SAFE DESIGN FOR RADIOLOGICAL BUILDINGS IN EGYPT

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ABSTRACT

The study discussed the safety design of some types of research buildings, which use radioactive materials. These buildings can cause higher pollutionin the environment and human. The probability of causing danger can be from radioactive contamination, and/or externally danger of bombings. In addition, these research buildings could lead to chemical or biological contamination. The present study described various design used. The suitable safety design is proposed to mitigate the effects of different type of pollution. The use of ventilation system in the building, with controlling of ventilation rates and the types of filters used are considered some safety engineered solutions. As well as, has been analysis for the geometric shapes of different designs for the research centers.

INTRODUCTION

Safety design is a design used to mitigate or reduce risk. Some research buildings are hazardous building due to the handling of radioactive materials. These materials can consider a threat that resulted from possibility of workers, public and environment contamination and blast hazard. In reality, some of these radioactive can also cause biological and chemical contamination. Accordingly, may be some of the properties of materials used in protection barriers that may have harmful aspects. There are several fundamentals should be implemented. The safety design criteria are to show design buildings to be more secure.

A building can enhance occupant protection from an airborne chemical, biological, or radiological (CBR). These buildings include laboratories and higher risk facilities. Several studies were used the so called, "Building Vulnerability Assessment & Mitigation Program (BVAMP)".The present study is discussed the design considered of each different case of contamination. But in this research was suggestion a means to address the one to face the three types of pollution. As well Preparation and advanced planning can reduce the likelihood and Contamination of chemical, biological, and radiological. [1]

There are four types of risk can face the building; it may be combined or separate. So that the subject of the study it was safety design, through engineering solutions as barriers to the face of danger.

Security is a fundamental principle of physical protection, is that it should be based on the current evaluation of the threat, and this evaluation is through Assessment for Design. To make the transformation from Threat Assessment to DBT, must be rigorous analysis and decision-making are essential (and Safety in some type of research building, Due to the radiological contamination, toxic chemicals and biological hazardous materials used in a laboratory research facility, are Considered challenged to create productive environments, while ensuring the protection and safety of laboratory personnel. Measures shall be taken to achieve the highest level in the design of research buildings, However, the design shall be consistent with national acceptance criteria and safety objectives. In the same time, it shallprevent accidents with harmful consequences that can be resulted from a loss of control over the sources of radiation. Additionally, the design shall be mitigate the consequences of any accidents.

For that, the main objectives of Chemical/Biological/Radiological (CBR) safety and protection are to provide building systems and controls that provide a safe and secure indoor environment in the event of a CBR release inside or outside of the building. To achieve optimum safety and to avoid possible hazards in research building, considering design fundamentals. Achieve optimum safety to avoid possible hazards. And there is some precautions should be considered to achieve a high quality design with optimum safety. This highlights predicted hazards like occupant protection from an airborne chemical, biological, or radiological (CBR) and blasts. In addition, some important design criteria, and assessment methods that evaluate probable risks.

The Buildings has been classified Depending on function of the building. Most research laboratory facilities and spaces will typically fall within the basic Business Group B occupancy classification, with perhaps a few accessory areas of Assembly Group A or Storage Group S occupancy classifications. In situations where the research being carried out is typically hazardous or hazardous material quantities exceed those allowed by other provisions of code; spaces may be required to be classified as High-Hazard Group H occupancy. Generally, the H occupancy classification however carries with it significantly more strict egress and fire-resistance requirements which can equate to a much more costly space to build.

It has been classified radioactive buildings, depending on the level of radioactivity user, and Radiological release consequences. There are several Types of radiological building must be studied to achievement suitable design:

- A building designed to deal with large amounts of radioactive material, necessary to adapt the air with a high degree of air filtration abroad and keeping waste in separate special tanks, and most of this type located in radiation research centers.
- Amount of radiation rolling in this kind of laboratory is less than that used in the first type, it is specifically designed for laboratory radioactive isotopes, regular and quality of chemical laboratories sufficient condition that the work surfaces are high standard specification and include Cupboards fumes and adequate ventilation.

  And development of the normal chemical plant, finishing floors and work surfaces with a high level of appropriate finishes.Factories are classified according to the radioactive toxic radioactive materials used, and the relationship between the quantities traded and the quality of finishing laboratories can be divided into three types of radioactive.[2]

The present study described various design used and proposed thee suitable safety design is proposed considering all various hazard.

Methodologies used in different designs.
Basic Requirements of safety Design.

Radiation safety precautions design:

- Choose the best materials used in protective buildings, for the different types of radiation.
- And flexibility in future planning and employability stretch.
- Synthesis and find internal movement axes and see trends.
- The application of conditions required in the workplace radiation and radioactive materials, in terms of space and ventilation system - the technical state of the roofs - protective armor accounts for each of the ceiling and the floor, walls and openings.

1. Minimize radiation damage caused by radioactive facilities and access to appropriate environmental design and its maximum safe.
2. Study of the foundations and architectural design standards for Radiation Facilities research centers that have a special nature.

When designing radioactive buildings must Subject to:

3. Study the safety requirements for laboratories radioactive at an early stage of the design phase, as a means of escape in an emergency such as ventilation rate and direction of movement of the air inside the building, and distance.
4. Taking into account the level of works surrounding the radioactive laboratories and adjacent areas.

The material used:

5. That all surfaces are smooth and non-porous and free of cracks chemically inert.

6. Use Structure concrete and strips of lead and gypsum board, gypsum barium.
7. Taking into account the standards of radiological safety that limit or mitigate the effects of radiation accidents.

So, It was study various cases expected from the pollution in the premises of research

<u>First case</u>

Radiological protective measures

The workplace of radioactive materials are required at least two exits in each plant to be of the facility outlet on a separate area. and must be in a position providing crossings separate, when an emergency the direction, and one of the corridor is not enough, must be directed to an alternative route and security for outside. The building and that the direction of opening in the direction of exit, Figure (1) shows a simple example of radiation laboratory study was the entrances and exits.

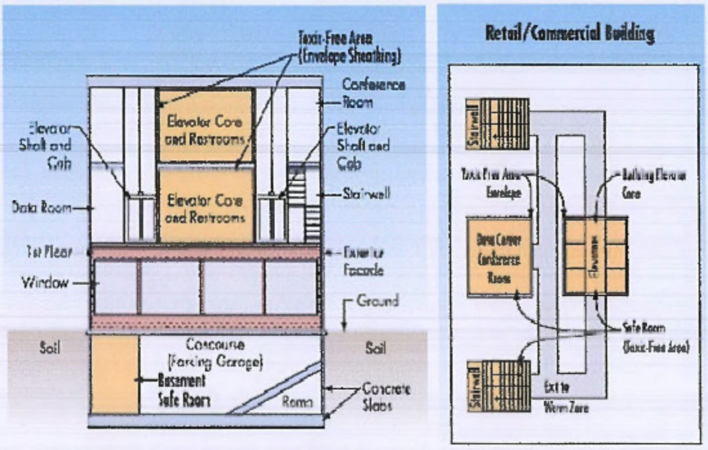


Figure1: Examples of internal locations in research building

Specification radiation Protection for layout Corridor and Doors:

It was suggested being of cavity enough so that must be study distribution and circulation of motion in corridors. To reduce contamination of radiation, figure (2). the door does not reflect more than 7 inches inside track corridor when open fully, which reduces the collision of people crossing and the following figure and different kinds of doors to be fitted with panels glass of 100 inches or less in doors exits lab also used in the prevention of fire, it helps not to collision of people entering and leaving, and glass must be kept low enough so that you can see the people, and less dimensions of exit 80 x 32 inches and 80 x 36-inch flat-reaction lever handles work easier in case of emergency to facilitate movement within and outside laboratories for people wheelchairs.

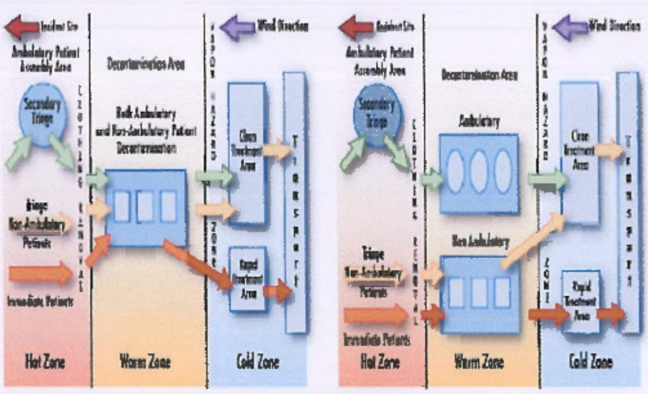


Figure:2 protection Corridor System layout (EDCS)

Second case

Chemical and Biological measures

Biological Attacks are including bacteria, viruses and toxins, it can break down quickly, or can be long lived animals, and water can be contaminated.

Chemical contamination Leads to damaged nerve factors, lung-damaging, and incapacitating, it is Can be released in liquid form to cause harm May be odorless and colorless.

Spend nine out of ten hours indoors, and indoor air are commonly contains higher concentrations of airborne chemical contaminants,and pathogenic microbes than outdoor air.Biological and chemical contamination makes sick and toxic buildings, all have made the issue of healthy air critical. Removing biological pathogens and toxic chemical compounds by air decontamination has been a recognized. it is mostly been accomplished through ventilation Airflow and ventilation are already key factors in worker comfort, health and productivity, building design, and energy efficiency.

This section presents the scientific fundamentals of clean air, vis-à-vis filtration and UV, and the benefits and obstacles associated with these technologies. To provide general understanding of air the decontamination technology.

The simplest solution to disinfecting the air is to capture offending particles in a filter mesh of some kind. The development of high efficiency particulate air (HEPA) filters has made it possible to efficiently clear the air of particles down to 0.3 μm (micrometers) in size of a particle in air.

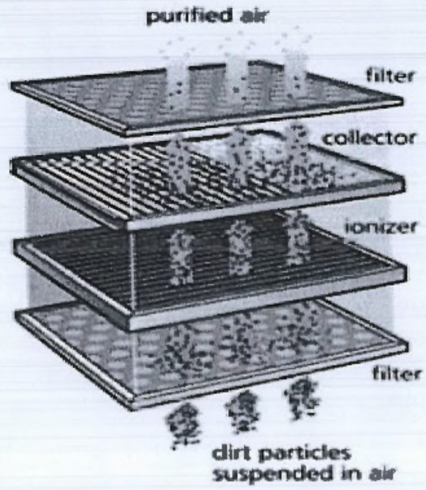


Fig3. An electrostatic precipitator contains two components, an ionizer and a collector. The ionizer gives a positive charge to dirt particles in the incoming airstream, which then adhere to a negatively charged collector. The resultant outgoing air is cleaned and purified.
Graphic source: Precision Graphics

Another well-known filtration technology is based on electrostatic precipitation. Electrostatic filters precipitate particles out of the air by passing contaminated air through a highly charged field (ionizer). The maximum removal efficiency was 81%. Smaller size microorganisms were more difficult to remove, making the use of this technology more tentative for virus removal.

HVAC Design Considerations

Ventilation and Air-Conditioning systems is used to withstand any attack that takes place and prevent the contamination of the rest of the building. These areas should have a lower air pressure than other parts of the building. They should have at least 12 air changes per hour and the exhaust should be filtered by high efficiency particulate, clean air should enter the level of the occupants as shown in Figure 4. Mailrooms are a high risk for attack because CBR agents could simply be mailed in. This means that an exhaust hood similar to those used in chemistry and biology laboratories should be placed over mail sorting area

Ventilation With One Ceiling Diffuser And Two Low Returns

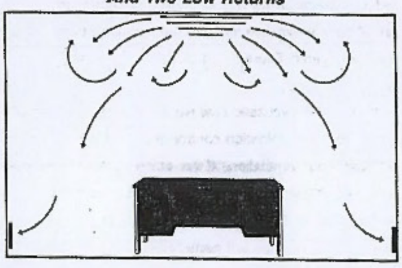


Figure 4: Air entering a room from the ceiling and leaving at floor level to create a downdraft.

High efficiency air filtration provides the highest level of protection against an outdoor release of hazardous materials. The idea of air filtration can be applied internally and externally. External involves bringing the air in from the outside environment, filtering it, and then releasing it into the building. Similarly, internal filtration basically recycles the air inside the building by filtering it and discharging it back into the structure. The most common filters are particulate air filters. These capture aerosols through different methods and highly depend on the size of the particle and the velocity of the air. Four main types of filters consist of inertial impaction, interception, diffusion, and electrostatic attraction. [3]

Third case blasts

Foundations and Metrology used in the design of buildings radiation research

The possible to identify some of the foundations and Metrology used in the design of radioactive buildings, in terms of functional, and the type of work being done in the planning work will determine the type of construction and functional processes of the building. The measures to be taken in the event of a CBR attack are summarized below in bulleted form. These suggestions include how to prepare in advance for an attack as well as how to protect oneself during an attack during an event, Things to do:

- Prevent access to outdoor air intakes
- Prevent access to building roofs
- Isolated storage areas with air locks and separate HVAC systems. These are likely places for contamination.
- Install HEPA filters
- Pressurize building
- Do not permanently seal outdoor air intakes systems or the occupants
- Learn where emergency exits are located
- Know different types of fire extinguishers
- Review evacuation procedures
- Stand clear of all windows in a blast even

Site and Architectural Issues

The placement of the building on the site can have a major impact on its vulnerability. Ideally, the building is placed as far from the property lines as possible. This applies not only to the sides that are adjacent to streets, but the sides that are adjacent to adjoining properties since we cannot be certain about who will occupy the neighboring properties during the life of the building. A common practice example of this is to creating a large plaza area in front of the building, but leaving little setback on the sides and rear of the building. Note that this practice generally increases the vulnerability of the other three sides. Also, if this approach is used, the exterior envelope may extend beyond the superstructure below ground which will also need to be considered as part of the protective design effort.

Building Layout

The first objective before designing Smart Building is to choose the appropriate piece of land. as well as internal considerations should be taken into account. Include construction type, desired occupancy level, to achieve antiterrorism security design features

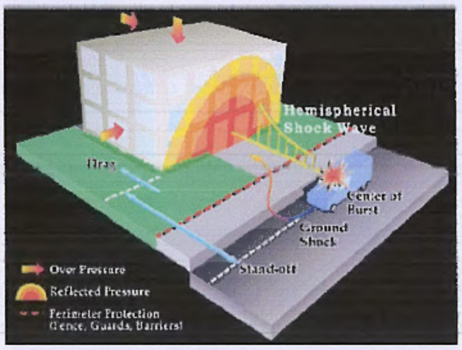
Building orientation on the selected land, refers to the building's spatial relationship to the site, its orientation relative to the sun, and its vertical or horizontal aspect relative to the ground. The spatial relationship determines the building's visibility as well as its proximity to a street or surrounding building.

The primary design objective is to save the lives of those important buildings, in the unlikely event is that an explosive terrorist attack occurs. The first goal is to prevent progressive collapse, which will limit injuries to those inside the building due to impact of flying debris and air-blast during an incident, near the building perimeter.

The following program (VULNERABILITY ASSESSMENT) can be used to assess the vulnerability of building. It works by taking the user through several sets of questions that asses the current security of the building and then it generates a set of instructions that can be used to decrease the vulnerability of the building. This is a tool for managers to mitigate the severity of a CBR attack. [3]

Landscaping features may also be used effectively to thwart a vehicle from ramming into the building by creating an obstacle course. Monumental stairs against the building, water features and other features can be effectively used to resist. This often is the approach which has been used for some Design Excellence projects where architectural integrity is paramount. This method is most effective when there is sufficient setback to have several layers of devices between the street and the building. CPTED (Crime Prevention through Environmental Design) concepts may also be effective.

To protect against attacks, it is recommended that the barriers along the secured perimeter have anti-ram capability consistent with the size of the maximum achievable velocity up to 50 miles per hour. Typically, for portions of the building that are parallel to adjacent streets, a maximum velocity of 30 miles per hour is considered. For street corners, or "T" intersections, a velocity of up to 50 miles per hour is considered. The weight of the vehicle may vary from 4000 pound car to 15000 pound truck depending on the criteria used. Two typical anti-ram barriers types are shown in Figures 6.



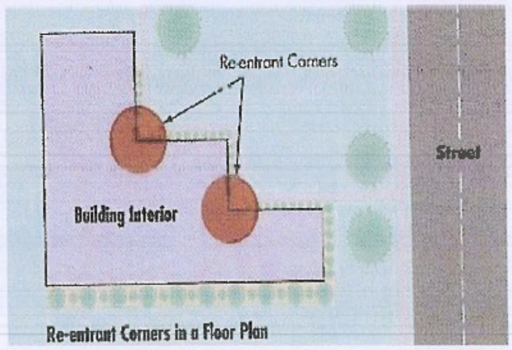


Figure 6 : Re-entrant corners should be avoided in the exterior of a building so it can better resists shockwave
Figure 7:. Vehicle Weapon Threat

Building shape also plays quite a significant role with respect to the overall damage of the structure. Some buildings that tend to trap shock waves from explosive blasts are 'U' and 'L'Shaped designs.In general, re-entrant corners should be avoided. Convex shapes are preferredto concave designs for the exterior of buildings because they will reduce the air-blast pressures in the instance of an attack. Figure 7 illustrates what not to do when designing a structure.Eaves and overhangs should be avoided because they can be points of high local pressure andsuction during a blast event. Pitched roofs are suggested to allow for the deflection of launched explosives during a terrorist attack.

When a blast occurs an incident blast wave is created that causes and instantaneous rise from atmospheric pressure to peak pressure. After this peak pressure is reached a negative phase occurs that lasts much longer than the positive phase of the blast. The duration of the entire event can be measured in milliseconds, which differs from natural disasters or other terrorist events measured in seconds or minutes. This rapid change does not allow the building to adjust to the extremely large load presented to the structure. Figure 7 shows the order in which various aspects of the asset will fail during a blast event.

Explosive pressures used for design are typically much greater than the other loads considered, with the distance from the explosion. The duration of the explosion is extremely short, measured in thousandths of a second, or milliseconds. Effects of shock wave expansion and engulfment of the building are shown in Figure 6.

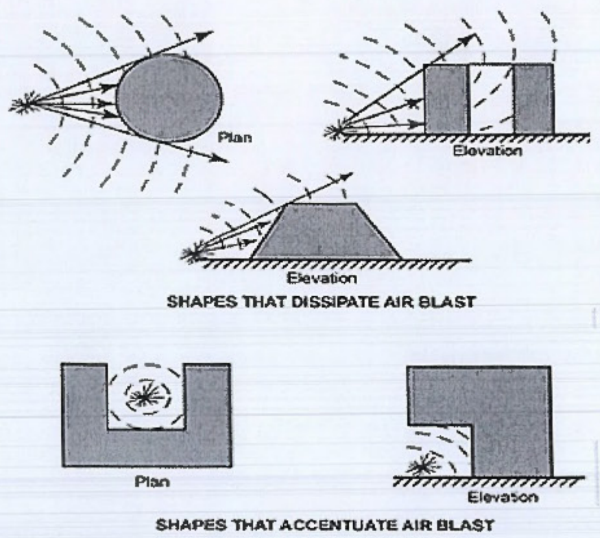


Figure 9: Affect of building Shape on air-blast loading.

After Study and analysis of the basic geometric shapes used in the design of buildings. As it illustrated in Figure 9 , the effect of each form and the reaction in the event of an explosion in the vicinity of the building.Because the design of the U-shaped and the L shaped may include external damage because of increased negative impact of the building structure, either form Parallel is more susceptible to direct damage. The destruction of almost entirely of the considerations is may be cause returns frequently in the building next. The conclusion was potential outlook for both the design to get the optimal test as evidenced in the conclusion.

Conclusions

It is important to prepare a new environmental design of the research buildings, taking into account the rules and standards of safety in the selection of optimal designs in architectural treatments that are compatible with the environment. It was found out, the risk in research buildings used radioactive material. Is not limited only on radioactive contamination but it is may be cause a chemical or biological contamination too.

Conclusion was reached to, the previous outlook for research buildings as a source of only radioactive contamination, is the wrong look. So we must also take into considerations internal hazard chemical Biology radiation, and external hazard.

The study is recommended to use the semi-circular shape and pyramid shape. These designs are good to minimize the impact of external risks. So I see finally, the recommendation is considered that the integration of the curved shape and trapezoidal is one of the best suggestions to achieve the highest probability for protection from potential risks.

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On this basis, we began to study each pollution case separately. For access to the appropriate engineering design to reduce risk.

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التصميم الآمن للمبانى الاشعاعية فى مصر

ناديه محمود سراج
هيئة الرقابة النووية والاشعاعية

الملخص

من خلال الدراسة استنتجنا ان بعض انواع من المبانى البحثية، التى تستخدم المواد المشعة، تعد من المبانى التى لها خطورة تلوث على البيئة والانسان. ولان هذه المبانى لها طبيعة استخدام خاصة، نظرا لاستخدامها مواد مشعة فى الابحاث والتجارب المعملية. لذلك وجد ان احتمالية الخطر فى هذه المبانى، تكون داخليا من التلوث الاشعاعى، وخارجيا من خطورة تعرضها لتفجيرات خارجية.
وماتم استنتاجه ان التلوث الاشعاعى قد يؤدى الى احتمالية خطر تلوث كيميائى او بيولوجي ايضا. وبدراسة حالات التلوث المحتملة، تم التوصل الى اقتراح المعالجة الهندسية التى تستخدم فى تخفيف اثار التلوث سواء التلوث الاشعاعى اوالكيميائى او البيولوجى، سواء كانت حالات التلوث الثلاث منفصلة او مجتمعة .وذلك باستخدام اسلوب التهوية فى المبنى مع التحكم فى فرق معدلات التهوية، وانواع الفلاتر المستخدمة.
كذلك تم عمل تحليل هندسى للاشكال الهندسية للتصميمات المختلفة لمراكز بحثية. وتوصلنا لاستنتاج افضل التصميمات التى تحقق افضل اداء لمجابهة المخاطر الخارجية وتقليل الخسائر.