

Laboratory Safety Manual

Montana State University – Bozeman
Civil Engineering Department

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1 Scope and Purpose of Document

This document is intended to provide a general overview of the activities and safe work practices for use of the material testing, structural engineering, bulk materials, sub-zero science and engineering, hydraulics/fluid mechanics, environmental and geo-technical laboratories for both teaching and research applications. Due to the changing and broad aspects of these activities in the lab, this document may not cover all possible risks at any one time. This safety manual is best used as a guide and cannot be expected to be comprehensive in defining all risks. Common sense and knowledge of safe work practices will be needed in ensuring safety for areas not covered by this document.

It is mandatory that all individuals who perform work in this laboratory are familiar with and understand this document as well as other training requirements set by the CE Department, their instructors and lab supervisors. Fulfilling these requirements is a shared responsibility of the instructors, teaching assistants, students and researchers, according to the specific work in the lab.

When unsure about a laboratory activity or situation, students are required to seek guidance from the instructor, teaching assistant or laboratory supervisor. Mr. Joe Eldring, M&IE and CE Operations Engineer (EPS 132, 406-994-3260) is available to assist you in using the labs. Do not hesitate to contact him.

2 Obtaining Laboratory and Equipment Use Authorization

Before students can independently work in the laboratories and operate any equipment *outside* of scheduled classes and laboratories they must

- Read and understand this document
- Undergo the Slips, Trips and Falls Training provided by the MSU Safety & Risk Management Department
- Complete a Safety & Operation training for the equipment and the laboratories they intend using (training is provided by a CE instructor, GTA or laboratory supervisor)
- Fill out and sign the CE Laboratory User Agreement, available through the CE department office.

3 General Safety (All Laboratories)

Safety procedures for all Engineering Laboratories follow the University's centralized plan and policies, located at <http://www.montana.edu/srm/policy.html>.

Specific laboratory procedures and safety requirements are included in Sections 5 -11 of this document and are also posted in each of the laboratories.

3.1 What is an Emergency? (Definitions)

www.Dictionary.com: 1) a sudden, urgent, usually unexpected occurrence or occasion requiring immediate action; 2) a state, especially of need for help or relief, created by some unexpected event

www.businessdictionary.com: Sudden, unexpected, or impending situation that may cause injury, loss of life, damage to the property, and/or interference with the normal activities of a person or firm and which, therefore, requires immediate attention and remedial action.

www.wikipedia.com: An incident, to be an emergency, conforms to one or more of the following, if it:

Poses an immediate threat to life, health, property, or environment

Has already caused loss of life, health detriments, property damage, or environmental damage

Has a high probability of escalating to cause immediate danger to life, health, property, or environment

3.2 What to do in Case of an Emergency?

In the event of an emergency,

- Get out of immediate danger!
- Report situation to police, dial 911 (or 406-994-2121, or ext. 2121 on campus phone).
- Explain the nature of the emergency.
- Provide your name and location.
- Provide the phone number from which you are calling.
- Answer all questions and do not hang up the phone until the operator is finished.

If the emergency has cause injury to a person,

- Provided it is safe for yourself, stay with the victim!
- If the victim is conscious, ask what the problem is.
- If the victim is unconscious, check for breathing and bleeding. Do not move the individual until trained personnel arrive or an immediate threat to life exists. Only trained individuals should administer first aid and CPR.
- Keep the victim still, comfortable, and warm.

- Protect the victim from any disturbances.
- Search for any emergency identification (i.e. ID bracelet)
- Wait for emergency help to arrive. Never leave the victim alone if possible.
- Once the emergency responders have arrived, stay out of the way of emergency personnel and emergency vehicles!

If the emergency is not life threatening, contact your lab supervisor followed by Campus Safety & Risk Management at 406.994.2711. In all cases, Campus Safety & Risk Management should be notified of any incidents. In certain situations, defined by Safety & Risk Management, laboratory supervisor are required to file an incident report.

If necessary, also contact:

- Facilities Services Office – 406-994-2107
- Vice President for Student Affairs/Dean of Students – 406-994-2826
- Student Counseling /ADA Services – 406-994-4531
- Student Health Center – 406-994-2311
- Poison Control Center – 800-222-1222
- Human Resource Department – 406-994-3651
- Switchboard/Communications – 406-994-2511
- Residence Life – 406-994-2661

3.3 What to do in case of fire or smoke?

All alarms should be taken seriously. If you hear an alarm, evacuate the building!

If fire or smoke is discovered anywhere on or about the campus:

- Leave the area where the fire is located, isolating it as well as possible by closing doors and windows around it.
- DO NOT attempt to retrieve valuables or use elevators.
- Pull the nearest fire alarm.
- Find a safe location and call 911 (or 406-994-2111, or ext. 2111 on campus phone). Then, call Campus Safety at 406-994-2711 or Facilities Services at 406-994-2107.
- Never attempt to fight a fire larger than wastebasket size. Even a small fire can generate enough smoke to cause serious injury. Never attempt to fight a fire by yourself. Call for help. Always stay between the fire and the exit.

3.3.1 FIRE EXTINGUISHER INSTRUCTIONS

- P * PULL safety pin from the handle
- A * AIM at the base of the fire
- S * SQUEEZE the trigger handle
- S * SWEEP foam side to side

3.4 *What if you or people are trapped in a burning building?*

- The universal sign for a person trapped in a burning building is to hang clothing or a sheet out the window of the room where you are trapped. The firefighters then will know where you are trapped.
- If you are aware that someone is trapped in a burning structure, inform the firefighters immediately.
- Do not re-enter the building alone.
- If you are trapped, stay low to the ground as you try to exit. Do not open any doors that feel hot. Use wet towels or clothes to protect you from flames and smoke.
- If your clothes catch fire, STOP, DROP, AND ROLL!!!

4 General Conduct (All Laboratories)

4.1 Behavior in the Laboratories

- Act in a professional manner at all times.
- No horseplay and practical jokes.
- Visitors must be escorted.
- Contact information is to be posted on all laboratory doors. If an experiment is being run unattended, the experiment contact information must be displayed.
- Students must be aware of the location and proper operation of laboratory safety equipment, i.e. fire extinguishers, flammable cabinets and fume hoods, eye-wash stations, and personal protective equipment.

4.2 Personal Habits

- Be alert to unsafe conditions. It is the responsibility of each individual to assure a safe working environment for themselves and other workers in the laboratories.
- No eating, drinking, gum chewing or cosmetic application in the labs.
- Closed toed shoes must be worn at all times in active laboratory areas. No sandals!
- Long hair and loose clothing shall be confined. Appropriate clothing must be worn at all times. No shorts, capris, skirts, or sleeveless shirts where chemicals or machines are present.
- Proper Personal Protective Equipment (PPE) must be worn (see Section 4.4). Users of the Lab must be familiar with the hazards of the materials with which they are working. Consult the **MSDS** sheets, before working with any hazardous chemicals.
- No glassware or utensils that are used for laboratory operations shall be used for storage, handling, or consumption of food or beverages.
- Hands should be washed before using the restrooms and before eating. Areas of exposed skin, i.e. forearms, should be washed frequently if there is potential of contact with chemicals.
- Do not conduct any unauthorized experiments.
- Personnel must have pre-approval by his/her direct supervisor in order to perform work alone.
- Work should not be conducted if the researcher is feeling tired or otherwise impaired.
- Any spills or accumulations of chemicals on work surfaces must be removed as soon as possible. Do not attempt to clean up a spill, if you have not received proper training. Call Safety & Risk Management (406-994-2711). The spill will be assessed by trained personnel who will ensure that proper clean-up techniques are employed.

4.3 *Housekeeping*

- Lab areas are to be kept clean and uncluttered. This will help prevent spillage, breakage, personal injuries and unnecessary contact with chemicals.
- Contaminated glassware should be cleaned daily.
- Small spills shall be cleaned up immediately from work areas and floors. (Contact Safety & Risk Management for large hazardous spills.)
- Doorways and walkways within the lab shall not be blocked or used for storage.
- Access to exits, hallways, emergency equipment, and utility controls shall remain accessible at all times.
- All tools and equipment shall be returned to their proper storage location after use.
- Chemical containers shall be properly emptied and cleaned prior to disposal. Glass bottles will be uncapped, washed out with an appropriate solvent, triple rinsed with water and placed in the glass container for disposal.
- All non-empty, non-cleaned containers must be labeled with a description of their content!

4.4 *Personal Protective Equipment*

- Proper eye protection must be worn at all times in laboratories. Proper protection includes, but is not limited to, chemical splash safety goggles, face shields, and safety glasses.
- Students wearing contact lenses must be informed of the special hazards associated with their use, (i.e., absorption of chemicals from the air) and must inform their supervisors so that appropriate measures can be taken in an emergency.
- Chemical resistant gloves shall be worn whenever the potential for hazardous skin contact exists.
- Heat resistant gloves shall be used for handling hot objects.
- Abrasion resistant gloves (e.g. leather) should be worn for handling broken glass and other similar materials, but should not be used to handle chemicals.
- Before each use, gloves are to be inspected for damage and contamination, i.e., tears, punctures, discoloration. If deficiencies are noted, the gloves should be cleaned, repaired, or replaced before use.
- Contaminated gloves shall be removed before touching surfaces outside the work area (i.e., doorknobs, faucet handles).
- Shoes that cover the entire foot must be worn in active laboratory areas at all times. No sandals or open-toed shoes shall be worn in active laboratory areas.
- Laboratory coats shall be worn by laboratory employees whenever a reasonable risk of chemical exposure to skin or street clothing exists or when specified by standard operating procedures. They should be kept in an appropriate clean storage area.

- Disposable laboratory coats are recommended when working with highly toxic materials such as select carcinogens, mutagens or teratogens.
- Chemical protective clothing must be removed before leaving the work area.
- Hearing protection (noise attenuating ear muffs or plugs) are required whenever employees are exposed to 85 dB A or greater as an eight hour time weighted average.

4.5 Working with Chemicals

Before working with chemicals, read the MSDS sheet in order to make yourself familiar with the nature of the chemical, its hazard level and emergency response recommendations.

4.5.1 What to Do if Your Body has Gotten in Contact With a Chemical?

- If you are not sure how dangerous the chemical contact is, call 9-1-1 and/or Safety & Risk Management (406-994-2711)
- The treatment of a chemical exposure takes precedent over spill cleanup, spill containment, or property damage including water damage from the use of an eyewash or safety shower.
- In the event of chemical contact with skin or eye, flush the affected area for a minimum of 15 minutes using the eyewash station or sink in your lab. If possible, obtain assistance to remove contaminated clothing after flushing has begun.
- If contact is made through inhalation, immediately move to an area away from the exposure.
- After immediate treatment for the exposure has been completed, the laboratory supervisor, course instructor or teaching assistant must contact MSU Safety & Risk management (406-994-2711).

4.5.2 What to Do in Case of a Small Chemical Spill

A small spill is defined as a spill less than or equal to 200 ml or 200 g and not of an extremely hazardous substance and within the cleaning capabilities and comfort level of the laboratory or laboratory workers.

- Inform your course instructor/teaching assistant/laboratory technician or supervisor and others in the area of the spill immediately.
- If the instructor or teaching assistant is not sure how to proceed with the cleanup, they should contact the CE Laboratory manager at 406-994-3260. If not available, contact MSU Safety & Risk Management 406-994-2711).
- Turn off any gas burners without putting yourself in harm's way.
- Retrieve the Material Safety Data Sheets (MSDS) without putting yourself in harm's way.
- Review applicable MSDS and determine controls, PPE, and need for assistance.
- Put on necessary protective clothing (gloves, safety goggles or glasses, and lab coat).

- Cover small spills with absorbent towels. Clean spill area working from outside toward the center.
- Rinse spill area with water. Label and retain spill materials for proper disposal.

4.5.3 [Large Chemical Spill](#)

A large spill is greater than 200mL or 200g or any amount of a hazardous substance or beyond the cleaning capabilities or comfort level of the laboratory or laboratory workers. If you are unsure of the spill severity, immediately call 911. Otherwise take the following steps:

- Inform others in the area of the spill.
- Turn off any gas burners without putting yourself in harm's way.
- Retrieve MSDS without putting yourself in harm's way.
- Evacuate the area, closing the doors behind you.
- Post a warning outside the area and lock doors if possible to prevent re-entry.
- Contact your supervisor; then call MSU Safety and Risk Management at 406-994-2711, and inform the S&RM director, 406-994-4146

4.5.4 [Chemical Storage](#)

Proper chemical storage requires that chemicals are stored to meet the following criteria:

- Chemicals are stored only with other chemicals they are compatible with.
- Some chemicals must be stored in special cabinets that provide proper ventilation or flammability protection.
- Some chemical require storage at certain heights.
- Chemicals are best stored in their original containers.
- Some liquid chemicals must be stored with appropriate secondary containers.
- Never store any chemical in a container that is incompatible or does not properly label its actual content.

In order to ensure proper chemical storage, return chemicals to their original place of storage at the end of the lab session.

4.5.5 [Chemical Labeling](#)

An unlabeled chemical can create substantial problems due to uncertainty about how to safely handle, store or dispose of it.

Therefore, all chemicals, including those stored in temporary storage or process containers, must be properly labeled. Never use any chemical or substance that is not clearly labeled or identified!

4.5.6 Definition of Chemical Waste

A variety of solid and liquid wastes can be generated in the laboratory. All lab workers that work with chemicals are required to understand how to safely handle, store, and dispose of these materials.

Once you determine a material:

- cannot be reused,
- cannot be used for its intended purpose,
- has exceeded its shelf life,
- has no known owner or generator,
- is no longer wanted or needed, or
- is an end product of a process or experiment that cannot be used as feedstock in an existing process,

IT IS A WASTE!

Please remember that maintenance fluids must, in most cases, be disposed of as waste.

4.5.7 Illegal Disposal of Waste

Examples of illegal waste treatment include:

- Leaving solvent wetted wipes in a hood or on the bench top to air dry.
- Leaving a container open to allow the waste to evaporate.
- Pouring an unapproved waste into a drain.
- Diluting a waste to render it non-hazardous.
- Venting a pressurized aerosol can solely to remove the propellant.

If you are in need of chemical waste disposal, contact MSU Safety & Risk Management (406-994-2711).

5 Materials Testing Lab (104 Cobleigh Hall)

5.1 Contact Information

5.1.1 Supervising Faculty

- Prof. Mike Berry, 224 Cobleigh Hall, 406-994-1566
- Prof. Damon Fick, 222 Cobleigh Hall, 406-994-6123
- Prof. Jerry Stephens, 205 Cobleigh Hall, 406-994-6113

5.1.2 Laboratory Supervisors:

- GRAs and GTA as to be determined

5.1.3 Technical and Safety Support:

- Joe Eldring, EPS 132, 406-994-3260

5.1.4 Administration and Operations Support:

- Annaliese Fry, 205 Cobleigh Hall, 406-994-2111

5.2 General Safety Rules

All lab users must understand and follow the below procedures in addition to the general safety and conduct rules described in Sections 2 through 4 of this safety manual.

- Do not operate any of the equipment unless you have been trained and authorized to do so.
- Inform the lab supervisor or the CE department office if there are any problems, or in case you are not sure if the equipment is operating properly and safely.
- During operation of tensile or compression test machines, provide a safe radius of at least 6 feet to protect spectators from any possible unexpected movement or release of testing material.
- Keep hands or loose clothing away from machines at all times during operation.
- The test procedures cause specimens to rupture and may release and accelerate pieces of matter. Therefore all personnel that are present in the laboratory must wear safety glasses at all times when operating the mechanical stress testing equipment.
- It is advised to use gloves and wear steel toed shoes with when placing or removing test specimens.
- The rupture of specimens can create a loud cracking noise. It is advised to wear earplugs as hearing protection.
- Keep the machine surface clear of material and tools.
- Make sure to close all hydraulic valves and turn off power once testing is complete.
- Keep fingers, hands and arms out of “pinch points” in load assembly, i.e. points where movement of the heads on the test machine could trap or crush these appendages.

5.3 Locations of Safety Equipment

- Fire extinguisher is located in the hallway leading to the laboratory
- Fire alarms are located in the hallways outside of the lab
- First aid kit is on wall behind the MTS Testing Machine
- MSDS notebook is on the workbench by the main lab door
- Safety glasses are located in the cabinet adjacent to the door

5.4 Baldwin & Riehle Testing Machines Safety Rules

The Baldwin test machine (Fig. 5.1) is designed to perform tension and compression tests on structural specimens, such as reinforced concrete columns or beams. The Riehle tester (Fig. 5.2) is designed to perform compression testing only. Operating instructions are summarized on orange cards attached to the Baldwin & Riehle test machines. In addition to the general safety rules described in section 5.2, the following, specific safety precautions must be observed:

- It is advised to use gloves and wear steel toed shoes with when inserting jaws into, or removing jaws (Fig. 5.3) from the cross heads.

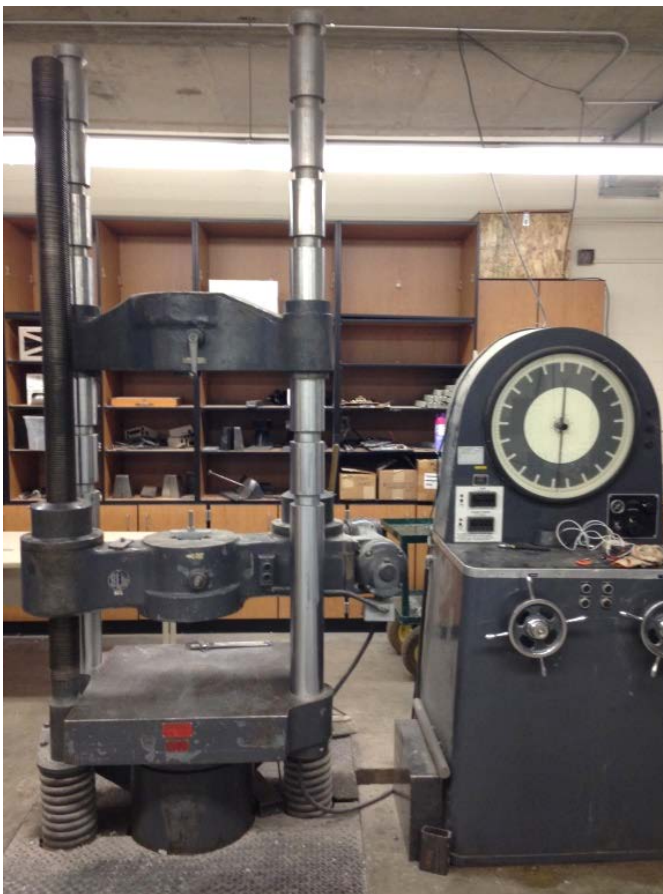


Fig. 5.1: Baldwin Testing Machine for Compression and Tension Testing of Concrete Specimens



Fig. 5.2: Riehle Testing Machines for Compression Testing of Concrete Specimens



Fig. 5.3: Claws for Baldwin Testing Machine

5.5 Test Mark Testing Machine Safety Rules

The Test Mark test machine (Fig. 5.4 & 5.5) is designed to perform compression tests on structural specimens, such as concrete compression test specimens and masonry prisms. Operating instructions are summarized on orange cards attached to the Test Mark machine. In addition to the general safety rules described in Section 5.2, the following, specific safety precautions must be observed:

- Make sure the limit switch for the hydraulic piston is not obstructed. (Fig. 5.6)
- Check if the chain for the limit switch is attached. (Fig. 5.6)
- Close the door and latch guard (Fig. 5.7) before beginning testing of specimen.



Fig. 5.4: Testmark Testing Machine



Fig. 5.5: Testmark Testing Controller



Fig. 5.6: Chain Connected to Limit Switch of Hydraulic Piston. (Before use, make sure limit switch and chain are not obstructed or jammed.)



Fig. 5.7: Test Mark Door Latch

5.6 *MTS Testing Machine Safety Rules*

The MTS machine (Fig. 5.8) is designed to perform compression and tensile stress tests on structural specimens, such as reinforced concrete columns or beams. Do not use the MTS machine without attendance of a faculty supervisor or supervising GRA.



Fig. 5.8: MTS Testing Machine and Controller

5.7 Concrete Temperature Cycling (Freezing and Thawing) Safety Rules

The Concrete Freezer (Fig. 5.9 - 5.11) is designed to expose concrete specimens to repeated freezing and thawing cycles. The following, safety precautions must be observed:

- Do not operate any of the equipment unless you have been trained and authorized to do so.
- Inform the lab supervisor or the CE department office if there are any problems, or in case you are not sure if the equipment is operating properly and safely.
- Turn off main power before loading and unloading specimens. It is advised to use gloves and wear steel toed shoes with when placing or removing test specimens.
- Turn off main power before filling specimen compartments with water. When filling the specimen compartments with water, make sure to not spill water over the heating and cooling elements (Fig. 5.10 & 11)
- Keep the freezer surface clear of material and tools.
- Make sure to turn off power once testing is complete.
- With power turned off, remove any residual water and debris once testing is complete.



Fig. 5.9: Concrete Freezer



Fig. 5.10: Concrete Freezer with Temperature Reference Specimen

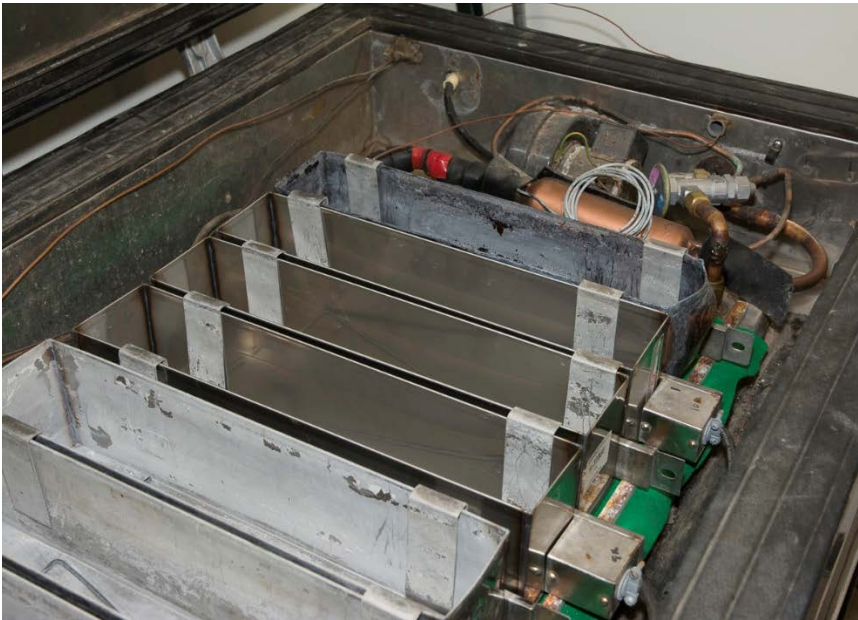


Fig. 5.11: Concrete Freezer Cooling and Heating Components

5.8 Clean Up

All lab users must clean up tools, equipment and work areas when finished with a task or at the end of work day, whichever comes first. All tested material shall be properly handled and disposed. Always maintain a clear egress and walking path – remove potential fall, slips and trip hazards before leaving the laboratory.

6 Structural Engineering Lab (107 Cobleigh Hall)

6.1 Contact Information

6.1.1 Supervising Faculty

- Prof. Mike Berry, 224 Cobleigh Hall, 406-994-1566
- Prof. Damon Fick, 222 Cobleigh Hall, 406-994-6123
- Prof. Jerry Stephens, 205 Cobleigh Hall, 406-994-6113

6.1.2 Laboratory Supervisors:

- GRAs and GTA as to be determined

6.1.3 Technical and Safety Support:

- Joe Eldring, EPS 132, 406-994-3260

6.1.4 Administration and Operations Support:

- Annaliese Fry, 205 Cobleigh Hall, 406-994-2111

6.2 General Safety Rules

All lab users must understand and follow the below procedures in addition to the general safety and conduct rules described in Sections 2 through 4 of this safety manual.

- Do not operate any of the equipment unless you have been trained and authorized to do so.
- Inform the lab supervisor or the CE department office if there are any problems, or in case you are not sure if the equipment is operating properly and safely.
- Before using any power tool, inspect it to make sure the cord is not damaged in any way and that the ground pin is intact.
- Do not use the saw, or any other power tools in a wet area.
- Appropriate eye protection must worn in the lab at all times.
- Keep hands or loose clothing away from machines and powered tools at all times during operation.
- Keep machine surfaces clear of material and tools.

6.3 Locations of Safety Equipment

- Fire extinguisher is located at the entrance to the lab.
- Fire alarms are located on the wall of the lab and hallways.
- First aid kit is on the workbench by the main lab door.
- MSDS notebook is the binder on the wall at the entrance to lab.

6.4 *Safe Storage of Testing Materials*

- Testing material is either stored outside in the adjacent laboratory court yard area or inside.
- Material must be stored in an organized and safe manner.
- Material must be stored on dunnage or pallets.
- Material to be stored shall be protected from rain, snow and wind as appropriate.

6.5 *Storage of Tools*

- All hand tools must be stored in an organized fashion within the provided tool boxes.
- All tools must be returned to their location of origin prior to commencement of an activity or work day, whichever comes first.

6.6 *Drill Press Safety Rules*

The JET and RYOBI Drill presses (Fig. 6. 1 & 6.2) are light to medium duty drill presses that typically drill hole sizes of up to 0.5” into steel. If larger holes are to be drilled please contact the lab supervisor or M&IE machine shop. In addition to the safety rules outlined in Section 6.2, the following must be observed.

- Do not wear any loose clothing or jewelry that could be caught up in the rotary action of the drill press.
- Always hold workpieces securely on the drill table in a vise or with a clamp. NEVER hold them by hand!
- Use a correctly ground drill bit for the material being drilled. Lab supervisor can help select the correct bit.
- Don't use a dull or cracked drill. Inspect the drill before using.
- Run drill at correct RPM for diameter of drill bit and material. Ask lab supervisor for the correct RPM.
- Use the proper cutting fluid for the material being drilled. Ask the shop staff about the appropriate fluid for the material you are machining.
- Stop machine for removal of chips. Use a brush for chip removal. Don't use your bare hands for chip removal. They may be hot and have sharp edges potentially causing injury.
- Ease up on drilling pressure as the drill starts to break through the bottom of the material.
- Don't drill with too much pressure.
- Always try to support part on parallels or a backing board when drilling through any material.

- Never place taper shank tools such as large diameter drills or tapered shank reamers in a drill chuck. Only straight shank tools such as standard drills can be clamped in chucks or collets.
- If the drill binds in a hole, stop the machine and turn the spindle backwards by hand to release the bit.
- When drilling a deep hole, withdraw the drill bit frequently to clear chips.
- Always remove the drill chuck key or the drill drift from the spindle immediately after using.
- Let the spindle stop of its own accord after turning the power off. Never try to stop the spindle with your hand.
- Plexiglas and other brittle materials can be difficult and dangerous to drill. Ask the lab supervisor for advice on drill and coolant selection when drilling these materials.
- Sheet metal can be difficult and dangerous to drill. Ask the lab supervisor for advice on drill when drilling sheet metal.



Fig. 6.1: JET Drill Press



Fig. 6.2: RYOBI Drill Press

6.7 Wheel Grinder Safety Rules

The Black & Decker grinding and brushing wheel (Fig. 6. 3) is a light duty grinder to be used with steel. In addition to the safety rules outlined in Section 6.2, the following must be observed.

- Do not wear any loose clothing or jewelry that could be caught up in the rotary action of the grinder.
- Do not operate the grinder with broken wheels.
- Engage the safety shield when grinding or brushing.
- Always attempt to place your work piece against the rest on disc and belt sanders, and wheel grinders.
- Hold the work piece in a horizontal (radial) position against the wheel.
- The grinding specimen can get hot. Wear leather gloves and cool the workpiece in water as necessary.
- NEVER grind any other materials than steel. They will clog up the grinding wheels, which ultimately may lead to wheel rupture during operation.



Fig. 6.3: Wheel Grinder

6.8 Cut Off Saw Safety Rules

The MAKITA circular cut-off saw (Fig. 6.4) is a light to medium duty saw that employs grinding action to cut metals or concrete. In addition to the safety rules outlined in Section 6.2, the following must be observed.

- Before using the saw, make sure that the correct, material specific cut-off wheel is installed.
- Disconnect the power cord before cleaning, changing blades, or making any adjustments to the saw. Always unplug the power cord when carrying the saw.
- Do not use the saw for cuts unless you can safely support and hold the material being cut.
- Before cutting small work pieces, the lab supervisor should be consulted.
- Keep your head out of the path of particles thrown out by the blade. Wear eye and ear protection.
- Keep flammables away from the saw at a safe distance as cutting steel creates sparks.
- Never wedge, wire, or otherwise jam the guard to prevent it from working.
- Wait until the saw stops before lifting it from a cut.
- Before setting the saw down, make sure the guard is closed, as the blade may still be turning.
- Don't pull the saw backwards in a cut if you can avoid it.
- Do not use the power hand saw for cuts if you cannot keep a firm and secure grip on the saw and the material being cut. A hand saw is still the best for some kinds of work and often faster.



Fig. 6.4: Cut-Off Saw

6.9 Welder and Cutting Torch Safety Rules

The MILLER welder is a wire feed (MIG) welder. The cutting torch uses Acetylene and Oxygen (Fig. 6.6). In addition to the safety rules outlined in Section 6.2, the following must be observed.

- Welders, assistants, and anyone else in the welding area shall wear glasses or shields of recommended shades during welding operations. Welders must wear appropriate welding gloves.
- Prior to each use, inspect all welding equipment to be used for possible damage.
- Avoid handling oxygen bottles with greasy hands, gloves or rags! Fatal explosions have resulted from this.
- Always strap tanks to a welding cart or a fixed object. Never allow a gas cylinder to be free standing. Replace the safety cap on all cylinders when not in use.
- When using the cutting torch, shut off the cylinder valves when the job is completed, release pressure from the regulators by opening the torch valves momentarily and back out regulator adjusting valves. Never leave the torch unattended with pressure in the hoses.
- When doing any kind of MIG welding, make sure work and/or work table is properly grounded. Do not weld in or near a wet area or with wet gloves/hands.
- Be alert to possible fire hazards. Move the object to be welded to a safe location, or, remove all flammable materials from the work area.
- Never weld in the same area where degreasing or other cleaning operations are performed.
- Keep suitable fire extinguishing equipment nearby and know how to operate it.
- Utilize all protective equipment and clothing. Do not weld with any part of the body uncovered, the arc light will cause burns similar to severe sunburn.
- Never weld inside drums or enclosed spaces without adequate ventilation, or the use of airline respirators or self-contained breathing apparatus.
- Check the room ventilation before starting to weld and periodically thereafter to insure adequate air ventilation in your work area.
- If no ventilation system exists, weld close to the open gate. Welding fumes should not be allowed to get into the rest of the shop working areas.
- Never cut or weld any container that has held explosive or flammable materials.
- Do not weld on painted, galvanized or greasy, oily metals. Not only can the fumes be toxic, but the welds will not be satisfactory and will fail in use.



Fig. 6.6: Welder and Cutting Torch

6.10 Load Frame Safety Rules

The Load Frame (Fig. 6.7) is designed to test structural components and assemblies with compression or bending loads of up to 110 kips. Do not use the MTS machine without attendance of a faculty supervisor or supervising GRA.

- During operation of the load frame, provide a safe radius of at least 9 feet to protect spectators from any possible unexpected movement or release of testing material.
- It is advised to use gloves and wear steel toed shoes with when placing or removing test specimens.
- Before using the power hydraulics, assure that the piston is NOT in its extended position. (Fig. 6.9). If the piston is in the extended position it must be returned to its retracted position. Failure to do so may result in over-pressurizing and bursting the hydraulic cylinder.
- Before using the power hydraulics, make sure that all hydraulic hoses are free of any kinks and have a minimum bend radius of ~ 4 inch. (Fig. 6.8 & 6.9)
- Before using the power hydraulics, make sure that all hydraulic hoses are free of leaks. (Fig. 6.8 & 6.9)

- Before using the power hydraulics, make sure that all hydraulic hoses are free of any obstruction. (Fig. 6.8 & 6.9)
- The rupture of specimens can create a loud cracking noise. It is advised to wear earplugs as hearing protection.
- Make sure to close all hydraulic valves and turn off power once testing is complete.
- Keep fingers, hands and arms out of “pinch points” in load assembly, i.e. points where movement of the heads on the test machine could trap or crush these appendages.

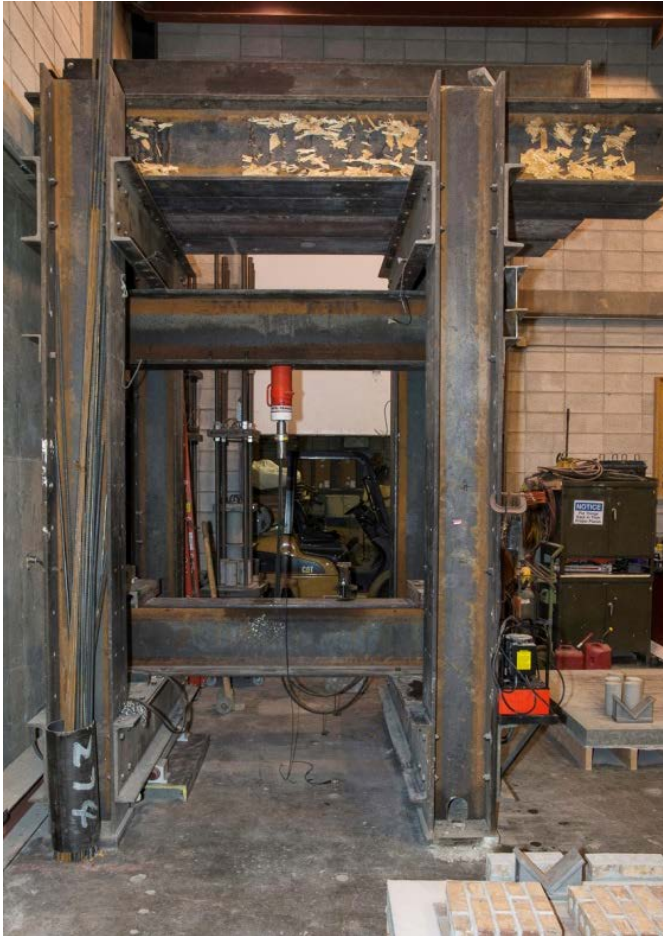


Fig. 6.7: Load Frame



Fig. 6.8: Hydraulic Drive of Load Frame

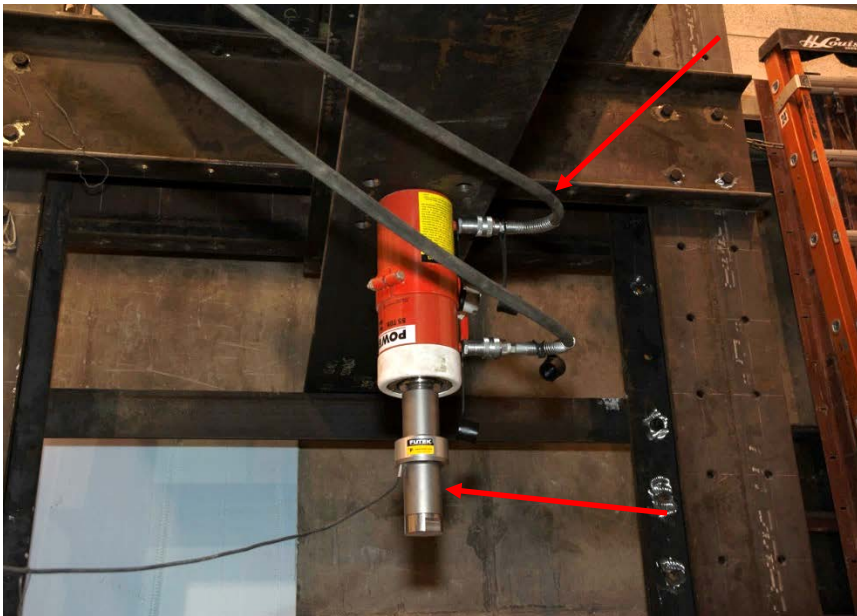


Fig. 6.9: Hydraulic Piston of Load Frame. (Before use, make sure piston is NOT in its extended position, and that hydraulic hoses are not kinked.)

6.11 Overhead Crane Safety Rules

The overhead crane (Fig. 6.10) is limited to 5 metric tons (~12000 lbs.) maximum load. In addition to the safety rules outlined in Section 6.2, the following must be observed.

- All individuals present in lab must wear hard hats when crane is in use.
- While operating the crane be conscious of your surroundings, like any personnel present, equipment and tools in the work area, and potential tripping hazards on the floor.
- Make sure to use rigging straps or chains with the correct load ratings for the items to be lifted.
- Inspect rigging straps and chains for deficiencies before use. Do not use any straps that appear to be torn or otherwise damaged.
- Make sure rigging straps are not wrapped around sharp edges that could cut the strap under load. Use tear proof cushions or pads as needed.
- Never move rigged material over any one present in lab. Never stand under the payload.
- Never leave the crane unattended while the load is lifted.



Fig. 6.10: Overhead Crane

6.12 Clean-up

All lab users must clean up tools, equipment and work areas when finished with a task or at end of work day, whichever comes first. All tested material shall be properly handled and disposed. Always maintain a clear egress and walking path – remove potential fall, slips and trip hazards before leaving the laboratory.

7 Bulk Materials Lab (109 Cobleigh Hall)

7.1 Contact Information

7.1.1 Supervising Faculty

- Prof. Mike Berry, 224 Cobleigh Hall, 406-994-1566
- Prof. Damon Fick, 222 Cobleigh Hall, 406-994-6123
- Prof. Jerry Stephens, 205 Cobleigh Hall, 406-994-6113

7.1.2 Laboratory Supervisors:

- GRAs and GTA as to be determined

7.1.3 Technical and Safety Support:

- Joe Eldring, EPS 132, 406-994-3260

7.1.4 Administration and Operations Support:

- Annaliese Fry, 205 Cobleigh Hall, 406-994-2111

7.2 General Safety Rules

All lab users must understand and follow the below procedures in addition to the general safety and conduct rules described in Sections 2 through 4 of this safety manual.

- Do not operate any of the equipment unless you have been trained and authorized to do so.
- Inform the lab supervisor or the CE department office if there are any problems, or in case you are not sure if the equipment is operating properly and safely.
- Before using any power tool, inspect it to make sure the cord is not damaged in any way and that the ground pin is intact.
- Appropriate eye protection must worn in the lab at all times when powered equipment is used.
- Appropriate eye protection must worn in the lab at all times when working with aggregates and cement.
- Keep hands or loose clothing away from machines and powered tools at all times during operation.
- It is advised to wear work gloves and steel toed shoes when handling concrete specimen.
- Keep machine surfaces clear of material and tools.

7.3 Locations of Safety Equipment

- Fire extinguisher is located in the hallway leading to the laboratory
- Fire alarms are located on the wall of the lab and hallways
- First aid kit is located on the wall above the sink

- Eyewash station is located at the sink
- MSDS notebook is on the workbench by the main lab door

7.4 Raw Material Storage, Handling and Disposal Safety Rules

Raw materials are stored in aggregate storage bins inside (Fig 7.1 & 7.2), and in super sacks outside the lab (Fig. 7.3 & 7.4). Any material brought inside the lab must be coordinated with the lab supervisor and stored in its proper location. Newly introduced materials must be accompanied by a Material Safety Data Sheet (MSDS or SDS). Material brought in without notification or MSDS may be disposed.

Inform the CE/CET lab supervisor or faculty if material supplies become low. The lab supervisor can also help get specialized materials that you need. Materials must be placed on pallets or in barrels and not directly on the floor. Do not leave any chemical materials (i.e. admixtures, etc.) outside.



Fig. 7.1: Admixtures on Pallette Stored Inside the Lab



Fig. 7.2: Indoors Aggregate Bins



Fig. 7.3: Outdoors Aggregate Storage (Super Sacks)



Fig. 7.4: Outdoors Cement Storage

7.5 Sump

The sump (Fig. 7.5) holds all concrete and water waste not able to be taken to the concrete disposal bins outside the lab. In addition to the safety rules outlined in Section 7.2, the following must be observed.

- The metal grates must be in place covering the sump at all times (except during maintenance).
- Care shall be taken to avoid excess concrete disposal in the sump. Always utilize portable screens (Fig. 7.6) to catch as much aggregate as possible from getting into the sump.
- Pour unused wet concrete into the square wooden trays (Fig. 7.7) and leave them outside next to the concrete waste bins (Fig. 7.11) to cure.
- Notify the CE/CET lab TA or Civil Engineering office if the sump is full or does not appear to be draining properly.



Fig. 7.5: Sump Inside Bulk Material Lab



Fig. 7.6: Screen to Capture Aggregate Waste



Fig. 7.7: Trays for Curing of Concrete Waste

7.6 Concrete Mixer

The Stone 125 CM concrete mixer (Fig. 7.8) is a 40" drum heavy duty mixer with $\frac{1}{2}$ yard capacity. In addition to the safety rules outlined in Section 7.2, the following must be observed.

- During operation, provide a safe radius of about 5 feet in front of the mixer to protect spectators from any possible unexpected release of material.
- Standing behind the mixer is prohibited during mixing!
- Keep hands free of any joints and moving parts at all times.
- Do not leave the mixer unattended when running.
- Make sure the drum is securely locked with the lock lever in down position (Fig. 7.9) at all times.
- Be aware that the mixing drum and wheel may immediately rotate into a balanced position by force of gravity once the lock lever is released. Fig. 7.10 shows the balanced position when the drum is empty.
- Always turn the power off (Fig. 7.11) and unplug the power cord when the mixer is not in use!
- The mixer must be cleaned completely when work is finished. Pour excess concrete over a screen into the sump and rinse the mixer until the inside is free of material. Leave the mixer in a position so all water may drain. Once the mixer drum is dry inside, it shall be moved into the balanced position.



Fig. 7.8: Concrete Mixer



Fig. 7.9: Concrete Mixer Positioning Wheel and Lock/Release Handle



Fig. 7.10: Concrete Mixer in Neutral Parking Position



Fig. 7.11: Power On/Off Button of Concrete Mixer

7.7 Concrete Specimen Handling and Storage

Place small concrete specimens on the curing shelves and large concrete specimens out of the way on the floor. After de-molding, take specimens to their proper curing location, clean the molds and return the molds to their storage location. Do not place any specimens outside unless instructed to do so by the TA. Dispose all unused specimens in the large concrete waste bins (Fig. 7.12) outside in the court yard adjacent to the lab.

7.8 Concrete Specimen Disposal

Dry concrete and specimens should be disposed in the large concrete waste bins (Fig. 7.12) outside as soon as you are finished testing. Notify the CE/CET technician if disposal barrels are full. Do not place anything outside the lab unless instructed to do so. Pour unused wet concrete in the square wooden trays (Fig. 7.7) and leave them outside next to the concrete waste bins to cure. The next day, make sure someone dumps the concrete from the trays into the waste bins. Contact the technician if you need storage space or disposal help.



Fig. 7.12: Concrete Waste Bins Outside Bulk Material Labs

7.9 Ovens

The Blue-M and Grieve Ovens (Fig. 7.13) are used for drying materials and test specimens. In addition to the safety rules outlined in Section 7.2, the following must be observed.

- Wear thermal insulating gloves when removing hot specimens.
- Do not put flammable items, including rags or wood, in the ovens.
- Turn ovens off when not in use.



Fig. 7.13: Blue-M (left) Grieve Ovens (right)

7.10 Hobart Mixer

The Hobart mixer (Fig. 7.14) is a heavy duty kitchen mixer that is being used for mixing concrete. In addition to the safety rules outlined in Section 7.2, the following must be observed.

- It is advised to unplug the power cord when loading, unlading and cleaning the mixer, and when inserting or removing the beater.
- Check if the guard sits tight around the collar before use.
- Close the guard before starting the mixer.
- Do not leave the mixer unattended when running.



Fig. 7.14: Hobart Mixer

7.11 Specimen Grinder

The GeneQ Inc. concrete grinder (Fig. 7.15) is used to grind the ends of concrete cylinders flat in preparation for stress testing. At the writing of this manual, no additional safety precautions, other than described in Section 7.2, are required.



Fig. 7.15: GeneQ Inc. Concrete Grinder

7.12 *Ball Mill*

The Ball Mill (Fig. 7.16) is used to grind aggregate. In addition to the safety rules outlined in Section 7.2, the following must be observed.

- Don't operate the ball mill without attendance of a lab supervisor.
- Never leave the mill unattended while running!
- Stay away from the ball mill when running and be very careful to not come in contact with the rotating drum and latches!



Fig. 7.16: Ball Mill

7.13 Fork Lift

The CAT Model P5000 (Fig 7.17) is a 5500 lbs. capacity forklift. It only can be operated by personnel that have been trained and certified by MSUs Safety & Risk Management Department. Contact your faculty supervisor in case you need the forklift or need to undergo training.



Fig. 7.17: CAT Forklift

7.14 Clean-up

All lab users must clean up tools, equipment and work areas when they finish using them. Wash wet concrete off tools and your work place before it dries up. All excess and spilled material must be cleaned up and properly disposed. Place tools and equipment back in their proper storage places. Remove potential trips, slips and falls hazards. Sweep floors. Secure all materials as necessary.

8 Science & Engineering Research Facility (Cobleigh Hall 110)

8.1 Contact Information

8.1.1 Supervising Faculty

- Dr. Ladean McKittrick, 208 Cobleigh Hall, 406-994-1648

8.1.2 Laboratory Supervisors

- GRAs and GTA as to be determined

8.1.3 Technical and Safety Support

- Joe Eldring, EPS 132, 406-994-3260

8.1.4 Administrative and Operations Support

- Anneliese Fry, 205 Cobleigh Hall, 406-994-2111

8.2 Cold Lab Briefs

All users of the cold laboratories must have permission to do so from the supervising faculty. Safety in the cold chambers is achieved primarily through common sense. In other words, working for an extended period requires appropriate cold weather clothing including jackets and gloves at the least. For more extended periods, additional layers of clothing will be necessary.

8.3 Solar Lamps

If using the solar lamps in chambers CC4, CC5, or CC8, do not look toward the lamp without appropriate sunglasses. The solar lamps produce sun like intensities and can be at least as hazardous as staring at the sun without UV protection.

8.4 Band Saw

Do not use the band saw (Fig. 8.1) without receiving proper training. In particular, be sure to find a way to feed your material into the blade without putting your hands near or in front of the blade. In many cases, you can hold one end of the material far from the blade by hand while stabilizing the end closest to the blade with a small wood rod or similar device.

- Examine blade before using the band saw or before installing a blade. Check if it is cracked; do not use or install a cracked blade. Check if teeth are worn out or broken out; do not use or install a blade with worn out or broken out teeth.
- The guides and guards should be set as close to the work as possible, at least within 1/2 inch.
- If the band breaks, immediately shut off the power and stand clear until the machine has stopped.
- Use the proper pitch blade for the thickness of the material, and type of material to be cut. There should be at least 3-4 teeth in the material when cutting.
- Do not run the band saw at a higher speed than recommended for the material being cut.

- If the saw stalls in a cut, turn the power off and reverse the blade by hand to free it. Wear heavy fabric or leather gloves!
- Band saw rpm is to be adjusted while the band saw is running. Band saw speed range is adjusted when the machine is stopped.



Fig. 8.1: Delta Bandsaw

8.5 Confined spaces

All cold chambers are confined spaces to a degree. If you plan to work inside chambers CC8 or CC6 for an extended period of time (greater than 1 hour), you must have a second person in the room outside the chamber to monitor your level of alertness. All other walk-in chambers have CO₂ monitors & will activate ventilation systems if CO₂ levels start to rise toward unacceptable levels. However, if you sense any sort of grogginess while working in any closed chamber, exit the chamber immediately.

8.6 CT-Scan

Anyone intending to use the CT scanner must contact the lab supervisor for permission to do so. The CT scanner is safely wrapped in lead & has multiple setting to prevent the x-ray from activating if the front door does not close. However, if the door does not close and you have any reason to believe that the x-ray source has been activated, exit the area and call the lab supervisor.

9 Hydraulics & Fluid Mechanics Lab (113 Cobleigh Hall)

9.1 Contact Information

9.1.1 Supervising Faculty

- Prof. Joel Cahoon, 224 Cobleigh Hall, 406-994-5961
- Prof. Matt Blank, WTI, 406.994.7120
- Prof. Jerry Stephens, 205 Cobleigh Hall, 406-994-6113

9.1.2 Laboratory Supervisors:

- Erin Hafla, 428 Cobleigh Hall, 406-570-7856
- Jack Wallis, 103 Cobleigh Hall,

9.1.3 Technical and Safety Support:

- Joe Eldring, EPS 132, 406-994-3260

9.1.4 Administration and Operations Support:

- Annaliese Fry, 205 Cobleigh Hall, 406-994-2111

9.2 Laboratory Safety

All lab users must understand and follow the below procedures in addition to the general safety and conduct rules described in Sections 2 through 4 of this manual.

- Do not operate any of the equipment unless you have been trained and authorized to do so.
- Inform the lab supervisor or the CE department office if there are any problems, or in case you are not sure if the equipment is operating properly and safely.
- Because the lab contains large stationary objects students must be aware of their surroundings and take care to not hit their head or feet on any of these objects.
- Hydraulics & Fluid Mechanics lab only uses low pressure and low temperature water. For this reason wearing of safety glasses is typically not required. However, use appropriate sight, hearing, and protective equipment when performing potentially hazardous operations.

9.3 Locations of safety equipment

- Fire extinguisher is located in the hallway leading to the laboratory
- Fire alarms are located on the wall of the lab and hallways
- First aid kit is located on the wall on the right hand side of the white board

9.4 Hydraulic Pumps

The lab has two hydraulic pumps. One is above ground (Fig 9.1); the other, larger pump is located in the sump, or area below the floor which stores excess water for the system. In addition to the safety rules outlined in Section 9.2, the following must be observed.

- Users need to stay at least 5 foot away from the above ground pump while it is running.
- Students shall not enter the sump.
- Pump usage must be supervised. The pump is only to be operated by the supervising CE technician, graduate student, or professor who is trained in the usage of the pumps, whose names are listed in Section 9.1.
- The technical panels on the wall used to monitor the pumps (Fig. 9.1) shall not be altered in any way unless it is by a CE technician, graduate student, or professor.
- Pump valve settings shall not be altered by students; however, valves allowing water to flow into the flume may be opened or closed within designated valve settings.
- After the use of the pumps has been completed, pumps will be turned off by the supervising CE technician, graduate student, or professor.
- All excess water shall be allowed to drain into the sump. Take care that any draining water is not draining onto an electrical outlet.



Fig. 9.1: Hydraulics Pumps – Hydraulics and Fluids Lab, 113 Cobleigh Hall

10 Environmental Lab (207 Cobleigh Hall)

Currently, there are specific equipment and procedure safety rules for the Environmental Lab. The general safety rules outlined in this document apply. Personnel authorized working in this lab must receive the MSU Safety and Risk Management General Laboratory training. Anyone intending to use this lab must contact the CE Department office, or Ellen Lauchner.

10.1 Contact Information

10.1.1 Supervising Faculty

- Prof. Ellen Lauchner, 220 Cobleigh Hall, 406-994-2134

10.1.2 Laboratory Supervisors:

- GRAs and GTA as to be determined

10.1.3 Technical and Safety Support:

- Joe Eldring, EPS 132, 406-994-3260

10.1.4 Administration and Operations Support:

- Annaliese Fry, 205 Cobleigh Hall, 406-994-2111

11 Geotechnical Lab (209 Cobleigh Hall)

11.1 Contact Information

11.1.1 Supervising Faculty

- Prof. Steven Perkins, 219 Cobleigh Hall, 406-994-6119

11.1.2 Laboratory Supervisors

- Libby Snider, 428 Cobleigh Hall

11.1.3 Technical and Safety Support

- Joe Eldring, EPS 132, 406-994-3260

11.1.4 Administrative and Operations Support:

- Anneliese Fry, 205 Cobleigh Hall, 406-994-2111

11.2 General Safety Rules

All lab users must understand and follow the below procedures in addition to the general safety and conduct rules described in Sections 2 through 4 of this manual.

- Do not operate any of the equipment unless you have been trained and authorized to do so.
- Inform the lab supervisor or the CE department office if there are any problems, or in case you are not sure if the equipment is operating properly and safely.
- Before using any power tool, inspect it to make sure the cord is not damaged in any way and that the ground pin is intact.
- Appropriate eye protection must worn in the lab at all times when powered equipment is used.
- Appropriate eye protection must worn in the lab at all times when working with asphalt/bitumen or asphalt concrete.
- Keep hands or loose clothing away from machines and powered tools at all times during operation.
- It is advised to wear work gloves and steel toed shoes when handling heavy asphalt specimen.
- Keep machine surfaces clear of material and tools.

11.3 Locations of Safety Equipment

- Fire extinguisher is located in the hallway outside of the lab
- Fire alarms are located on the lab wall and in the main hallway
- First-aid kits are located on the wall in between the sieve shelves and the sink
- MSDS notebook is located on the wall near the lab tables and red shaker table.

11.4 Asphalt Ovens

The Grieve and Despatch ovens (Fig. 11.1 & 11.2) are used to heat asphalt specimens and molds to a temperature that makes the asphalt more malleable for compacting. The ovens are typically set to 350F. In addition to the safety rules outlined in Section 11.2, the following must be observed.

- Turn on and shut down the Grieve ovens in the correct sequence. That is, start the blower before turning on the heaters, and turn off the heaters before stopping the blower. Allow the ovens to cool down for 2 hours while the blowers are running. Otherwise, the heater elements may overheat and fail. (This does not apply to the Despatch oven, as that oven has automatic blower controls.)
- Keep away all flammables. Make sure any flammables or combustibles are at least 9 ft. away from the ovens at all times.
- Wear heat protecting gloves when removing hot asphalt specimen, molds and other containers.



Fig. 11.1: Grieve Ovens Model 333 (left), and AF-500 (right)



Fig. 11.2: Despatch – Lab Series Oven

11.5 Gyratory Compactor

The Pine Instruments Gyratory Compactor (Fig. 11.3) compacts hot asphalt concrete specimens. In addition to the safety rules outlined in section 11.1, the following must be observed.

- Asphalt and asphalt molds can be up to 300F hot. Make sure to wear heat insulated gloves when loading and unloading asphalt molds into the compactor.
- Make sure the internal components, the seating and rotation surfaces for the molds are free of any asphalt debris before inserting the new specimen.
- Although the front door has a safety switch, it is advised to turn off the compactor when cleaning the internal components, and when inserting/removing compacting molds.
- The on/off switch for the compactor is located on the right side at the rear of the device.
- When inserting asphalt molds, turn them until the locked position (stop tabs are in contact) is reached before starting the compactor. (Fig. 11.4 & 11.5)
- Don't open the front door while the compactor is running.
- Don't open the front door unless the compactor has come to a complete stop.



Fig. 11.3: Dynamic Compactor

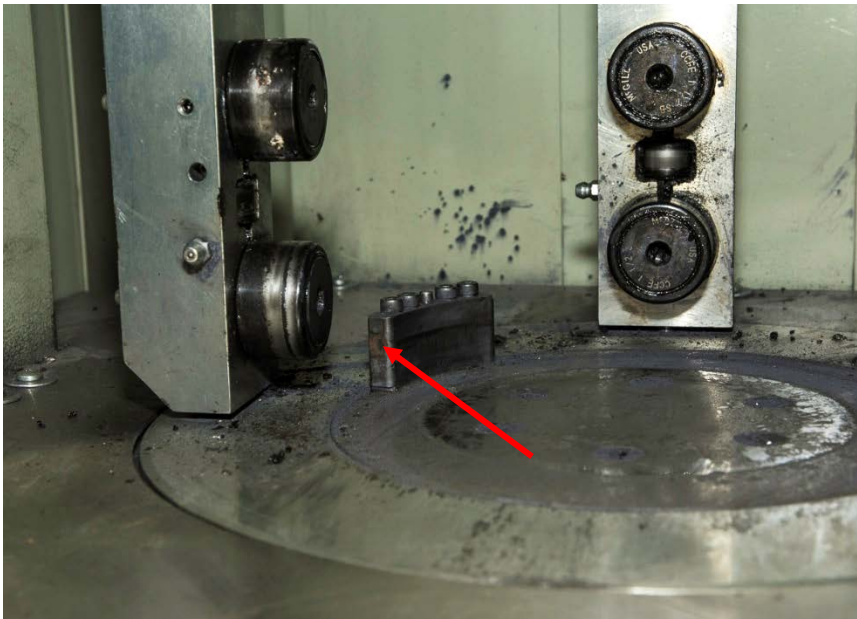


Fig. 11.4: Dynamic Compactor - Mechanical stop on rotating drive



Fig. 11.5: Compacting Mold - Mechanical stop to engage with rotating drive

11.6 Asphalt Wash Station

The Asphalt Wash Station (Fig. 11.6) uses solvent to remove asphalt binder from tools and molds used in the preparation of asphalt pucks. In addition to the safety rules outlined in section 11.2, the following must be observed.

- Wear solvent resistant gloves when cleaning tools and molds. In case of skin or eye contact with solvent, wash off immediately.
- Keep open flames away from the wash station!



Fig. 11.6: Asphalt and Mold Wash Station

11.7 Sieve Shaker

The ROTAP Model RX 29 and Model “B” Sieve Shakers (Fig. 11.7) are used to separate aggregates by their size. In addition to the safety rules outlined in Section 11.2, the following must be observed.

- Make sure the sieves are stacked securely fitting them on top of each other. Place the black cap on the top sieve before lowering the arm onto the stack.



Fig. 11.7: Siever Shakers

11.8 Shaker Table

The shaker table (Fig. 11.8) is used to compact and consolidate aggregate specimens. It shall only be operated by, or under attendance of the supervising GTA/GRA.



Fig. 11.8: Shaker Table

11.9 Incineration Oven

The Thermolyne NCAT Asphalt Content Tester (Fig. 11.9) is a high temperature oven that incinerates asphalt specimens. It shall only be operated by, or under attendance of the supervising GTA/GRA or faculty.



Fig. 11.9: Incineration Oven

11.10 All Other Ovens

While operating any other ovens, i.e., the drying ovens observe the following safety rules:

- Keep away all flammables. Make sure any flammables or combustibles are at least 9 ft. away from the ovens at all times.
- Wear heat protecting gloves when removing hot asphalt specimen, molds and other containers.

11.11 Shelby Tube Extractor

The Shelby Tube Extractor (Fig. 11.10 & 11.11) is used to remove concrete specimen from test tubes by means of a hydraulically driven piston. In addition to the safety rules outlined in section 11.2, the following must be observed.

- Make sure that all hydraulic hoses are not leak free, not kinked or otherwise obstructed (Fig. 11.10)
- Before activating the hydraulics, make sure the tube is secured in the tub fixture with the bar as shown (Fig. 11.11)



Fig. 11.10: Shelby Tube Extractor - Hydraulics



Fig. 11.11: Shelby Tube Extractors – Tube Fixture

11.12 Specimen Disposal

Dispose of waste soil and other materials in the designated outdoor bins as instructed by lab TA.

- Soil waste must be disposed of in one of the red bins. Do not put soil into any of the grey trash cans.

11.13 Clean-up

Clean your work area after each use before leaving the laboratory.

- Tools must be cleaned and moved back to their designated storage location after use.
- Floors and table tops must be cleared of spills, debris and tools.
- Floors must be cleared of any tripping hazards.
- Tables and chairs must be placed in their proper locations to be ready for upcoming lectures and laboratories