

Constructing/Renovating Laboratories: The Twelve Truths!

Safe Science: Be Protected

By Dr. Ken Roy*

I. TRUTH OR CONSEQUENCES?

There is a high frequency of science laboratory construction and renovation nationwide as a result of increasing enrollments, aging facilities, and a new dedication to hands-on science. Science teachers and supervisors usually have a role in this process, though limited in some districts. The bad news is many science educators either have limited knowledge in building science facilities or if they are knowledgeable, they may not be allowed to provide this valuable input.

The purpose of this writing is to expose teachers and supervisors of science to some (twelve in fact!) of the important truths or aspects of building science facilities. If these are not addressed satisfactorily, the consequences will be lived with for a very long time.

II. BASIC BUILDING TRUTH #1

Architects and builders don't necessarily know more about your lab design needs than you do. In fact, they may know less!

There are a multitude of fire codes, building codes, health/safety codes, professional standards, and more to be considered in constructing science laboratories. Science teachers and supervisors need to find resources which will provide them with background information on designing and building their laboratories. They then can work in concert with architects to make sure their facilities meet the needs of students and teachers.

Three examples come to mind. The new American National Standards Institute (ANSI) code for eyewash/shower units in labs call for tepid water. Yet, in renovating a series of science laboratories for a school district,

the architects and construction manager were unaware of these new standards. They had planned on using only regular tap water. The reason the code changed was because of the result from research noting exposure of 15 minutes to regular tap water could cause more damage to eyes than using tepid water.

In another case, architects planned on building a magnet school for science with no walls or barriers between labs and hallways. The purpose was to foster an open atmosphere and sense of community. Again, though the concept was good, the practicality of it was

unacceptable safety wise. OSHA requires physical barriers to protect those who do not have personal protective equipment from those who do in a lab situation.

A favorite is the "canopy hood" case. An architect

decided to install a canopy hood

for a fume hood in a chemistry lab renovation. Again, National Fire Protection Association (NFPA-45) codes require a prescribed fume hood unit. The canopy hood might have looked fine but would only be functional for flipping burgers in well-known fast food chain facilities.

III. BASIC BUILDING TRUTH #2

The Educational Technology needs to be all you want it to be and more!

Technology started out evolutionary and then went revolutionary. Any planning for technology in a science laboratory is minimal at best. With the rapid changes in technology, teachers and supervisors are put in the position of thinking about instructional tools that may have not yet been invented.

Having said that, there are a number of technology items for planning consideration. They include the following:

- Telephone/intercom – essential for emergency contacts!
- Computer – desk top/handheld
- Video cameras, projectors, monitors.
 - Location is everything!
- Sight (lighting) and sound (acoustics)
- Electricity needs
- Future technology capabilities

IV. BASIC BUILDING TRUTH #3

Size matters in determining Occupancy Load!

The number of occupants depends on the size of the laboratory. This statement is based on net square footage. Middle and high school science laboratories fall under the fire, building and OSHA definitions for laboratories. This is a hard pill for some architects to swallow because of the occupant issue in designing laboratories. The number of laboratory stations should not out number the occupancy load, minus one – for the teacher. Codes specifically relevant to occupancy load and design of the laboratory are found in the following codes: National Fire Protection Association (NFPA) – Life Safety Code 10-1.7.1 "Shops & Laboratories: 50 net sq. ft.;" and, Building Official and Code Administrator (BOCA) – National Building Code 1008.1 "Shops/Labs: 50 net sq. ft."

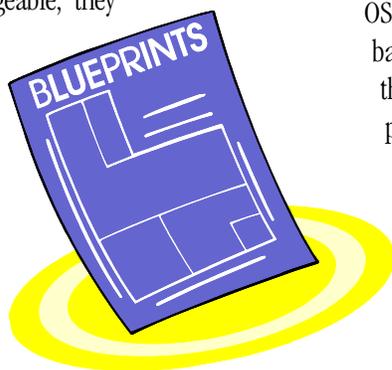
There is a rule on the number of laboratory doors to exit access corridor or public way – 1000sq. Foot Rule – 20% Rule.

Factors that are considered in occupancy load for laboratories include number of exits, aisles, furniture configuration, hazards, etc.

V. BASIC BUILDING TRUTH #4

Ventilation — Laboratories are not supposed to smell!

How often have science teachers heard from principals or supervisors that "laboratories are supposed to smell – don't worry about the ventilation!" The NFPA45 standard specifically addresses ventilation protocols in



laboratories, preparation rooms, storerooms and workrooms/offices. In general, science laboratories are required to have 6-10 room exchanges/hour during occupancy and 4-room exchanges/hour during unoccupied times. In addition, there is to be no re-circulation of laboratory air to other laboratories or other rooms. Chemical storage rooms must have a separate ventilation system.

VI. BASIC BUILDING TRUTH #5

You need to be in control of energy!

If the electricity needs to be immediately shut down in “shock” emergency, is there quick access to master shut offs? Building plans should include energy controls with electricity, water and gas. All laboratories need to have ground fault circuit interrupter or GFCI.

VII. BASIC BUILDING TRUTH #6

Keep up your guard when dealing with Laboratory Hazards!

Personal Protective Equipment (PPE) and engineering controls are not only necessary but also required by safety standards/codes in science laboratories. These include eye wash stations and showers, aprons, gloves, safety shields and safety glasses/chemical splash goggles. A means to sanitize eyewear is required. Chemical emergency crash carts should also be secured and placed for easy access.

VIII. BASIC BUILDING TRUTH #7

Know Your Sign!

Signage is another often overlooked area of safety prevention. Specific signs, size and location need to be addressed. Those include but are not limited to Exit/Not An Exit, Eyewash/Shower, Fire Extinguisher, Storage, Goggle Statutes, Fire Blanket, Master Shut-offs, Chemical Storage, and Flammable Liquids.

IX. BASIC BUILDING TRUTH #8

Laboratory Hygiene: Cleanliness is next to Safety!

Students or teachers tripping over electrical cords in labs, slipping on water dripped on the floor, eating chemically adulterated food

– the list goes on and on. Bottom line is work surfaces must be kept clean, trip/slip, fall hazards must be removed, and a food/drink policy must be adopted and enforced.

X. BASIC BUILDING TRUTH #9

Educational Specifications: The Compass for Decision Making Direction!

By definition “Ed Specs” are a general statement of needs/problems to be solved by architects and other professionals. The philosophy of science education in a district should determine the footprint of laboratory design; i.e., cluster labs vs. pod/core labs; laboratory and separate lecture rooms vs. class or combined classroom/laboratory.

XI. BASIC BUILDING TRUTH #10

Science Education Is For All Students, Including Special Needs, Physically Challenged, etc!

The American Disabilities Act prescribed handicap access for science laboratories. Special attention/accommodations need to be made relative to exit/entrances, laboratory furniture, sinks, safety equipment, etc.

XII. BASIC BUILDING TRUTH #11

Science Laboratories Are To Be Designed and Operated As Secured Areas! (“Danger Will Robinson!”)

Science laboratories in schools are designated as secured areas resulting from the inherent hazards such as gas, chemicals, electricity, etc. These specialized facilities are to be operated only under the direction of licensed or certified science teachers. Special attention needs to be given to planning for uniquely keyed laboratory doors, preparation and storerooms. Cabinets/drawers need locks to secure labware, etc. Use of science laboratories for study halls, non-science classes and homerooms is a very dangerous practice. Given that students and non-science employees are exposed to hazards by being assigned in laboratories, there are liability and negligence issues should there be an accident.

XIII. BASIC BUILDING TRUTH #12

Storage Sites and Preparation Areas Must Be Based On Instructional Needs!

Proper storage and preparation areas are necessary for safety use of hazardous chemicals and other science instruction related materials. Areas to be addressed should include locked cabinets, display areas, storerooms, test tube racks.

Preparation rooms are necessary for safe preparation of laboratory instructional materials. Separate rooms for preparing laboratory materials are a must! Included in this area should be a dishwasher, dedicated explosion proof refrigerator, chemical shelving, fume hood, sinks and source of lab grade water.

Chemical storage again usually needs



a separate room with its own ventilation system. In addition, there should be appropriate shelving with lips, sunken floors to accommodate chemical spills, signage, etc.

XIV. FINAL WORD

There Should Be Life After The Architect and Contractor!

What kind of life will there be after the architect and contractor have gone? Science teachers and supervisors need to take an active role in planning for change by the 3A's:

- Awareness
- Assessment
- Action

Resources:

NSTA – National Science Teacher's Association – <http://www.NSTA.org>

Labs - continued from page 5

OSHA – Occupational Safety and Health
Administration – <http://www.OSHA.gov>

NFPA – National Fire Protection Association
– <http://www.NFPA.org>

BOCA – Building Official and Code
Administration – <http://www.BOCA.org>

NSELA – National Science Education
Leadership Association – <http://www.NSELA.org>

ADA – Americans with Disabilities - <http://www.ada.gov>

**LIVE LONG AND
PROSPER SAFELY!**

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