja Malaysia, Bukit Aman. Kuala Lumpur. After the firing, the damages on the targets were examined and recorded the findings through photographs. The data were analyzed and interpreted.

RESULTS AND DISCUSSION

The firing exercise was conducted with different distances with different guns. Figure 2 shows that the entry and exit damages fired by 38 revolvers at a distance of 5 m. A characteristic holes were formed on both brands. The exit side showed damages without hole formation. The damage diameter of exit sides is comparatively larger than the entry side. Figure 3 shows that the entry damage caused by 9mm semi-automatic pistol is larger in SSSB brand than the other brand at a firing distance 10m. The exit side of the hollow block was damaged much in both brands. Figure 4 shows that the entry and exit damages on the hollow blocks of two different brands by 9mm sub-machine gun. The entry hole is found to be slightly larger in SSSB than MUHB brand. Similarly, the exit damage is larger in MUHB brand than SSSB brand.

Figure 5 shows the damages caused by 5.56 mm rifle at a distance of 20m. When compared the entry holes of both brands, the size of hole in MUHB is comparatively larger than another brand. The interesting feature observed is the formation of linear crack at middle of the hole. The exit damages are larger in both brands with broader linear crack. Figure 6 shows the damages caused by 7.62 mm rifle at a distance of 30m. The comparison of entry

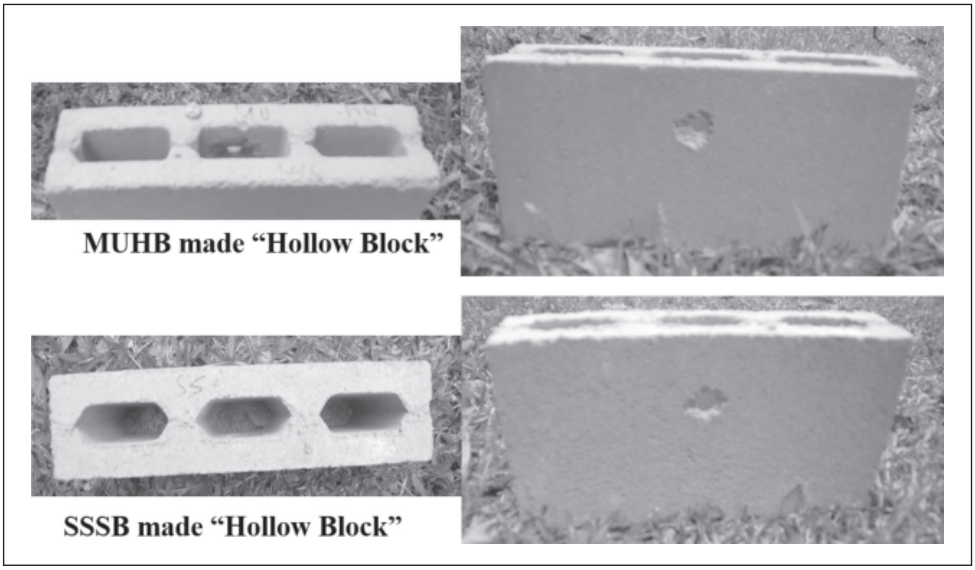


Fig. 1. Two different types of Malaysian made hollow blocks from 2 different manufacturers.

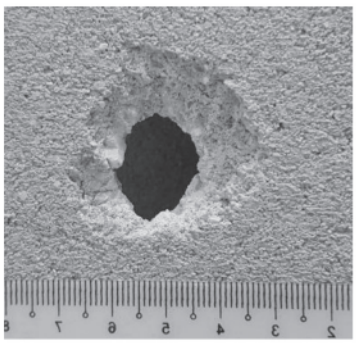
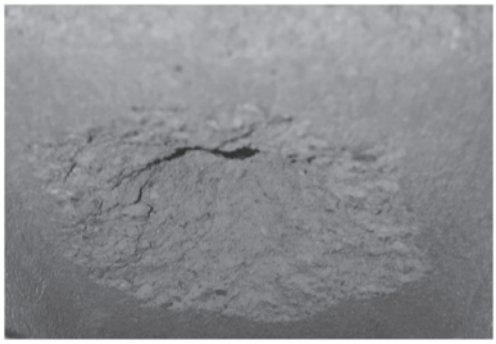
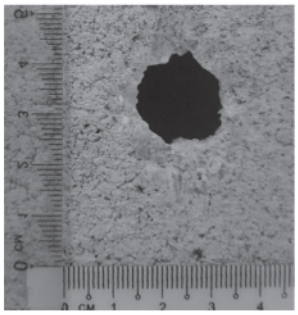
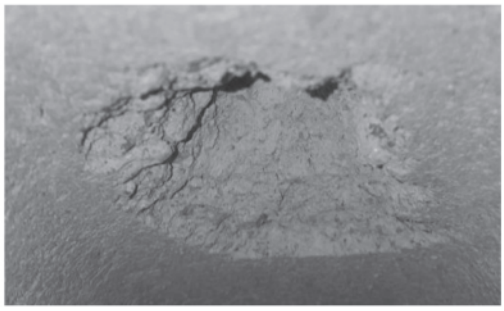
Brand	Entry damage	Exit damage
MUHB		
SSSB		

Fig. 2. The size and shape of entry and exit damages on hollow blocks fired at a distance of 5m by using .38 revolver.

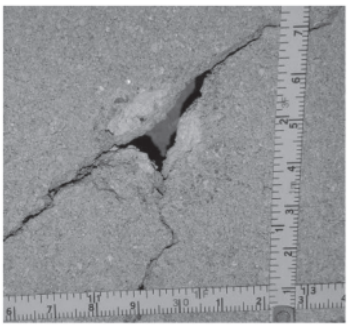
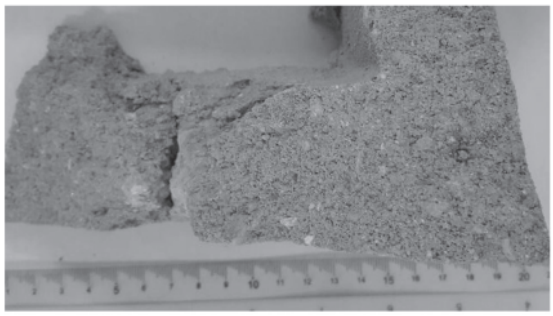
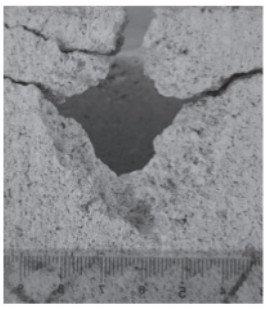
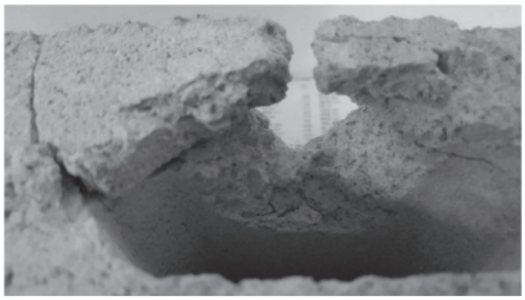
Brand	Entry damage	Exit damage
MUHB		
SSSB		

Fig. 3. The size and shape of entry and exit damages on hollow blocks fired at 10m by using 9mm semi-automatic pistol.

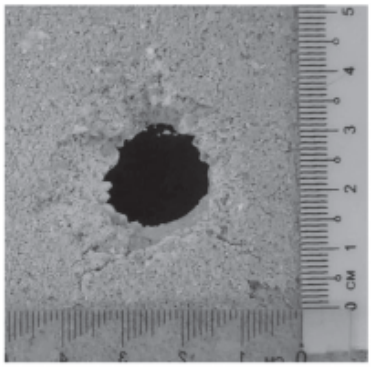
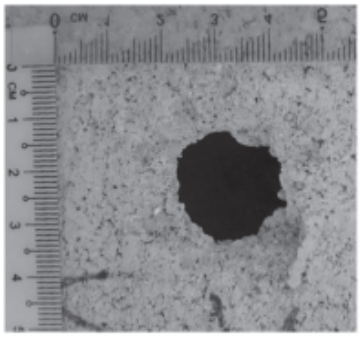
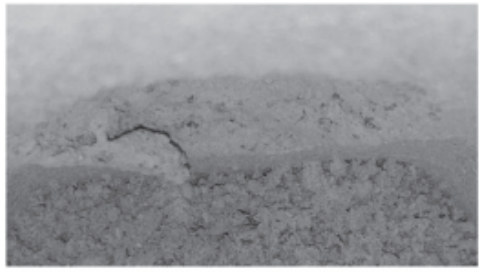
Brand	Entry damage	Exit damage
MUHB		
SSSB		

Fig. 4. The size and shape of entry and exit damages on hollow blocks fired at a distance of 15 m using 9 mm sub-machine gun.

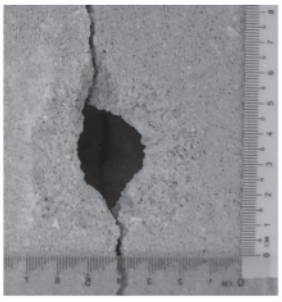
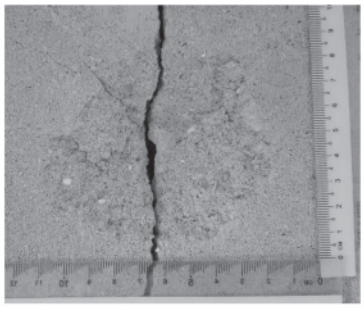
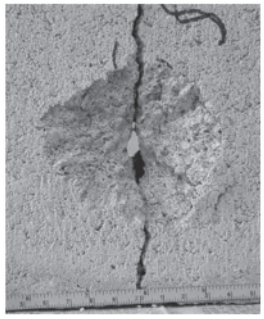
Brand	Entry damage	Exit damage
MUHB		
SSSB		

Fig. 5. The size and shape of entry and exit damages on hollow blocks fired at a distance of 20 m using 5.56 mm rifle.

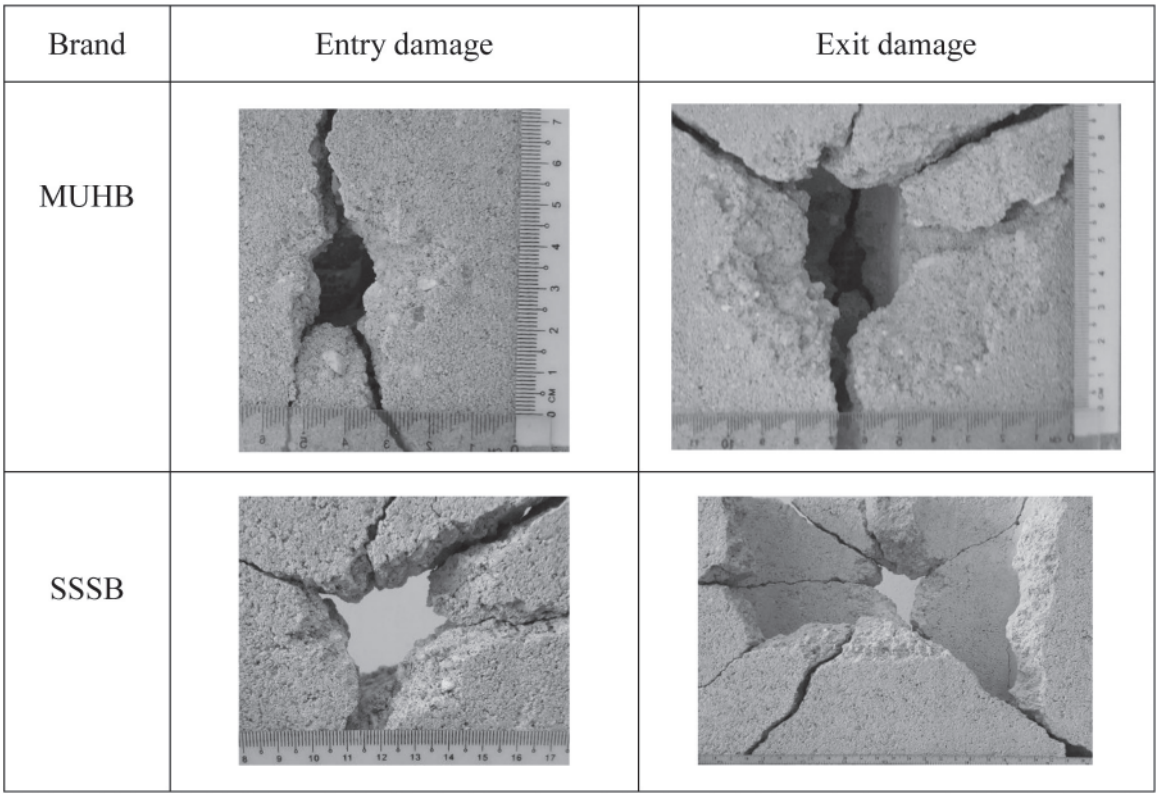


Fig. 6. The size and shape of entry and exit damages of 2 holes hollow block manufacture at 30m by using 7.62 mm Rifle.

damages between the brands showed that SSSB entry hole is bigger than MUHB brand. Both entry damages showed multiple crack marks. Similarly, the exit hole is comparatively bigger in SSSB brand than the other. Both damages showed multiple crack marks.

The result of the experimental study showed that entry hole is smaller than exit hole. The handgun muzzle velocities generally run from 750 ft/sec to 1,300 ft/sec and this is true for all calibres. On the other hand, rifle velocity is in the range of 1,900 – 4,000 ft/sec. The velocity effect is reflected in this experimental firing exercise.

Damaged bullets/Impact damage

Most evidence bullets received in the forensic science laboratory have sustained some type of damage associated with impacting the target or object. The damage can range from minimal to mutilate beyond use. A bullet that expands has a bigger cross-sectional area, so it creates a bigger hole in the target. It takes more energy to make a bigger hole in something. Bullets can be designed to expand by making them hollow at the pointed end and, after impact, they expand and squash down into a shape that looks like a button mushroom; that's why deforming bullets are called mushrooming bullets. Also the damaged end of the bullets can indicate the type of target, based on extent of damage and the adhering trace evidence. Israel police have conducted a firearm research and found out that the diameter of the entrance bullet holes in military helmets made of laminated composite materials can be estimated (Levin, 2001). The microscopic analysis of damaged bullets in this experimental study showed the presence of particles of hollow blocks and thus indicated the type of target material. Figure 7 shows the characteristic damages caused by different types of guns and firing distances. Many fired bullet studies were conducted on various targets like wood (Nattapontangtawee, 2015), Aluminium sheet (Gupta, 2007), multi-layered metallic plates (Flores-Johnson, 2011), human tissues (Peter, 2014), and glass (Haag, 2012) and studied their damage characteristics but very limited studies were conducted on walls and hollow blocks.

Researchers have conducted experimental firing study by using various brands of wooden boards as target materials. The different type of the bullets showed different outcome as in entry hole and exit hole (Nattapontangtawee, 2015). Similar study was conducted on walls as target materials. The target was setup for direct and corner shots on vinyl siding, stucco siding for 13mm and 19mm, clay brick, concrete block and cavity wall and different types of gun (Kashuba, 2002). The result showed different type of findings depending on the type of gun used,

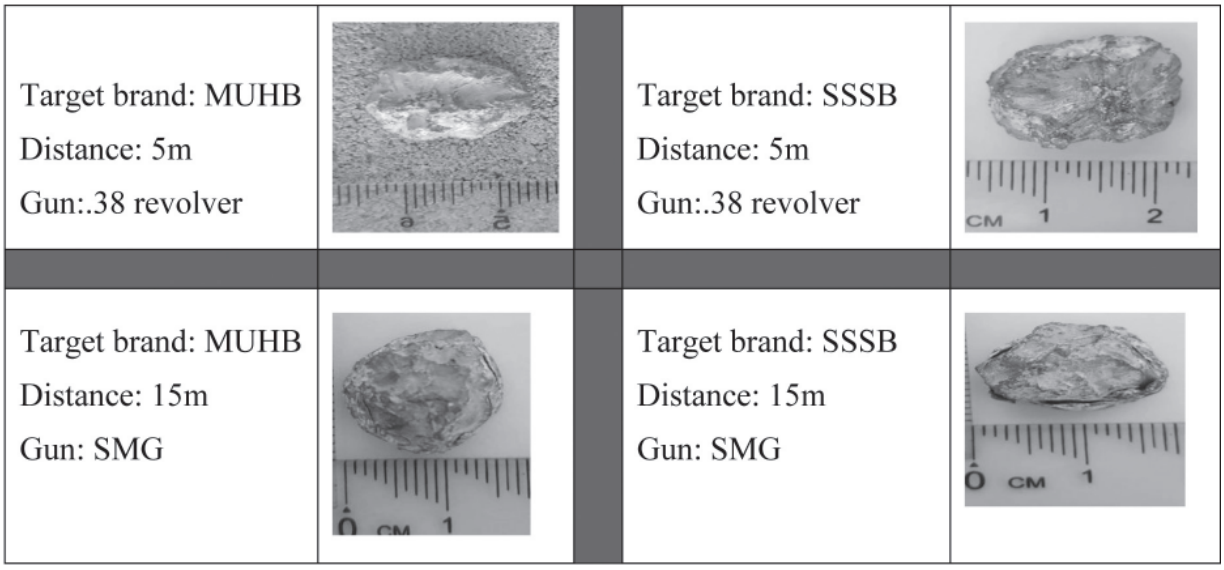


Fig. 7. Illustrative examples of bullets that expands showing bigger cross-sectional area after the target impact.

i.e., the target damages include hole in the brick and cracking on mortar.

CONCLUSION

Based on the damages caused on different hollow blocks MUHB brand is stronger than SSSB. The entry hole is smaller than the exit holes, almost in all firing experiments. The damage characteristics viz. mild crack line, larger crack line, multiple crack line and broke pieces, are based on the strength of hollow blocks and effective range of the firearms concerned.

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REFERENCES

Bunch & Stephen, G. 1998. Some proposals for standardizing trajectory analysis and reporting. *Association of Firearm and Tool Mark Examiners Journal,* **30(3)**: 48.

Bogosian, D. & Gerber, B. 2008. Analytical predictions of fragment penetration through hollow concrete masonry units. *Shock and Vibration*, **15(1)**: 61-70.

Druid, H. 1997. Site of entrance wound and direction of bullet path in firearm fatalities as indicators of homicide versus suicide *Forensic Science International*, **88(2)**: 147-162.

Flores-Johnson, E.A., Saleh, M. & Edward, L. 2011. Ballistic performance of multi-layered plates impacted by a 7.62-mm APM2 projectile. *International Journal of Impact Engineering,* **38(12)**: 1022-1032.

Forde, L.C., Proud, W.G. & Walley, S.M. 2010. Ballistic impact studies of a borosilicate glass. *International Journal of Impact Engineering*, **37(5)**: 568.

Gupta, N.K., Iqbal, M.A. & Sehon, G.S. 2006. Effect of projectile nose shape, impact velocity and target thickness on deformation behaviour of aluminium plates. *International Journal of Solids and Structures*, **44:** 3411-3439.

Hargarten, S.W., Karlson, T.A., O'Brien, M., Hancock, J. & Quebbeman, E. 1996.

Characteristics of firearms involved in fatalities. *The Journal of American Medical Association*, **275(1)**: 42-45.

Haag, L.C. 2012. Behavior of expelled glass fragments during projectile penetration and perforation of glass. *The American Journal of Forensic Medicine and Pathology*, **33(1)**: 47-53.

Haag, L.C. 2015. Base Deformation of Full Metal-Jacketed Rifle Bullets as A Measure of impact Velocity and Range of Fire. *The American Journal of Forensic Medicine and Pathology,* **36(1)**: 16-22.

Kashuba, S.D., Kuzik, M.D. & Hatzinikolas, M.A. 2002. Resistance of exterior walls to high velocity projectiles. *Canadian Police Research Centre*, Technical report. Her Majesty the Queen in right of Canada.

Laurent, M., Alain, A., Cristina, C. & Eric, B. 2007. A deceptive case of gunshot entry wounds – Beware of frangible bullets. *Journal of Forensic Legal Medicine*, **14(3)**: 161.

Levin, N. & Glattstein, B. 2001. The Characterisation of Bullet Holes in Helmets Made of Composite Materials: A Case Study. *Problems of Forensic Sciences,* **46**: 303-310.

Mickael, G.H. & Lucien, C. 2006. *Shooting Incident Recon-struction*. Amsterdam: Elsevier Inc, Singapore. 62-65 pp.

Nattapontangtawee, Theerayutmaneeruangrit. & Weerachaiphutdhawong. 2015. ICP and Bullet Damage Analysis on Sheet-Metal and Wooden Boards. *Chemical Science Transactions*, **4(3)**: 668-671.

Noedel Matthew. Studying Fired Bullet Performance in a Unique Environment. 2010. *Journal of the Association for Crime Scene Reconstruction,* **16(3)**: 27-30.

Noor Hafzalinda, H. 2016. Development of an objective method for comparison of fired projectiles using an air pistol as a template. *Forensic Science International*, **264**: 106-112.

Peter, A.O., Stephen, C.J. & Josephat, J. 2014. Atypical gunshot injury to the right side of the face with the bullet lodged in the carotid sheath: a case report. *Journal of Medical Case Reports*. **8**: 29-34.

Razali, N., Sultan, M.T.H., Mustapha, F., Yidris, N. & Ishak, M.R. 2014. Impact Damage on Composite Structures – A Review. *The International Journal of Engineering and Science.* **3(7)**: 08-20.

Sue, H. 2008. The Bermuda Triangle, ABDO Publishing Company.

Trahin. & Jimmy, L. 1987. Bullet Trajectory Analysis. *Association of Firearm and Tool mark Examiners Journal,* **19(2)**: 124.

Xiaoyun, Z., Cheng, X., Yaoke, W. & Shaomin, L. 2015. The experimental and numerical study of indirect effect of a rifle bullet on the bone. *Forensic Science International*, **257**: 473-480.