CPRC CCRP

CANADIAN POLICE RESEARCH CENTRE CENTRE CANADIEN DE RECHERCHES POLICIÈRES

TR-03-2002
Resistance of Exterior Walls to High Velocity Projectiles

Scott D. Kashuba
Marc D. Kuzik
Michael A. Hatzinikolas

TECHNICAL REPORT
February, 2002

Submitted by:
Scott D. Kashuba
Firearms Section, Forensic Laboratory Edmonton
Royal Canadian Mounted Police

NOTE: Further information about this report can be obtained by calling the CPRC information number (613) 998-6343

NOTA: Pour de plus ample renseignements veuillez communiquer avec le CCRP au (613) 998-6343

ACKNOWLEDGEMENTS

The Canadian Police Research Centre wishes to thank the authors of this paper for their permission to reprint it for distribution to the law enforcement and public safety communities.

REMERCIEMENTS

Le Centre canadien de recherches policiΠres tient B remercier les auteurs du présent document de lui avoir accordé la permission de le réimprimer aux fins de diffusion aux collectivités policiΠre et de sécurité publique.

Resistance of Exterior Walls to High Velocity Projectiles

by

Scott D. Kashuba[1], Marc D. Kuzik[2], Michael A. Hatzinikolas[3]

ABSTRACT

This paper contains the findings of an experimental evaluation on the behavior of common exterior wall assemblies found in residential construction when impacted by bullets fired from a wide variety of firearms of different caliber. Three basic types of exterior wall finishes were evaluated: stucco, vinyl siding, and masonry. All the walls were constructed in wood frame, with the exception of one wall, which was constructed using 140 mm hollow concrete blocks as the back-up system. The findings of the study have demonstrated that a bullet fired from a .22 caliber firearm, a relatively small and readily available firearm, can consecutively penetrate two walls constructed in wood frame and vinyl siding. Walls constructed with a 90 mm masonry veneer however, are effective in stopping bullets fired from a 9 mm submachine gun. These preliminary findings are intended to assist both engineers and architects in choosing the appropriate wall materials for structures where gun fire may occur.

Key Words: masonry, stucco, vinyl siding, walls, firearms, bullet penetration, public safety, shooting

RÉSUMÉ

Le document qui suit renferme les résultats d'une expérience visant à évaluer l'effet de balles provenant d'une grande variété d'armes de divers calibres sur les finitions extérieures couramment utilisées en construction résidentielle. L'expérience a porté sur trois types de finition : le stuc, le bardage en vinyle et la maçonnerie. Tous les murs avaient une ossature de bois, sauf un seul, qui avait été construit à l'aide de blocs de béton creux de 140 mm. L'expérience a révélé qu'une balle tirée à l'aide d'une arme à feu de calibre .22, relativement petite et facile à obtenir, peut traverser consécutivement deux murs à ossature de bois bardés de vinyle. Par contre, les murs ayant un parement de maçonnerie de 90 mm arrêtent efficacement les balles de mitraillette de 9 mm. Ces résultats préliminaires sont présentés afin d'aider les ingénieurs et les architectes à choisir les matériaux appropriés pour les bâtiments où il y a risque de tir.

Mots clés : maçonnerie, stuc, bardage en vinyle, murs, armes à feu, pénétration

[1] BSc, MA, MBA, Royal Canadian Mounted Police (RCMP) Firearms Section, Forensic Laboratory Edmonton, 15707-118 Avenue, Edmonton, Alberta, CANADA T5V 1B7
[2] Ph.D. student, Dept. of Civil & Environmental Engineering, University of Alberta, 220 Civil/Electrical Building, Edmonton, Alberta, CANADA T6G 2G7
[3] Ph.D., P.Eng., Executive Director, Canadian Masonry Research Institute (CMRI), Suite 200, 10524-178 Street, Edmonton, Alberta, CANADA T5S 2H1

INTRODUCTION

To the best knowledge of the authors, no study on the resistance of wall assemblies to bullet penetration has been published. As the incidences of "drive-by-shootings" and "armed standoffs" increase, so does the risk of injury to the unaware public in adjacent structures from direct or indirect projectiles. The objective of this research program is to start a database on the performance of wall systems when subjected to gun fire. A preliminary experimental program was conducted whereby a series of wall assemblies constructed with different types of building materials was fired upon using many different caliber of common firearms. After each of the wall specimens was tested, a qualitative assessment of the walls ability to reduced the bullets energy was made. Presented in this paper are the findings from this preliminary study.

EXPERIMENTAL PROGRAM

Test Specimens

A total of 13 wall assemblies were constructed using standard construction procedures and in accordance with the applicable building standards. Each wall assembly was built in an "L–shape" as viewed in plan. For 11 of the walls, the main framing consisted of 51 mm x 102 mm (2"x 4") wood studs spaced at 400 mm (16") on center. The framing was covered with 13 mm ($^1/_2$") thick wood sheathing and exterior tar paper while fiberglass insulation was placed between the studs. The interior side of each wall was covered with drywall and then painted.

The exterior of the wood framed walls was then finished with four different systems: concrete brick, clay brick, vinyl siding, and stucco. Three walls were finished with concrete brick units of which two walls utilized 90 mm (thick) x 57 mm (high) units and one wall utilized 90 mm (thick) x 200 mm (high) units. Standard vinyl siding was placed on two walls and wire mesh with stucco was applied on four walls. The stucco walls were divided into two categories: a two coat stucco having a total thickness of 13 mm, and a three coat stucco having a total thickness of 19 mm. The two remaining wall specimens were constructed using a standard 150 mm hollow concrete masonry unit for the backup wythe and 90 mm (thick) x 57 mm (high) clay bricks for the veneer. These walls were detailed with a bituminous air barrier membrane and 50 mm (2”) of rigid foam insulation. Figure 1 shows a typical wall specimen.

The nominal strength of the concrete masonry units was 15 Mpa, the strength of the clay units was 17.5 Mpa. Type S mortar was used in the construction of all masonry components of the walls tested.

Figure 1 - Concrete Brick with Wood Stud Backup Wall Specimens

Firearms

An extensive variety of firearms were used in the testing program. Because literally thousands of different types of firearms exist, the objective was to select a sample of some of the common firearms and ammunition typically available to civilians and police. Table 1 lists all the firearms along with the corresponding ammunition used.

Testing Procedure

The walls were tested in the firing range at the Royal Canadian Mounted Police (RCMP) forensic laboratory located in Edmonton, Alberta, Canada. Testing was performed on one wall at a time due to the physical layout and size constraints of the firing range; however, the test procedure used for each wall specimen was identical.

The walls were located at a horizontal distance of 25 m from the location of the riffle. Each wall was then fired upon twice with each caliber of rifle selected. For the first shot , the given wall was positioned such that one leg of the "L–shape" was perpendicular to the trajectory of the bullet. The second was fired with the wall rotated 45 degrees such that the theoretical trajectory of the bullet before impact passed through both faces of the "L–shaped" wall assembly. This procedure was repeated once for each caliber, beginning with the .22 caliber and then sequentially increasing the caliber, until the wall was penetrated. Figure 2 shows the plan view of the two wall positions used during testing.

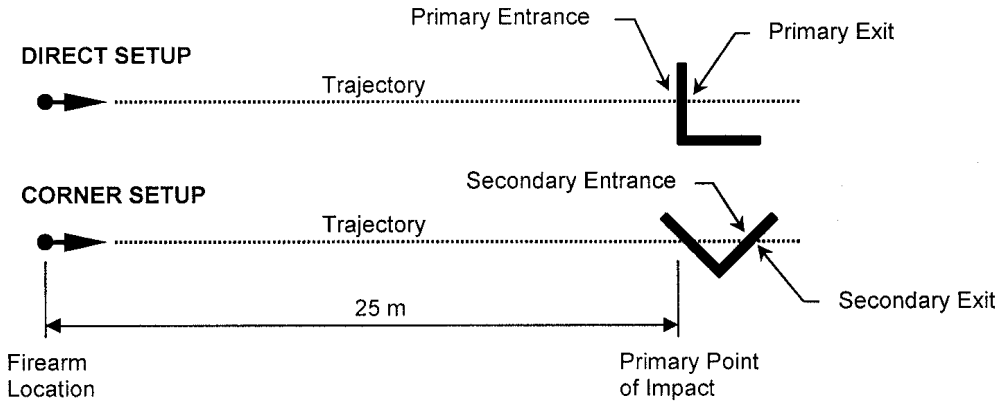

Figure 2 - Test Setup for "Direct" and "Corner" Shots

RESULTS AND DISCUSSION

Vinyl siding (direct)

The direct shot entrance holes were round and approximately equal to the diameter of the bullets. This circular entrance shape would probably become more irregular in cold temperature conditions due to the brittle nature of vinyl. The .177 pellet did not penetrate the wall assembly but was almost totally embedded in the plywood sheeting. All of the remaining projectiles traveled completely through the wall assembly. The direct exit holes were larger than the diameter of the projectiles due to the nature of the drywall. All the entrance and exit holes were consistent with a bullet traveling in a nose front direction.

.177 Pellet	Through siding, partially into plywood
.22 Revo lver	Through wall
.22 Long Rifle	Through wall
.25 Automatic	Through wall
.32 Automatic	Through wall
.223 Remington	Through wall
.308 Winchester	Through wall
12 Gauge 0 Buck	Through wall

Vinyl siding (corner)

Side shot primary entrances were slightly larger than the diameter of the bullets. This difference became greater as the caliber of the bullets increased, likely due to the length of the bullet becoming larger. As the length increases, so does the area of the bullet surface striking the siding as it passes through the vinyl.

The primary exit holes in the drywall were slightly larger than those created by a bullet traveling normal to the wall.

The secondary entrance holes exhibited a characteristic "key-holing" of the bullets as they entered the second sheet of drywall. This means that each bullet apparently lost its gyroscopic stabilization while traveling through the first leg of the wall at the approximate 45 degree angle. This key-holing was most notable in the .223 and .308 bullets as they had a greater length to diameter ratio than the other bullets used in this portion of the project. The base of all of the test bullets turned toward the inner corner of the test wall assembly, hitting the second wall in an almost "side on " orientation. This was probably due to a rotation of the bullets about their tip upon impact at the primary entrance location.

The secondary exit holes in the vinyl siding were much larger than the diameter of the bullets fired. The holes in the plywood indicate that the bullets traveled sideways as they passed through the plywood and before exiting through the inner surface of the siding. All of the secondary exit holes in the siding were ragged in shape due to the damage caused by both the bullet and the small mass of the associated wall materials (i.e. plywood) traveling along with it. The .22 Long Rifle bullets produced the smallest holes with an observed tearing of the vinyl siding rather than shattering. This tearing effect noticed in the vinyl at the secondary exit holes was most likely due to a slow exit velocity coupled with the blunt impact of the bullet traveling sideways.

.22 Revolver	Through both walls
.22 Long Rifle	Through both walls
.25 Automatic	Through 1 ½ walls
.32 Automatic	Through both walls
.40 Smith & Wesson	Through both walls
.223 Remington	Through both walls
.308 Winchester	Through both walls

Stucco siding–13 mm (direct)

The energy of the .22 Long Rifle and revolver, .25 Automatic, and .32 Automatic bullets was not great enough to penetrate the 13 mm stucco layer. The .25 and .32 bullets were only partially embedded in the outside surface. All the direct entrance holes were larger than the diameter of the associated bullet.

The direct exit holes caused by the remaining bullets were larger than the diameter of the bullets. This is likely due to the combined mass of the bullet and displaced wall material. In addition, the reduced velocity of the bullet prevented it from "punching" through the drywall. The bullets may have also been rotated off their longitudinal axis upon striking the stucco, which would contribute to the increase in the size of the exit hole. This sideways movement theory was confirmed when the .25 and .32 bullets were found at rest within the stucco at an approximate 45 degree angle to the stucco surface.

.22 Revolver	Stopped in stucco layer of wall
.22 Long Rifle	Through wall
.25 Automatic	Stuck in stucco layer of wall
.32 Automatic	Stuck in stucco layer of wall
9 x 19 mm Pistol	Through wall

Stucco siding–13 mm (corner)

The primary entrance holes of the test projectiles were significantly larger than the diameter of the bullet. These holes were also elliptical in shape with the width being larger than the height. This size and shape was likely due to the fracturing characteristics of the stucco.

The primary exit holes were also significantly larger than the diameter of the bullet.

The secondary entrance holes consisted of multiple impacts. Three test shots were fired with the .223 Remington cartridge to eliminate the possibility of this observation being a random event. The bullets appeared to have fragmented upon exiting the wall due to the interaction of the bullet structure with the wall elements (i.e. stucco, metal lathe). These fragments then entered the second wall and stopped either in the drywall or plywood. The secondary entrance of the 12 Gauge Sabot Slug also showed multiple impacts. This impact zone, however, was dominated by one major hole, caused by the slug, and a few minor holes which were most likely caused by pieces of displaced stucco or metal lathe. These small fragments stopped in the layer of drywall at the secondary entrance.

The secondary exit hole of the 12 Gauge Sabot Slug was approximately the same size as the primary entrance. Fractured ends of the metal lathe protruded outward within the exit hole in the direction of travel of the slug.

.223 Remington (3 shots)	Through first wall and embedded in second
12 Gauge Sabot Slug	Through both walls

Stucco siding–19 mm (direct)

The thicker 19 mm layer of the stucco was robust enough to prevent complete penetration of the .22 Long Rifle bullet fired from the rifle. Again, the entrance holes were slightly larger than each of the diameters of the projectiles used.

Exit holes of all the bullets, except for the .308 Winchester, were also larger than their related entrance holes. It is likely that the .308 Winchester bullet retained enough energy and a sufficient velocity to maintain a nose forward trajectory resulting in a smaller exit hole. The exit hole of the .223 Remington bullet was significantly larger than the other caliber's, suggesting that the bullet fragmented while traveling through the wall.

The 12 Gauge Buck Shot contained twelve pellets each having a diameter of 0.32". Four of the twelve pellets completely penetrated both the stucco and plywood and came to rest in the insulation. No evidence indicated that any of the pellets contacted the back side of the drywall.

.22 Long Rifle	Stopped in stucco layer of wall
9 x 19 mm Pistol	Through wall
9 x 19 mm Sub-machine gun	Through wall
.40 Smith & Wesson	Through wall
.223 Remington	Through wall

.308 Winchester	Through wall
12 Gauge O Buck	4/12 pellets penetrated through to drywall layer
12 Gauge Rifled Slug	Through wall
12 Gauge Sabot Slug	Through wall

Stucco siding–19 mm (corner)

The primary entrance holes of the three bullets used were smaller is size than the corresponding primary entrances in the 13 mm stucco. This could be due to the characteristics of having a thicker layer of material.

The 9 x19 mm bullet traveled completely through the first wall section but did not have enough energy to penetrate the surface of the drywall on the second wall. The .223 Remington bullet showed the characteristic fragmentation as multiple projectiles entered the surface of the drywall on the second wall. In addition, a portion of the copper jacket material was partially embedded in the paper surface of the drywall. The secondary entrance of the .308 Winchester bullet indicated that it struck the drywall in a sideways orientation. However, due to the drywall damage at the perimeter of the hole, the precise orientation of the bullet upon impact could not be determined. There were a few very small secondary projectiles next to the main hole indicating that some material from the first wall was transported with the bullet and had enough energy to penetrate the paper surface of the drywall.

9 x 19 mm Sub-machine gun	Through first wall (found between walls)
.223 Remington	Through first wall and embedded in second
.308 Winchester	Through both walls

Clay Brick (direct)

Only a few bullets from the high power hunting cartridges were able to penetrate completely through a single brick. None of these bullets penetrated the tar paper layer which was located between the plywood and the back side of the brick. Upon disassembly of the wall, it was observed that the impact from the bullets fired from the center-fire rifle cartridges cracked and/or broke the individual “struck” brick into many pieces. These pieces either fell into the airspace behind the brick, or were held loosely in place by the surrounding bricks and mortar. The impact of the larger caliber bullets also fractured many of the surrounding bricks and mortar joints. These surrounding bricks easily broke apart when the wall was dismantled.

The .22 Long Rifle chipped a piece approximately 4 mm deep by 35 mm in diameter in the surface of the brick. This was the only damage sustained.

The .223 Remington bullet created a semi-circular chip that was approximately 85 mm wide and 45 mm high (the brick being about 55 mm in height). A circular hole to the center of the unit was produced and the brick was fractured vertically between the hole and the top edge of the brick. In addition, the mortar was disturbed both above and below the shot brick. This bullet pulverized the brick into powder at the point of impact.

The 7 mm Remington Magnum bullet removed a piece approximately 70 mm wide by 55 mm from the front of the brick. Again, a hole penetrating to the center of the brick was produced.

The 7 mm Shooting Times Westerner bullet left a hole through the brick to the tar paper layer. The brick was cracked from top to bottom originating from the impact point.

The .308 Winchester bullet produced a chip approximate 80 mm wide by 55 mm high from the brick. In addition, a 35 mm diameter hole was produced to a depth of about two thirds the brick thickness. The mortar was cracked around the perimeter of the brick. Figure 3 shows the damage caused by the .308 bullet.

Figure 3 - Damage to clay brick caused by .308 Winchester

The double .308 Winchester impact (two shots fired at the same point of aim) caused a 90 mm wide by 50 mm high piece of the clay unit to break off. A hole approximately 55 mm wide by 40 mm high through to the tar paper was observed however, no damage to the tar paper was found. The brick was again cracked from the top edge of the hole to the top of the brick. The hole was larger than the one caused by a single bullet probably due to a slightly different point of impact.

The .30-06 Springfield bullet chipped an approximately 70 mm wide by 55 mm piece out of the surface of the brick. A 30 mm hole through to the center of the brick was produced.

The .375 Holland & Holland bullet also produced a hole through the brick to the tar paper. The adjacent bricks in the courses above and below the target brick were cracked and the mortar around the perimeter of the shot brick.

.22 Long Rifle	Large chip in brick
.223 Remington	Large hole in brick
7mm Remington Magnum	Large hole in brick
7mm Shooting Times Westerner	Through brick to tar paper layer
.308 Winchester	Large hole in brick
.308 Winchester (x2 shots)	Through brick to tar paper layer

.30-06 Springfield	Large hole in brick
.375 Holland & Holland	Through brick to tar paper layer

Clay Brick (corner)

The .308 Winchester bullet fired at a 45 degree angle chipped a out a piece approximately 100 mm wide by 55 mm high from the front of the brick. The bullet created a circular hole approximately 50 mm in diameter and became lodged in the center of the brick. This impact also fractured the brick in many places that were not visible from the outside of the wall.

.308 Winchester	Large hole in brick (embedded)

Concrete Brick (direct)

The .22 Long Rifle bullet produced a shallow chip approximately 3 mm deep and 15 mm in diameter in the surface of the brick. The point of impact was difficult to detect due to the color and texture of the concrete and thus would be hard to notice in a real wall if the existence was not known in advance.

The .223 Remington bullet created a chip size approximately 50 mm wide by 55 mm high. A 15 mm diameter hole was created to a depth of about two thirds of the brick thickness.

The 7 mm Remington Magnum bullet chipped an approximately 90 mm wide by 55 mm high piece from the front of the brick. In addition, an approximately 20 mm diameter hole about two thirds the brick thickness was produced.

The .308 Winchester bullet removed a region approximately 100 mm wide by 55 mm high. The hole was 25 mm by 20 mm to a depth of approximately half the brick thickness. This damage is shown in Figure 4.

The .30-06 Springfield bullet removed a piece approximately 95 mm wide by 55 mm high. The hole produced was about 20 mm in diameter and about half the brick thickness in depth.

.22 Long Rifle	Chip in brick
.223 Remington	Hole in brick
7mm Remington Magnum	Large hole in brick
.308 Winchester	Large hole in brick
.30-06 Springfield	Large hole in brick

Figure 4 - Damage to concrete brick caused by .308 Winchester

Concrete Block (direct)

The .22 Long Rifle bullet produced a small chip out of the surface of the unit. Full height 90 mm thich split-faced colored concrete units were used to construct this wall. Like the concrete brick specimen, the impact area was very difficult to notice due to the roughness of the surface, as well as, the coloring of the block.

The .223 Remington bullet produced a chip that was approximately 27 mm in diameter. A fragment of the bullet was found at rest in a hole which was approximately 18 mm in diameter and 14 mm deep.

The impact from the 7mm Remington Magnum bullet resulted in a circular chip approximately 50 mm in diameter and a hole approximately 17 mm in diameter and 36 mm deep. Cracks originating from both the top and bottom of the hole to the top and bottom of the brick were produced. In addition, the mortar around the shot block and surrounding units was disturbed. When the block was removed, it easily separated into two pieces along the crack induced by the bullet. A large conical failure zone was observed on the back side of the block.

The .308 Winchester bullet displaced a portion of the block approximately 40 mm in diameter. It left a hole approximately 21 mm in diameter and 13 deep as shown in Figure 5. The unit was also cracked from top to bottom with the fracture plane running through the hole.

.22 Long Rifle	Chip in brick
.223 Remington	Hole in brick
7mm Remington Magnum	Hole in brick with cracking of block and mortar
.308 Winchester	Hole in brick with cracking of block and mortar

Figure 5 - Damage to red concrete masonry units caused by .308 Winchester

Concrete Block–grey (direct)

These tests were conducted by shooting the back side (concrete block) of one of the cavity walls. This procedure simply reduced the number of test specimens which had to be constructed.

The .22 Long Rifle bullet created a large chip in the front face shell of the 140 mm thick concrete block that was approximately 30 mm in diameter.

The .223 Remington bullet penetrated only the front face shell of the block, leaving a chipped section approximately 27 mm in diameter and a hole approximately 10 mm in diameter.

The .308 Winchester bullet penetrated both the front and rear face shells of the concrete block, passed completely through the foam insulation, and came to rest against the clay brick. It left a chip approximately 28 mm in diameter and hole approximately 10 mm in diameter. The entrance hole is shown in Figure 6.

.22 Long Rifle	Large chip in block
.223 Remington	Hole through first side of block
.308 Winchester	Through brick (sitting in brick and block cavity)

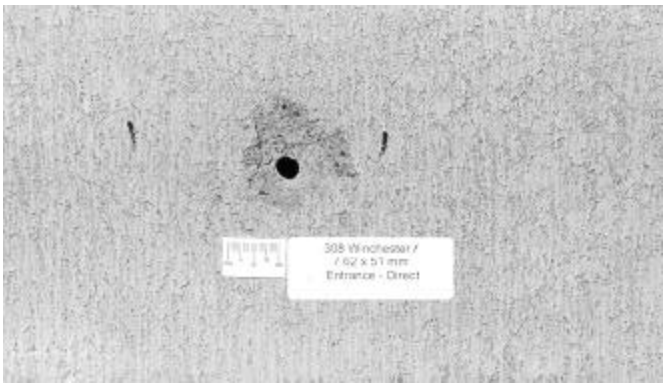

Figure 6 - Damage to the 140 mm concrete block wall caused by .308 Winchester

Cavity Wall (direct)

The Full Metal Jacketed bullet had no problem penetrating the brick/block cavity wall. Significant damage to the bricks, mortar, and concrete blocks was observed. These bullets also penetrated a piece of ¾" plywood that was placed 0.6 m directly behind the wall. The shape of the holes through this plywood indicates that these projectiles, similar to the .223 Remington and .308 Winchester bullets fired through the vinyl and stucco walls, struck the board sideways.

.50 Browning Machine Gun	Through wall

Cavity Wall (corner)

Due to the thickness of the wall construction, the bullet traveled through the corner of wall unit rather than exiting one wall and then entering the other. Subsequent testing was done by firing a series of shots at two brick/block units lined up one behind the other. While the bullet fully penetrated through the first wall, it would only chip the surface of the brick veneer of the second. The impact damage of the .50 BMG bullets on the second wall unit was consistent with them hitting on their side rather than their nose.

.50 Browning Machine Gun	Through first wall and embedded in second

Conclusions

The results of this project were somewhat unexpected. The ability of a .22 Long Rifle bullet to easily travel completely through the corner of a typically constructed vinyl sided house was as unforeseen as the clay and concrete brick walls stopping all but the bullet with the greatest velocity. Standard 13 mm or 19 mm stucco finishing does not significantly reduce life-threatening situations for people inside or outside a wall that is subjected to most centerfire bullet impacts. This danger increases with the velocity and energy of the bullet fired. A person struck by one of these projectiles would be at risk of serious bodily injury or death. Secondary projectiles (wood, lathe, stucco, etc.) produced by a bullet travelling through one of these walls would also present a risk to a person. Walls finished with either a clay brick or concrete brick veneer prevented all but the .50 Browning from complete penetration of the wall assembly.

These tests have provided valuable forensic firearms information regarding the type of damage expected to buildings after they have been struck by gunfire. Certain inferences about velocities and caliber can be made by observing the damage found on primary and secondary targets. The results provide members of law enforcement with the knowledge of what consequences they can expect in situations where firearms are being used by and/or against them. These results will also provide builders and architects of high risk projects the knowledge of what finishes can be used in specialized or high risk applications.

ACKNOWLEDGEMENTS

This project was funded by the Canadian Masonry Research Institute and the Royal Canadian Mounted Police. The authors wish to thank the management of the Crime Laboratory of the RCMP for supporting the project for without their cooperating, this project could not have been undertaken.

Table 1 Description of Firearms and Ammunition

FIREARMS			Ammunition			
Calibre/Make	Description	Barrel Length	Description	Weight	Velocity	Energy
		mm (in)		g (grain)	m/s (fps)	J (ft lb)
.177 Pellet	1 Weihrauch Model HW 80 air rifle	495.3 (19.50)				
.22 Long Rifle	2 Anschutz Model 310 bolt action rifle 3 Smith & Wesson Model 617 revolver	609.6 (24.00) 152.4 (6.000)	Federal Classic Velocity Copper Plated (#710)	2.59 (40)	384 (1260)	190 (140)
.223 Remington/5.56x45mm	4 Remington Model XP-100 Custom bolt action rifle	571.4 (22.50)	Federal American Eagle Metal Case Boat Tail (#AE223)	3.56 (55)	988 (3240)	1735 (1280)
7mm Remington Magnum	5 Winchester Model 70 bolt action rifle	609.6 (24.00)	Federal Premium Nosler Partition (#P7RF)	10.37 (160)	899 (2950)	4189 (3090)
7mm Shooting Time Westerner	6 Remington Model 700 bolt action rifle	609.6 (24.00)	Federal Premium Sierra GameKing Boat Tail Soft Point (#7STWA)	10.37 (160)	1009 (3310)	5288 (3900)
.308 Winchester/7.62x51mm	7 Ruger Model 77 bolt action rifle	609.6 (24.00)	Winchester USA Training Full Metal Jacket (#Q3130)	9.53 (147)	853 (2800)	3474 (2562)
.30-06 Springfield	8 Ruger Model 77 bolt action rifle	558.8 (22.00)	Federal American Eagle Metal Case Boat Tail (AE#3006N)	9.72 (150)	887 (2910)	3823 (2820)
.375 Holland & Holland	9 Sako Model Hunter bolt action rifle	584.2 (23.00)	Winchester Super X Full Metal Case (#X375H3)	19.44 (300)	771 (2530)	5780 (4263)
.25 Automatic (25 A.C.P.)	10 Beretta Model 20 semi-automatic pistol	60.30 (2.375)	Remington Metal Case (#R25AP)	3.24 (50)	232 (760)	87 (64)
.32 Automatic (32 A.C.P.)	11 Browning Model 1910 semi-automatic pistol	88.90 (3.5.00)	Remington Metal Case (#R32AP)	4.60 (71)	276 (905)	175 (129)
9x19mm (9mm Luger)	12 Smith & Wesson 5946 semi-automatic pistol 13 Heckler & Koch MP-5 sub-machine gun		Winchester Ranger Law Enforcement Ammunition (#RA9SXT)	9.53 (147)	308 (1010)	451 (333)
.40 Smith & Wesson	14 Glock Model 22 semi-automatic pistol	114.3 (4.500)	Federal Tactical Hollow Point (#LE40T1)	11.66 (180)	302 (990)	529 (390)
.50 Browning Machine Gun	15 Barrett Model 82A1 semi-automatic rifle	736.6 (29.00)	BMG 12.7x99mm	45.36 (700)	869 (2850)	17083 (12600)
12 Gauge	16 Browning Auto-5 semi-automatic shotgun	762.0 (30.00)	Federal Classic 2 ¾" Riffle Slug (#F127RS)	28.38 (438)	442 (1450)	2847 (2100)
			Federal Premium 3" Sabot Slug (#P151SS)	29.16 (450)	472 (1550)	3254 (2400)
			Federal Classic 2 ¾" Buck Shot (#F127OB)	0 Buck	389 (1275)	n/a (n/a)