

1. HUMAN IMPACT

One of the major causes of injury is human-to-glass impact. For this reason, there is existing legislation that covers the use of safety glazing materials in certain building constructions. This legislation is designed to protect individuals from bodily harm, should they walk into or through the pane of glass. The major cause of injury to the human body when impacting a pane of glass is what is known as the “guillotine effect.” This is where the person walks into or through the pane of glass with great speed. By the time the individual realizes that they have walked into the glass, they are already in a position where they have broken the pane of glass and do not have sufficient time to back-track. As soon as the glass is broken, due to the effects of gravity, it falls and injures the person. Statistics reflect that the majority of injuries are to the knee and upper leg portion of the body. The next most likely area of injury is the head, neck, and shoulder region. In many cases, these injuries, if not fatal, will lead to severe damage to tendons and possible loss of limb or limb function. At the very least, several operations and several months or years of therapy will be necessary.

The Consumer Product Safety Commission reported that in 1991 that there were over 150,000 glass related accidents in the U.S. These statistics are gathered from the emergency rooms of hospitals and doctors throughout the nation.

Safety film decreases and virtually eliminates injury from this type of human impact. The glass, while it may be broken or cracked, remains adhered to the film, and in most cases, is still intact in its frame. The tensile strength of the film, coupled with its elasticity and high resistance to shear, greatly reduces, if not virtually eliminates, the ability of a person to walk through a pane of glass.

There have been several cases overseas where companies have been sued (particularly retail companies) because customers have walked through plate glass windows of shops or in shopping malls. The onus is on the building owner or the lessee of the premises to ensure that the glass is adequately protected or marked clearly to prevent people from walking into it. The application of safety film to existing windows is a quick and economical way to overcome this risk.

This product can also be fitted to residential sliding doors and glass doors, particularly in areas where children are present. It may also be fitted in other risk areas such as sliding doors which lead to swimming pools. There is a high incidence of people walking through sliding glass doors near swimming pools, caused primarily by surface water glare and the presence of slippery surfaces around a pool.

2. THROWN OBJECTS

Many windows are broken either intentionally or unintentionally by thrown objects. Whether this is a child accidentally throwing a baseball through a window or a smash and grab robbery attempt, the results are the same. The projectile hits the glass with some degree of velocity, breaking the glass inward. This causes large dagger-like glass shards to fly into the room. Not only does this pose a risk to property, but it also poses a risk to unsuspecting individuals. Whether at home or in the office, people tend to put furniture near windows in order to enjoy the benefits of light, warmth, and view allowed by large windows. In the event of a thrown missile, this presents the likelihood of injury.

In the case of retailers, there is a two-fold problem associated with a thrown object. First of all, the resultant glass shards can damage the merchandise on display in their windows. Secondly, because the glass generally breaks and collapses, it gives the robber an opportunity to quickly and easily reach into the window and remove something.

The application of safety film to these windows will reduce, if not completely eliminate, both damage to people and property. Because the polyester film has a high degree of elasticity, it is resistant to such

breakage. The type of object thrown will determine the chance that that object has of penetrating both film and glass. In most documented cases, the pane of glass itself remains intact in the frame with only a small hole where the object penetrated. This sustained protection serves to thwart the would-be smash and grab burglar. Should the robber persist in the attempt to gain entry into the premises, repeated efforts to smash a hole through the glass and film or to enlarge the existing hole will have to be made. The resultant time delay and noise factor is generally sufficient to scare off most would-be robbers empty handed. This has been documented in many cases across the nation.

3. EXPLOSIONS

There are many types of explosions which can be accidental or intentional. The majority of accidental explosions are related to industrial manufacturing processes and can result in massive devastation. Intentional explosions are often motivated by political or revenge motives. Explosions may be caused by specialized explosive devices such as plastic explosives, hand grenades, or in the case of industrial explosions, gas leaks.

Whatever the cause, the results are the same. The explosion, by displacing air, creates a shock wave or (as it is more commonly known) an over pressure. This over pressure results in a vacuum being created where the blast has pushed air away from the blast center, generating a shock wave. Depending on the size of the shock wave, this could be up to several miles away from the initial explosion.

When the shock wave hits the glass, it causes it to break. The incidental area of damage surrounding the blast center depends upon the amount of energy the shock wave carries with it. The intensity of this energy will vary according to the distance of the window from the origin of the blast and the type and nature of the explosive.

This shock wave, with sufficient velocity, can turn the broken pieces of glass into extremely lethal dagger-like missiles. There have been cases where pieces of glass have penetrated car doors. Photographs exist showing where shards of glass have either penetrated right through a human body or have penetrated to the degree that they have caused the death of a person. There are other problems related to glass breakage and explosives. To begin with, if the glass is close to the origin of the explosion, and sufficient explosive is used, the glass is atomized. The shock wave causes the oxygen to be knocked out of the person, and as they resultantly gasp for air, they suck in atomized glass particles. This often results in death several days later.

Another factor that is problematical to treating glass injuries is when glass penetrates the body. The glass assumes the color of the body organs, making it extremely difficult to see. Moreover, the glass particles do not show up on x-rays, making it very difficult for emergency room physicians to find the glass inside the body cavity.

Over and above the possible damage to human life, the damage to property caused by shock waves and glass pressure is significant and can result in the partial or complete destruction of the contents of the building.

The benefit of safety film applied to windows in these circumstances is as follows:

First, because the film has the ability to stretch without tearing, it has the ability to absorb a large degree of the shock wave. As this large pressure of air moves towards the glass and pushes the glass inwards, the glass eventually gets to a point where it cracks and breaks. However, the film applied to the rear of this pane of glass continues to absorb the shock wave and stretches until it reaches the point that it can no longer bear the pressure, at which stage it will burst. In some cases, the shock wave, while great enough to break the glass, is not enough to shear the safety film. This results in the pane of glass being broken but held intact by the film. In these cases, not only are there no injuries, but there is no damage to the property inside the

building. In other cases, the shock wave is sufficient to break the glass and shear the film. In a majority of these cases, the glass collapses in one pile attached to the safety film with minimal damage and virtually no injuries. In most cases, no less than 95% of the glass remains affixed to the film.

The initial shock wave itself creates a vacuum. Because of the vacuum created by the over pressure of air, there is an immediate rush of air back to the origin of the explosion. This causes the glass to be pulled back towards the original direction of the shock wave. This is why after an explosion the glass is in a convex rather than concave position. This is a major cause of concern because in the event of a skyscraper or multi-story building, the implosion force may be sufficient to pull the window from its frame. When there is a shock wave, the glass breaks, and the resulting implosion sucks it out into the street below, before the glass has had an opportunity to fall into the interior of the building. This causes a rain of thousands of glass shards onto the street below. This could easily occur in a crowded city center at lunchtime, and the injuries to people in the street below could be substantially greater than to the few inhabitants in the building at that time of day.

In the majority of cases, if these windows had been coated with safety film, a large percentage of the windows would have remained intact in the frame with most of the broken glass shards adhering to the film.

There is a far smaller risk when the entire sheet of film and glass is pulled out of the window, rather than having thousands of individual shards of glass falling in to the street below.

4. NATURAL CATASTROPHES

Climactic and geographic conditions can result in a variety of natural catastrophes, the most prominent of these being hurricanes and earthquakes.

The nature of the stresses put on glass as a result of these two natural events differ somewhat. Hurricanes produce intense winds which, as in the case of explosions, create over pressures or pressures great enough to break glass. There is a difference between hurricanes and explosions. In the case of most explosions there is a single blast, whereas hurricanes sustain winds over several hours. This continuous buffeting of the glass may well result in breakage. Again, as in explosions, this over pressure of air bursting into the building is capable of creating a large degree of damage which is somewhat intensified by the addition of flying glass fragments, wind, and rain.

Another important consideration in the case of hurricanes is that the windows often form one of the weakest points of a building's envelope. In the case of houses, the wind gets through the windows and into the structure where pressure accumulates and often results in the roof being blown off the house. This was particularly evident in the case of Hurricane Andrew in Miami, Florida during August 1992. In fact, so much attention was drawn to that single factor that Dade County changed the building codes so that windows may be more adequately protected.

Safety film offers a high degree of protection in the case of such sustained winds. Should the winds get to the point that the glass can no longer hold the pressure, in many cases, the glass will break and the film will shear to some degree. The film and glass will often remain intact in the frame, preventing wind and rain from entering the building. At a minimum, it will prevent flying glass shards. This alone should be sufficient to justify the expenditure.

The stresses caused by earthquakes are somewhat different from hurricanes and are related to twisting or mechanical flexing of the glass. The intensity of the earthquake will largely determine whether the glass breaks. Other contributing factors are the design and method of construction of the building. In the case of earthquakes of significant magnitude, thousands of panes of glass can be broken. In the Whittier, California earthquake of the late 1980's, more than 110,000 panes of glass were broken.

Because there is no implosion factor involved, this does not generally pose as great a threat as a large explosion. Yet, there is still a distinct possibility that a large portion of these panes of falling glass will result in substantial injury.

The percentage of injuries that are caused by flying glass is roughly equal to the percentage that are caused by falling glass. Therefore, these two factors constitute virtually 95% of all glass related injuries.

The result of a bullet hitting a pane of glass is similar to that of any flying object. Damage is more a result of flying glass than the bullet itself. There have been several cases where extremely large shopfront windows have been shot by vandals or gang members and the entire pane of glass has been broken, yet remains intact in its frame as a result of the application of the safety film. In other cases where safety film has not been applied, there has been substantial damage to property within the shopfront. With the glass missing, the contents of the shop are exposed to looting, casual theft, and the elements.

6. FIRE BOMBS

While it is not a common method of attack in Ireland, fire bombs constitute a very real threat by the nature of the damage that they cause. Generally, a fire bomb or Molotov Cocktail consists of a bottle filled with approximately one-half beach sand or dirt, gasoline, and a piece of cotton cloth used as a fuse. The sand is put in the bottle to give it sufficient weight to penetrate the pane of glass. The object of the exercise is to light the fuse and throw the bomb through the pane of glass where it bursts into flames in the interior of the building.

In a majority of cases, safety film applied to windows at risk will prevent the bottle from penetrating the glass, thus preventing fire inside the structure. More often than not, the fire bomb will break the glass and burst into flames on the exterior of the building. While this does constitute a danger, it is far less dangerous than a fire bomb actually penetrating the building. In most cases, the resulting property damage is also considerably less than if the fire bomb had penetrated into the building.