Avrupa Bilim ve Teknoloji Dergisi
Özel Sayı, S.34-37, Ocak 2018

Konferans Bildirisi

www.ejosat.com ISSN:2148-2683

European Journal of Science and Technology
Special Issue, pp. 34-37, January 2018

Conference Paper

Restructuring of University Laboratories within the Scope of Occupational Health and Safety

Kamil Musa Ordu[1*], Gülçin Çivi Bilir[2]

[1] Corresponding author: Istanbul Technical University, Workplace Health and Safety Unit, Maslak, 34469, Istanbul, Turkey,
[2] Istanbul Technical University, Workplace Health and Safety Unit, Maslak, 34469, Istanbul, Turkey,

*Email: orduk@itu.edu.tr

Abstract

Laboratory safety is major of importance to occupational health and safety, which manages, and responds to all issues and concerns surrounding physical, biological, ergonomic, electrical, chemical, and other standard operating procedures.

In this work, laboratory design and equipment, which are arranged according to precautions that are taken against to all hazards regarding to work environment or personal expose at the work environments in laboratories that are already exist or will be established in universities, are discussed according to legislation and regulations of Occupational Health and Safety Law No. 6331. In addition, some examples of Occupational Health and Safety applications of leading university laboratories in the world are given.

Keywords: Laboratory safety, hazard, occupational health and safety law.

1. Introduction

It is quite important to build up the culture of occupational health and safety, which becomes a discipline that has increasing importance day by day in our country as well as world, in laboratories, which are already exist or will be established in universities, and supply sustainability of this culture.

Asumeng et al. (2015) categorized the hazards as biological, physical, ergonomic, chemical, psychological and defined management of these hazards. İleri (2014) studied the hazards in mining, construction, metal industry, textile industry, agriculture industry, and asbestos ship dismantling, repair and maintenance motor vehicle industry, shipyards, etc.

On the other hand, laboratories are considered dangerous environments as a place of work and may carry many risk factors that can cause occupational accidents. In this manner, it is very important that laboratory users should follow the regulations and safety rules in order to eliminate or minimize the risks for laboratory users working with biological, physical, chemical and radioactive substances, and electrical accident associated with low/high voltage. A variety of hazards exists in university laboratories. To manage these hazards, and in response to a heightened concern for safety in the workplace, university has to preserve safety and health of the lab users and provide enable the work secure in laboratory spaces according to the current law and regulations.

2. Laboratory Hazards

Laboratory spaces in university area considered high-risk environment when compared to other areas like offices, amplifier classes and cultural center etc. Laboratory hazards may result health effects in short or long terms. All persons working in a university laboratory may be exposed to under these hazards, which can be categorized as

- Physical Hazards (vibration, noise, insufficient air condition, excessive heat, humidity, and air movements, insufficient or excessive lighting, high electromagnetic fields, gases under pressure such as compressed gases, liquefied gases, refrigerated liquefied gases, dissolved gases, etc.),
- Biological Hazards (bacteria and viruses, insect bites, fungi/mold, blood and other body fluids, working with animals, poisoning plants, etc.),
- Ergonomic Hazards (improperly adjusted workstations and chairs, frequent lifting, repeating the same movements over and over can be taken as ergonomic hazards, etc.),
- Electrical Hazards (deficiency in periodic controls, grounding system problems in electric circuits, damaged and repaired faulty hand tools, insulated floor, high voltage in the study with required rules, interference of unauthorized persons, etc.) and,
- Chemical Hazards (toxic gases, organic vapors of liquids, gases of the molten metal, acids and bases due to combustion, inert powder, fibrojenik powder, powders of toxic, carcinogenic, allergenic dusts, hazardous waste, flammable materials like solvents, explosive chemicals, etc.).

Many scientific or technological research, experiments, and measurements may be performed in university laboratories. Thus, the use of physical, biological, ergonomic, electrical, chemical methods including their technical applications contains a number of risks defined above.

In this manner, the laboratory design and planning has played an important role to destroy or minimize the risks, which may occur in laboratory space.

3. Laboratory Design and Planning

The safety culture in a university encompasses a health and safe environment achieved through everyone understands of his or her responsibilities, rights, and university safety policies. As a part of safety culture; safety assessments for university laboratories should be covered laws, policies, planning, applications, evaluation and measurement. It is important to know how to plan laboratory design in universities. In this framework, according to legislations related to Occupational Health and Safety Law No. 6331 design and planning can be taken into account as follows (6331 sayılı İş Sağlığı ve Güvenliği Kanunu, 2012).

3.1 Walls, doors, floors and ceilings

Designers must select materials cleanable, alterable and appropriate for maintenance. Walls and corner protection should be provided where equipment or user traffic occur regularly. Laboratory doors should open in the direction of exit and close itself. In addition, doors provided with vision panels should have from the outside by a key and push bar from the inside. The floor should be covered up resistant, cleanable, seamless and non-slip material. Ceiling panels and modules should be taken into account by considering usage requirements and the necessary lab class. Insulation in walls and the ceiling reduces acoustical problems. Since the ceiling covering materials must be cleanable, acoustical design for ceiling cannot be destroy the noise fully (Binaların Yangından Korunması Hakkında Yönetmelik, 2007).

3.2 Air quality, ventilation

Particulate emissions and other air pollutants should be considered in laboratories design and operations so as to minimize such emissions and promote the health of the laboratory users. All laboratories shall have mechanical ventilation and parts using 100% outside air and exhaust to the outside. The Local ventilation systems are to designed to remove the contaminants generated by an experiment or device outside of the building involving laboratory. Heating, ventilation and air-conditioning (HVAC) systems should be consider during laboratory design for temperature, humidity, and air quality.

3.3 Lighting and electrical systems

The appropriate design of lighting systems is especially important in university laboratories in terms of significance of work carried out in laboratories and the long work hours spent by users. According to the Turkish lighting standard numbered

TS EN 12464-1: 2013, day lighting should be maximized and lighting should be even across the room with a maintained light level capable of 500 lux on the work area. A combination of lighting zones, dimmable fixtures, and controlled daylight and occupancy sensors with adjustable sensitivity in the room is ideal.

Laboratories should have a sufficient number of electrical outlets and informed from the users to eliminate the need of extension cords and multi-plug adapters. Electric outlets should be coordinated with the electrical characteristics of the laboratory equipment. Emergency power distribution should be considered as required to serve the equipment and loads as a minimum such as domestic water system, environmental rooms, critical equipment, refrigerator, freezers, cold rooms, critical laboratory equipment and their required support systems, one circuit per lab module for discretionary convenience receptacle, fume hoods and their exhaust and makeup air systems, 33% of lighting in laboratories, procedure rooms, and equipment areas, equipment and communications technology power distribution systems, entire animal facilities. Storage should be at least 1 m from electrical panels, mechanical rooms, air ducts, heaters, light fixtures in Laboratories. In emergency cases, it may be necessary to access these panels quickly.

3.4 Chemical storage rooms and waste minimization

There are many potential chemical hazards in laboratories involving chemical materials. Laboratories design should be designed to satisfy with the appropriate precautions. Planning should be involved storage rooms such that, the quantities that may be stored, handled and used in a laboratory unit, chemicals for use in a laboratory unit may be stored in a dedicated storage room. Such rooms may enhance the efficiency of laboratory operations and should be considered if space considerations allow. Consult with EH&S (Environmental Health and Safety) for specific code requirements. Construction and demolition debris and material shall be recycled or reused at a rate consistent with the overall projects country goals (Kimyasal Maddelerle Çalışmalarda Sağlık ve Güvenlik Önlemleri Hakkında Yönetmelik, 2013). Chemical storage rooms should be designed in which an appropriate smoke and fire sensor, flood sensor and automatic fire extinguisher must exist. The fire extinguisher systems should be selected as FM-200, dry powder or CO_2 type, depending on the hazard classification of the usage area.

3.5 Overhead emergency shower, eye washer, fire extinguishers and life safety system

An overhead emergency shower and eye washer equipment should be provided the user with both a full body penetration and located in laboratories where there is the potential for a hazardous material splash to the body. The equipment should also be designed such that the flow of fluids is non-injurious under the varying water pressures.

Fire extinguishers should be placed in external cabinets, which are identifiable, by proper signage. Initial cabinet placement should be located near (within 10 m.) of main entrance doors. Maximum travel distance to any extinguisher must be within 25m. It is necessary to select an extinguisher appropriate to the type of fire likely to occur in that section so that an efficient intervention can be carried out (Binaların Yangından Korunması Hakkında Yönetmelik, 2007). Additionally, an integrated fire alarm, smoke detection and sprinkler alarm system should be provided in laboratories. The system should be a fully addressable distributed processing topology providing alarm and all detectors should be addressable and self-testing.

There are many examples of good applications among the world universities designed according to concept given above.

4. Some Examples of Laboratory Safety in The World Universities

In University of Toledo; for any news construction or renovation of laboratory areas consider health, safety and regulator compliances issues early in the design stage of the project. The outlines some of these issues can be classified as layout, furniture's and fixtures, storage laboratory ventilation, emergency equipment, materials handling, project checklist (University of Toledo, 2016). On the other hand, Columbia University laboratories are designed to comply with applicable federal state and local laws and regulation to facilitate compliance and reporting requirements not limited to the latest edition with respect to OSHA (Occupational Health and Safety Administration) LEED (Leadership in Energy Environmental Design) for labs (Columbia University, 2011). Moreover, In Stanford University, the primary objective in laboratory design is to provide a safe environment for workers laboratory to conduct their work. A secondary objective is to allow for the maximum flexibility for safe research use undergraduate teaching laboratories require other specific design considerations. Therefore, all health and safety hazards must be anticipated and carefully evaluate that protective measures can be incorporated into the design (Stanford University, 2004). In addition, Princeton University goals providing an efficient laboratory safety program assistance to groups planning laboratory renovations, new laboratories and new laboratory buildings. University building standards developed to ensure safe, efficient and sustainable building practices are observed during all new construction and major building renovations (Princeton University, 2016).

5. Conclusions and Recommendations

Research and student laboratories present many challenges. In the day-to-day bustle of conducting research experiments, worker health and safety can be easily overlooked. However, with proper guidance, a trained eye, and practice in noticing the mundane, we can find and correct many common mistakes and prevent illness or injury. Each laboratory that is already exist or will be established in universities, should be structured according to their special intended purpose through detections and suggestions of all person who work in relevant field. In addition, laboratory design should be created by making a prediction work for all risks that may occur. An emergency action plan should be generated by determining accidents and emergencies, and regulations in this plan should be performed.

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