

Construction  
Risk Control  
Partnership

# Risk Control Curriculum

## **INTEGRATION GUIDE**

*A Partnership With*

The St Paul Companies

University of Wisconsin-Stout

Construction Safety Council

The Construction Industry

Prepared 12-1-99

# Foreword

## The Construction Risk Control Partnership

The St. Paul Companies, the University of Wisconsin-Stout, the Construction Safety Council, and the Construction Industry have initiated the Construction Risk Control Partnership. Its mission is to provide educational opportunities for new and existing construction professionals, which will lead to the prevention and elimination of human, material and financial loss. A major priority identified by industry partners is to include safety, health and environmental risk control content, including associated costs and actions, into construction education programs. In response to this need, the partnership has developed this curriculum guide as a reference tool for college and university construction programs.

Members of the partnership developed the following materials through collaborative efforts. Construction faculty provided outlines that delineated the content by work area and specific phases of work. Construction industry safety professionals identified the risk controls associated with various phases of work. Based on these efforts, the St. Paul Companies and the University of Wisconsin-Stout identified resources that faculty can use to support the integration of safety, health and environmental risk control content into their curriculum.

Further information about this and other programs at UW-Stout can be obtained by contacting the Construction Risk Control Partnership. UW-Stout offers a M.S. in Risk Control with an emphasis in construction and a B.S. in Construction with a minor in construction risk control.

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125 Jarvis Hall  
University of Wisconsin-Stout  
Menomonie, WI 54751  
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# Contents

## **The Construction Risk Control Partnership**

This section provides an overview and summary of the Construction Risk Control Partnership. It includes background, purpose, goals, and summary of the partnership's activities.

*The following sections identify the competencies typically taught in courses pertaining to the section title. Each subsection includes a chart identifying construction phases, identified risks, risk controls, and resources. Also included are suggested risk control foci and various teaching references and resources.*

### **RESIDENTIAL AND LIGHT BUILDING CONSTRUCTION**

- (1) Mobilization and Site Preparation
- (2) Excavations, Footings and Foundations
- (3) Floor systems
- (4) Wall Systems
- (5) Roof Systems

### **COMMERCIAL, INDUSTRIAL AND HIGHWAY CONSTRUCTION**

- (1) Site Preparation and Mobilization
- (2) Foundations
- (3) Concrete Structural Systems
- (4) Metal Structural Systems
- (5) Heavy and Highway Construction
- (6) Underground Construction

### **CONCRETE AND MASONRY TECHNOLOGY**

- (1) Basic Concrete Ingredients
- (2) Work Below Grade
- (3) Work At Grade
- (4) Above Grade
- (5) Masonry

### **SOILS, EXCAVATIONS AND MINING**

- (1) Soils and Excavations
- (2) Excavations and Trenching
- (3) Mining Operations

# Resources

## **Associated General Contractors of America**

333 John Carlyle Street  
Alexandria, VA 22314  
(202) 383-2732

## **Construction Safety Council**

4415 West Harrison Street  
Suite 407  
Hillside, IL 60162  
(800) 552-7744

## **Construction Risk Control Partnership**

125 Jarvis Hall  
University of Wisconsin-Stout  
Menomonie, WI 54751  
(715) 232-2163

## **The St. Paul Companies Construction Risk Control**

385 Washington Street  
St. Paul, MN 55102  
800-356-4098

Construction  
Risk Control  
Partnership

Summary  
Report

The St. Paul Companies  
Construction Industry Partners  
University of Wisconsin-Stout

August 1999

# SUMMARY REPORT

## Background

The Construction Information Exchange is a bi-annual event sponsored by The St. Paul Fire and Marine Insurance Company and the Construction Safety Council (CSC). It provides a forum for the St. Paul Construction Loss Group, CSC members and St. Paul insurance policy holders to discuss current safety, health and risk control issues and trends impacting the construction industry. The policyholders represent a nation-wide cross section of contractors who engage in high rise, commercial, heavy/highway, utility and tunneling construction. **A significant concern identified at the Exchange was the inadequate training in safety, health and risk control issues evident in many of the new construction professionals entering the employment market.** As a top priority, training of future project managers, supervisors and estimators, must include safety, health and risk control issues including associated costs and actions as integral factors in the bidding and building process.

In January 1997, The St. Paul Group entered into a project with the University of Wisconsin-Stout to develop a construction management curriculum that integrates risk control issues into all its courses. The intent of the integrated curriculum is to produce a construction professional with an ingrained safety and health consciousness. This project is called the **Construction Risk Control Partnership** and includes the St. Paul Companies, the University of Wisconsin-Stout and contributing construction industry partners.

## Partnership Purpose

The purpose of the Construction Risk Control Partnership is to assure that construction management graduates enter the construction industry as employees who are capable of integrating technical and managerial safety and health components into project management actions that effectively prevent human and financial loss. This partnership is a win-win situation for all those involved. It is designed to meet the needs of the construction industry, students entering the employment market, St. Paul Companies Construction Group, their policyholders, and the University of Wisconsin-Stout.

Three major milestones were accomplished in the initial stages of the partnership. The first was to complete course curriculum guides which integrate safety, health and environmental content into selected construction courses. These have been made available to instructors and suggest logical integration points for risk control competencies. The guides were designed around UW-Stout course objectives and include unit by unit Risk Control Focus Points.

The second milestone was the university approval of the Construction Risk Control minor and a new Construction Risk Management course. The third milestone, the development of the Construction Risk Control Chair position, was initiated by a generous gift from the St. Paul

Companies to the UW-Stout Foundation. Thus began the fund-raising effort designed to ensure long term funding for an additional faculty member to continue the work of this partnership.

## **Summary of Major Activities**

In reviewing the partnership goals, there are six specific measurable outcomes that indicate the success of the partnership to date. They are:

**Integrated Curriculum** - Content packages that identify hazards, controls and suggested references in eight different areas of construction are completed.

Curriculum guides have been completed for:

- ?? Residential and Light Building Construction Methods
- ?? Commercial, Industrial and Highway Construction Methods
- ?? Concrete and Masonry Technology
- ?? Soils, Excavations and Mining

Four additional curriculum guides are under development. In addition, every construction major is required to complete the Construction Safety course.

**Risk Control Minor** - A course in Construction Risk Control Management has been approved. Other support courses and the minor format were approved by the university in Fall 1998.

**Seminars and Workshops** - Industry experts delivered nine seminars totaling 38 training hours. Attendance in these seminars included 542 students/faculty and 51 construction industry personnel. Eleven industry guest speakers made presentations to 44 construction classes, reaching 980 students.

**Scholarships** - Twenty-seven construction students were awarded cash scholarships.

**Internships** - Fourteen students were placed in industry internship positions as part of their educational program.

**Employed Graduates** - In this short period of time, 13 students who have taken the integrated courses and completed the Risk Control emphasis, are employed by construction companies, or by companies who have designated them as their construction risk control specialists.

## **Continuing Partnership Goals**

**Goal 1 - Integrate safety, health and environmental risk control content into the undergraduate construction program at UW-Stout.**

Work with the UW-Stout faculty to develop curriculum guides for:

- ?? Environmental Systems – HVAC
- ?? Environmental Systems - Electrical and Plumbing

- ?? Structural Systems - Wood and Steel
- ?? Structural Systems - Concrete and Masonry

Offer eight seminars and guest speakers during 1999.

**Goal 2 - Finalize the Construction Risk Control Minor and related course work for the B.S. in Construction and M.S. in Risk Control at UW-Stout.**

Meet with curriculum committee to gain formal approval of a minor for the B.S. in Construction and as an emphasis in the M.S. in Risk Control.

Meet with the curriculum committee to gain formal approval for a new course, Construction Risk Management, to be included in the minor.

Recruit students into Construction Risk Control.

- ?? Develop recruitment strategy
- ?? Develop a brochure
- ?? Develop mentorship opportunities

Develop and place students in appropriate internship opportunities.

Award 10 scholarships.

**Goal 3 - Disseminate the integrated content to various selected colleges and universities which provide the construction industry with graduates.**

Proof and finalize the content of the consultant's work that identified hazards, controls and suggested references in eight different areas of construction.

Develop a format for the risk control content packages, which other construction programs can use to begin integrating into their course and curriculum design.

Offer consultation to other construction programs to help them begin the integration process.

**Goal 4 - Work cooperatively with the St. Paul Companies and construction industry partners for a long-term commitment to fund a permanent Construction Risk Control Chair position.**

Work with the Stout University Foundation and the St. Paul Companies to develop a fund-raising strategy.

The total project goal is \$2 million. This includes funding a Chair position (\$1.5million), endowed scholarships (\$250,000) and the Construction Risk Control Center (\$250,000).

Develop an informational packet that includes:

?? History and summary of the partnership including goals and accomplishments to date.

?? Opportunities available to those who are contributing partners including:

- Training, workshops and seminars
- Internships
- Mentoring opportunities
- Educational opportunities for current employees
- Applied research projects
- Network with new and up-coming construction and risk control graduates.

?? Curriculum content packets

Develop a plan to provide safety and risk control assistance to construction companies that contribute to the partnership.

?? Customized services (including curriculum and training)

?? Certifications

# Residential and Light Building Construction

## Risk Control Curriculum

### **INTEGRATION GUIDE**

This Guide has been developed by

The Construction Risk Control Partnership  
125 Jarvis Hall  
UW-Stout  
Menomonie, WI 54751

# RESIDENTIAL AND LIGHT BUILDING CONSTRUCTION

## Course Information

**Description** - This guide has been designed to introduce the student to the fundamentals of the construction industry as they apply to light residential construction and the risk controls associated with this type of work. The development of knowledge, practical skills, problem solving abilities and behaviors applicable to the construction industry will be emphasized.

**Risk Control Integration Focus** - There are many hazards associated with the construction of residential and light commercial buildings. The risk control focus of this guide is to integrate hazard recognition and avoidance techniques into each of the respective units. Emphasis will be on protecting individual workers, those with whom they are working and the contractor's investment in the building project. Since this is usually one of the first courses a construction student enrolls in, it emphasizes the use of personal protective equipment and other basic safety and health risk controls.

**Guide Outline** - There are five units of instruction presented to the students. Each unit listed below has a risk control focus integrated into the unit instructional objectives. The units are:

Unit 1	Mobilization and Site Preparation
Unit 2	Excavations, Footings and Foundations
Unit 3	Floor Systems
Unit 4	Wall Systems
Unit 5	Roof Systems

In the lab portions of these types of classes, students generally build a small, light frame building, or mock-up building components such as floors, walls, and roof rafters. Techniques of building practices and hazard avoidance should be continually observed when students are engaged in work activities. Students are required to follow all safety regulations, policies, and procedures. Wearing of personal protective gear while in work areas is mandatory. Students disregarding safety policies and procedures are removed from the work environment.

The following pages present an overview of the work associated with the identified phase of construction, risks commonly associated with the type of work, suggested risk controls and resources to help integrate risk control competencies into construction practices.

## Mobilization and Site Preparation

<b>Construction Phase</b>	<b>Identified Risks</b>	<b>Risk Controls</b>	<b>Resources</b>
<b>Tools and Materials</b>	?? Using hand, power, and pneumatic tools ?? Using powder actuated tools ?? Lifting heavy materials	?? Use personal protective equipment such as respirators, ear plugs, safety glasses ?? Practice lifting techniques ?? Use material handling equipment designed to handle the job at hand	<b>AGC Videos</b> ?? Head, Hearing, Eye Protection ?? Respirators ?? Lifting and Back Injuries  <b>Hilti Corp</b>  <b>St. Paul Technical Guides</b> ?? Hand Tool Safety ?? Personal Protective Equipment ?? Material Handling

## Mobilization and Site Preparation

Construction Phase	Identified Risks	Risk Control	Resources
<b>Site Preparations</b>	<ul style="list-style-type: none"> <li>?? Underground and overhead utility location removal and/or protection</li> <li>?? Heavy equipment movement, both public and worker exposure to truck traffic</li> <li>?? Material placement</li> <li>?? Fire protection, emergency action plan (SARA requirements)</li> <li>?? Public liability issues</li> </ul>	<ul style="list-style-type: none"> <li>?? Contact one-call system and local utilities for location of underground and overhead systems</li> <li>?? Plan truck movement to minimize backing</li> <li>?? Utilize spotters</li> <li>?? Provide barricades in accordance with the uniform traffic code</li> <li>?? Plan the sequence of the construction and order materials only when needed.</li> <li>?? Keep materials organized to minimize theft.</li> <li>?? Stage materials to maintain good housekeeping reducing tripping and ergonomic type losses.</li> <li>?? Contact local police, fire, and EMS for advice and coordination.</li> <li>?? Post signs and notify schools and neighbors.</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Excavating</li> <li>?? Trenching</li> <li>?? Traffic Control</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Public Liability</li> <li>?? Security</li> <li>?? Traffic Control</li> </ul>

## **Mobilization and Site Preparation**

This unit deals with contractor mobilization and site preparation. There are numerous activities that take place during this phase of work. There are many hazards that need to be identified and controlled to protect workers and the general public.

**Introduction** - When a contractor moves on site they assume responsibility for public safety, traffic control, identification and protection of utilities and site emergency plans. Since work is just starting, it is a good time to reinforce basic tool safety and personal protective equipment use. Additionally, many new workers may be on site and need orientation to company safety policies and procedures.

**Risk Control Focus 1: Be aware that contractors assume responsibility for protecting the public from the many hazards associated with a construction site.**

### **Resources**

- ?? *Public Liability on Construction Sites*. St. Paul, Technical Guide
- ?? *Job Site Security*. St. Paul, Technical Guide
- ?? *Tool Box Talks: Warning Signs*. AGC, Tape 180.18

**Risk Control Focus 2: Protect the workers and the public by controlling traffic on and around the jobsite.**

### **Resources**

- ?? *Traffic Control for Work Zones*. St Paul, Technical Guide

### **OSHA Reference**

- ?? 1926 Subpart F - Signs, Signals and Barricades, Signaling

**Risk Control Focus 3: Contact utility companies for locating underground utilities and protection of overhead utilities.**

### **Resources**

- ?? *Tool Box Talks: Working Around High Voltage*. AGC, Tape 180.19
- ?? *Power Line Hazard Awareness*. Chicago Safety Council, CSC Video Elect 6
- ?? *Power Line Hazard Awareness Manual*. Chicago Safety Council, CSC Elect 2
- ?? *Underground Utilities*. St. Paul, Technical Guide

### **OSHA Reference**

- ?? 1926 Subpart V - Power Transmission and Distribution, Overhead and Underground Lines, Construction in Energized Substations

**Risk Control Focus 4: Recognize the need to plan for job-site emergencies.**

### **Resources**

- ?? *Job Site Emergency Planning*. St. Paul, Technical Guide
- ?? *Fire Protection*. St Paul, Technical Guide

### **OSHA Reference**

- ?? 1926 Subpart C - General Safety and Health Provisions, Employee Emergency Action Plans
- ?? 1926 Subpart F - Fire Protection & Prevention

## **Risk Control Focus 5: Use personal protective equipment.**

### **Resources**

- ?? *The Best Strategy: Personal Protective Equipment*. AGC, Tape 181
- ?? *Personal Protective Equipment*. St Paul, Technical Guide
- ?? *Tool Box Talks-Head Protection*. AGC, Tape 180.20
- ?? *Hard Hats*. St. Paul, Group Meeting Report
- ?? *Tool Box Talks-Eye and Face Protection*. AGC, Tape 180.2
- ?? *Eye and Face Protection*. St. Paul, Group Meeting Report
- ?? *Tool Box Talks-Hearing Protection*. AGC, Tape 180.6
- ?? *Sound Advise: Hearing Conservation on the Job*. AGC, Tape 178
- ?? *Breathing Easier: The Basics of Respiratory Protection*. AGC, Tape 172
- ?? *Breathing Easier; Selecting, Fitting and Maintaining Respirators*. AGC, Tape 173

## **Risk Control Focus 6: Handling heavy material is common practice on construction sites.**

### **Resources**

- ?? *Back to Basics: Back Injury Prevention*. AGC Tape 149
- ?? *Make the Right Move: Material Handling Safety*. AGC, Tape 150
- ?? *Heavy Lifting*. St. Paul, Group Meeting Report

### **OSHA Reference**

- ?? 1926 Subpart E - Personal Protective and Lifesaving Equipment, Hearing Protection, Respiratory Protection

## **Risk Control Focus 7: Select, maintain and use hand tools appropriately. Remember to use associated personal protective equipment.**

### **Resources**

- ?? *Hand Tool Safety*. St. Paul, Group Meeting Report
- ?? *Take Charge: Working with Temporary Electricity*. AGC, Tape
- ?? *On Your Guard: Power Tool Safety*. AGC, Tape 148
- ?? *Power Tool Safety*. St. Paul, Group Meeting Report
- ?? *Tool Box Talks-Powder-Actuated Safety*. AGC, Tape 180.10
- ?? *Powder-Actuated Hand Tools*. St. Paul, Technical Guide

**OSHA Reference**

- ?? 1926 Subpart I - Tools-hand and Power, Powder-actuated Hand Tools  
Woodworking Tools
- ?? 1926 Subpart K - Electrical, Ground Fault Protection

## Excavations, Footings and Foundations

Construction Phase	Identified Risks	Risk Controls	Resources
<p><b>Excavation</b></p>	<ul style="list-style-type: none"> <li>?? Underground and overhead utilities</li> <li>?? Working around heavy equipment</li> <li>?? Cave-in hazards</li> <li>?? Atmospheric hazards depending on building location</li> <li>?? Fall hazards to both public and workers.</li> </ul>	<ul style="list-style-type: none"> <li>?? Contact one-call system and local utilities to locate underground and overhead systems</li> <li>?? Pre-determine soil types from soil boring tests or by referencing OSHA subpart P to identify proper cave-in protection system</li> <li>?? Pre-determine in excavation bid documents that side walls shall be benched at 4 feet and sloped back at 1« to 1 (typical light construction situation)</li> <li>?? Perform a site assessment</li> <li>?? Investigate prior site use, evaluate site location (marsh or wet areas etc.)</li> <li>?? Contact local police, schools and neighbors</li> <li>?? Fence in work area</li> <li>?? Provide ladders and proper egress</li> <li>?? Stage materials to minimize handling</li> <li>?? Provide adequate work force numbers</li> <li>?? Keep equipment and materials an appropriate distance from excavation to prevent collapse</li> <li>?? Schedule work when all other construction activities that may cause a cave-in are complete</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Excavation</li> <li>?? Heavy Equipment</li> </ul> <p><b>Construction Safety Council</b></p> <ul style="list-style-type: none"> <li>?? Excavation Safety</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Excavation and Grading</li> <li>?? Soil Analysis</li> <li>?? Heavy Equipment</li> <li>?? Ladders</li> </ul>

## Excavations, Footings and Foundations

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Footings</b>	<ul style="list-style-type: none"> <li>?? Form material handling and other ergonomic considerations</li> <li>?? Boom truck placement</li> <li>?? Concrete placement, truck access</li> <li>?? Excavation hazard during placement of drain tile and granular backfill</li> <li>?? Concrete burns, concrete splashes in eyes, etc</li> </ul>	<ul style="list-style-type: none"> <li>?? Organize staging to minimize material handling</li> <li>?? Utilize mechanical systems</li> <li>?? Plan concrete placement to minimize truck movement and subsequent side pressure that can cause wall collapse and truck rollover</li> <li>?? Identify access points and wash areas to minimize environmental impact</li> <li>?? Mandate backup alarms, spotters and the use of stop logs</li> <li>?? Identify PPE requirements</li> <li>?? Provide wash facilities or a clean water supply</li> </ul>	<p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Concrete Mixing and Placement</li> <li>?? Concrete Operations</li> </ul>

## Excavations, Footings and Foundations

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Foundation Walls</b>	<ul style="list-style-type: none"> <li>?? Handling form materials and ergonomic considerations</li> <li>?? Boom truck placement</li> <li>?? Excavation and trench hazards on backside of form sections</li> <li>?? Fall exposure while squaring form sections</li> <li>?? Fall exposure while pouring, striking and finishing concrete</li> <li>?? Trench hazard while removing wall ties, water proofing</li> <li>?? Electrical hazards during vibration</li> <li>?? Blowout due to excess vibration</li> <li>?? Concrete truck falling into foundation area</li> <li>?? Concrete burns, concrete splashes in eyes, etc</li> </ul>	<ul style="list-style-type: none"> <li>?? Provide adequate work force numbers</li> <li>?? Organize staging to minimize material handling</li> <li>?? Utilize mechanical systems</li> <li>?? Proper PPE</li> <li>?? Utilize sawhorses, scaffolding or ladders, rather than climbing on forms</li> <li>?? Install form scaffolds or cat walks if over 4 feet high</li> <li>?? Use proper fall protection, harnesses and lanyards</li> <li>?? Place power cords out of traffic areas</li> <li>?? Use assured grounding program and Ground Fault Interrupter systems</li> <li>?? Utilize qualified personnel to inspect corners and joints periodically for signs of failure</li> <li>?? Maintain supply of forming materials to brace if necessary</li> <li>?? Use face and eye protection when vibrating, and handling</li> <li>?? Provide adequate water for washing</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Fall Protection</li> <li>?? Personal Protection</li> </ul> <p><b>St. Paul</b></p> <ul style="list-style-type: none"> <li>?? Tie or Die Program</li> <li>?? Fall Protection</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Concrete Walls and Decks</li> </ul>

# Excavations, Footings and Foundations

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Basement Slabs</b>	?? Access in and out of work area ?? Carbon monoxide problems during interior pours and finishing ?? Power screeds ?? Concrete burns, silica dust ?? Buggy traffic noise ?? Imposed loads from concrete trucks (wall failure) ?? Sawing joints	?? Ladders for egress ?? Proper ventilation ?? Continuous monitoring of equipment ?? Plan concrete placement to minimize truck movement and subsequent side pressure that can cause wall collapse and truck rollover ?? Proper PPE ?? Properly tuned motors	<b>St. Paul Technical Guides</b> ?? Concrete Wall and Decks

## Excavations, Footings and Foundations

This unit is concerned with the excavation and construction of footings and foundations for residential and light buildings. Workers and the public must be protected from excavation operations. Concrete and masonry workers need to be cautious because of the caustic nature of the material, as well as the pouring and finishing of footings, walls and slabs.

**Introduction** - Excavation and foundation work exposes workers to heavy equipment, cave-in, cranes, and many other potential hazards. When planning this work, pay special attention to controlling risks that are associated with this work. Also, be aware of fall protection needed by those working on wall forms during erection of the foundation walls.

**Risk Control Focus 1: Become oriented to the general areas of on-the-job safety.**

### Resources

?? *Getting the Job Done Safely: Worker Safety Orientation.* AGC, Tape 183

### OSHA References

?? 1926 Subpart C - General Safety and Health Provisions

**Risk Control Focus 2: Beware of risks when working around heavy equipment.**

### Resources

?? *Tool Box Talks: Working Around Heavy Equipment.* AGC, Tape 180.12

?? *Hydraulic Excavator Safety.* St. Paul, Technical Guide

?? *Loader/Backhoe.* St. Paul, Technical Guide

?? *Construction Equipment -Heavy Earthmoving.* St. Paul, Group Meeting

### OSHA References

?? 1926 Subpart N - Cranes, Derricks, Hoists, Elevators & Conveyors

?? 1926 Subpart O - Motor Vehicles, Mechanized Equipment & Marine Operations.

**Risk Control Focus 3: Preplan the site for excavation safety.**

### Resources

?? *On Solid Ground: A Plan for Excavation and Trenching Safety.* AGC, Tape 136

?? *Handle with Care: Job Site Hazardous Waste Safety.* AGC, Tape

?? *Excavation Safety: Student Manual.* Construction Safety Council

?? *Excavation Safety Checklist.* St. Paul, Technical Guide

?? *In the Trenches: Excavation Safety for Workers.* Construction Safety Council video

?? *Excavation Safety: Soil Analysis.* St. Paul, Technical Guide

?? *Excavation and Safety.* St. Paul, Technical Guide

- ?? *Grading of Land*. St. Paul, Technical Guide
- ?? *Excavations*. St. Paul, Group Meeting

**OSHA References**

- ?? 1926 Subpart P - Excavations

**Risk Control Focus 4: Avoid falls from walls and wall forms.**

**Resources**

- ?? *Fall Protection for Employees*. Construction Safety Council video
- ?? *Concrete Walls and Decks*. St Paul, Technical Guide
- ?? *Fall Protection*. St. Paul, Technical Guide
- ?? *100 % Fall Protection*. St. Paul, Technical Guide
- ?? *Let's Eliminate Falls on the Jobsite*. St. Paul, Group Meeting
- ?? *Safety Belts and Harnesses for Fall Protection*. St. Paul, Group Meeting
- ?? *Tie or Die Program*. St. Paul Companies

**OSHA References**

- ?? 1926 Subpart M - Fall Protection

**Risk Control Focus 5: Handle and place concrete safely.**

**Resources**

- ?? *Concrete Mixing and Placement*. St. Paul, Technical Guide
- ?? *Concrete Pumping Operations*. St. Paul, Technical Guide

**OSHA References**

- ?? 1926 Subpart Q - Concrete and Masonry

## Floor Systems

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Framing Floor System</b>	<ul style="list-style-type: none"> <li>?? Impairment hazard on anchor bolts</li> <li>?? Fall exposure into basement while installing sill plates and headers</li> <li>?? Ergonomic considerations when handling floor joists</li> <li>?? I.H. considerations when sawing pressure treated lumber for sill plate</li> <li>?? Pneumatic nailers</li> <li>?? Crane or boom truck</li> <li>?? Rigging for installation of beams or girders</li> <li>?? Powder-actuated tools for sill installation</li> <li>?? Fall exposure while installing floor joists</li> </ul>	<ul style="list-style-type: none"> <li>?? Cap exposed anchor bolts</li> <li>?? Utilize scaffold or ladder</li> <li>?? Adequate work force</li> <li>?? Organized staging of materials, mechanical system for handling</li> <li>?? Qualified personnel trained on specific types of equipment</li> <li>?? Trained signal person</li> <li>?? Qualified rigger, rigging and crane inspection</li> <li>?? Set first floor joists using ladders and saw horse scaffold system</li> <li>?? Second floor and above utilize scaffold, make sure floor is sheathed to limit fall distance, build wood scaffold attached to load bearing wall below</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Power Tools</li> <li>?? Personal Protective Equipment</li> <li>?? Back Injuries</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Power Tool Safety</li> <li>?? Personal Protective Equipment</li> <li>?? Material Handling</li> </ul>

## Floor Systems

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Sheathing Installation</b>	<ul style="list-style-type: none"> <li>?? Rigging</li> <li>?? Crane and boom truck</li> <li>?? Ergonomic considerations carrying sheet stock</li> <li>?? Windy conditions</li> <li>?? Leading edge work - fall exposure</li> <li>?? Floor openings for stairs, HVAC, ceilings etc.</li> <li>?? Pneumatic nailers (user and crews working below)</li> <li>?? Slippery surfaces</li> <li>?? Fall exposure off side of structure</li> <li>?? Fall exposure for workers and public if temporary stairs are not built correctly</li> </ul>	<ul style="list-style-type: none"> <li>?? Qualified rigger and signal personnel</li> <li>?? Rigging and crane inspection</li> <li>?? Adequate workforce for crane or boom truck</li> <li>?? Good supervision to evaluate environmental conditions</li> <li>?? Proper training, warning lines and controlled access zones underneath work</li> <li>?? Handrail systems, hole covers</li> <li>?? Coordinate subcontractor's work to minimize exposure, install warning tape when workers are overhead</li> <li>?? On first floor use surveyor's tape to limit access</li> <li>?? On second floor and above, build handrail system (wooden or manufactured bracket systems)</li> <li>?? Do not install substandard stair systems</li> <li>?? Secure structures at night and weekends</li> <li>?? Use surveyor's tape to mark stair locations</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Handling Heavy Loads</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Fall Protection</li> <li>?? Housekeeping</li> <li>?? Tie or Die Program</li> </ul>

## Floor Systems

This unit deals with the installation of floor systems that provide adequate support for all design loads. Various floor arrangements, fabricating techniques, selection of materials and equipment to construct a floor system pose various risks for workers.

**Introduction** - The work activities noted in this unit require using hand and power tools to fabricate a flooring system. Strong reinforcement of personal hazard avoidance learned in Unit 1 is encouraged. Observe the workers in the work area to be sure they are protecting themselves, their contractor and other workers.

**Risk Control Focus 1: Use personal protection when engaged in construction activities.**

### Resources

- ?? *Hand Tool Safety*. St. Paul, Group Meeting Report
- ?? *Take Charge: Working with Temporary Electricity*. AGC, Tape
- ?? *On Your Guard: Power Tool Safety*. AGC, Tape 148
- ?? *Power Tool Safety*. St. Paul, Group Meeting Report
- ?? *Tool Box Talks-Powder-Actuated Safety*. AGC, Tape 180.10
- ?? *Powder-Actuated Hand Tools*. St. Paul, Technical Guide
- ?? *The Best Strategy: Personal Protective Equipment*. AGC, Tape 181
- ?? *Personal Protective Equipment*. St Paul, Technical Guide
- ?? *Tool Box Talks-Head Protection*. AGC, Tape 180.20
- ?? *Hard Hats*. St. Paul, Group Meeting Report
- ?? *Tool Box Talks-Eye and Face Protection*. AGC, Tape 180.2
- ?? *Eye and Face Protection*. St. Paul, Group Meeting Report
- ?? *Tool Box Talks-Hearing Protection*. AGC, Tape 180.6
- ?? *Sound Advice: Hearing Conservation on the Job*. AGC. Tape 178

### OSHA References

- ?? 1926 Subpart I - Tools-hand and Power, Powder-actuated Hand Tools, Woodworking Tools
- ?? 1926 Subpart K - Electrical, Ground Fault Protection

**Risk Control Focus 2: Constructing floor systems requires handling heavy materials and equipment.**

### Resources

- ?? *Back to Basics: Back Injury Prevention*. AGC Tape 149
- ?? *Make the Right Move: Material Handling Safety*. AGC, Tape 150
- ?? *Heavy Lifting*. St. Paul, Group Meeting Report

## Wall Systems

Construction Phase	Identified Risks	Risk Control	Resources
<b>Wall Systems</b>	?? Ergonomic considerations (material handling) ?? Pneumatic nailers ?? Wind loads on wall sections, crush hazard if not braced properly ?? Fall exposures from window and door openings ?? Cranes and boom truck if use is required ?? Power saws ?? Fall exposure during wall squaring ?? Ladder use near window openings, rafter plate installation ?? Fall exposure during sheeting installation if done after wall erection ?? Scaffolds ?? Pneumatic tool use when installing cabinet and dry wall backing ?? Material lull or forklift use ?? Saw cuts and drilling into plumbing and electrical ?? Ergonomic type injuries	?? Adequate workforce ?? Use of mechanical systems in material handling ?? Qualified personnel trained on specific brand used ?? Brace walls for overnight expectations ?? Maintain controlled access zone ?? Monitor weather conditions ?? Plan work, install top-rail (39to42 inches) and mid-rail after cutting openings ?? Qualified signal and rigging personnel ?? Inspect crane and rigging ?? Qualified personnel using saws ?? Work from inside of wall on ladder or scaffold ?? Install top-rail at 62 inches, mid-rail at 42 inches and bottom-rail at 24 inches. ?? Proper scaffold use ?? Use PPE	<b>AGC Videos</b> ?? Personal Protective Equipment ?? Fall Protection ?? Housekeeping ?? Scaffolds  <b>St. Paul Technical Guides</b> ?? Housekeeping ?? Scaffolds ?? Wind Hazards ?? Material Handling ?? Fork Truck Safety

## Wall Systems

This unit deals with construction of various types of wall structures typical to residential and light building. Construction of walls expose workers to risks associated with material handling and work above ground. At this stage of construction, housekeeping generally becomes an issue.

**Introduction** - Workers recognize that wall construction follows floor construction. General construction hazards persist through this phase with additional exposures created by working above ground and using scaffolds and ladders. Housekeeping on the site, and specifically in the work area, usually becomes an issue at this phase of construction.

**Risk Control Focus 1: Construction of wall systems requires using hand and power tools and using PPE.**

### Resources

?? Refer to various previous units for information about hand tools and PPE

**Risk Control Focus 2: Encourage good housekeeping practices. As walls go up, work areas easily become cluttered with materials.**

### Resources

?? *Getting the Job Done Safely: Worker Safety Orientation.* AGC, Tape 183

?? *Housekeeping on the Jobsite.* AGC, Tape 138

?? *Housekeeping: Trash Management.* St. Paul, Technical Guide

?? *Construction Site-Housekeeping.* St. Paul, Group Meeting Report

**Risk Control Focus 3: Setting wall sections in place can be labor intensive or may require use of cranes. Ladders and scaffolds are frequently used in this process. Numerous hazards are associated with this work.**

### Resources

?? *Success at the Top: Stairway and Ladder Safety.* AGC, Tape

?? *Tool Box Talks: Ladder Safety.* AGC, Tape 187

?? *Stairways and Ladders.* St. Paul, Technical Guide

?? *Floor, Roof and Wall Openings, and Stairways and Ramps.* St. Paul, Technical Guide

?? *Tool Box Talks: Working Safely on Scaffolds.* AGC, Tape 180.8

?? *Putting It All Together : Scaffold Safety.* AGC, Tape 439

?? *Tubular Welded Frame Scaffold Safety Rules.* St. Paul, Technical Guide

?? *Scaffolds.* St. Paul, Group Meeting Report

### OSHA References

?? 1926 Subpart L - Scaffolding

?? 1926 Subpart X - Stairways and Ladders

**Risk Control Focus 4: Be wary of working on wall systems in windy conditions.**

**Resources**

?? *Protection from Wind Hazards in Construction*. St. Paul, Technical Guide

?? *Temporary Bracing for Freestanding Masonry Walls*. St. Paul, Technical Guide

**Risk Control Focus 5: Working with insulation and installation materials require special care.**

**Resources**

?? *Insulation Contractors-Residential, pages 1-13*. Best's Loss Control Engineering Manual

# Roof Systems

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Roof Systems – Cut Rafters</b>	?? Crane or boom truck when setting ridge beams, etc ?? Fall exposure during beam setting ?? Wind load consideration ?? Material handling-ergonomic considerations ?? Saw use ?? Pneumatic nailer use because of odd work positions ?? Fall exposure during installation of common hip and valley rafters ?? Fall exposure during installation of gable end studs and lookouts	?? Qualified operator, rigger and signal person ?? Crane and rigging inspection ?? Utilize scaffold or ladders ?? Supervision to evaluate environmental conditions and develop contingency plan for work schedule ?? Adequate work force ?? Use crane or boom truck if possible ?? Qualified personnel do all sawing on ground if possible ?? Keep area clear during nailing operations ?? Construct from outside of building utilizing scaffold or ladders	<b>AGC Videos</b> ?? Personal Protective Equipment ?? Fall Protection ?? Scaffolds and Ladders  <b>St. Paul Technical Guides</b> ?? Tie or Die Program ?? Scaffolds and Ladders ?? Fall Protection on Residential and Wood Frame Buildings

# Roof Systems

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Roof Systems – Truss Type</b>	<ul style="list-style-type: none"> <li>?? Crane boom truck and rigging issues</li> <li>?? Wind load considerations</li> <li>?? Pneumatic nailer use because of odd work position</li> <li>?? Fall exposure during erection and nailing to top or rafter plate</li> <li>?? Fall exposure during spacing and squaring sequence and installation of wind bracing across top of trusses</li> </ul>	<ul style="list-style-type: none"> <li>?? Qualified operators, riggers and signal personnel</li> <li>?? Inspect crane and rigging</li> <li>?? Supervision needs to evaluate environmental conditions and develop contingency plan for alternative work if necessary.</li> <li>?? Qualified operator trained on specific brand used</li> <li>?? Develop controlled access zone and coordinate work schedule.</li> <li>?? Install from inside of building utilizing scaffold or ladders</li> <li>?? Utilize metal truss brackets - after installation of three or more trusses tie off to truss group, or use scaffold unit.</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Personal Protective Equipment</li> <li>?? Fall Protection</li> <li>?? Scaffolds and Ladders</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Tie or Die Program</li> <li>?? Scaffolds and Ladders</li> <li>?? Fall Protection on Residential and Wood Frame Buildings</li> </ul>

# Roof Systems

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Roof Sheeting Placement</b>	<ul style="list-style-type: none"> <li>?? Crane and boom truck - rigging issues</li> <li>?? Wind can create a fall hazard if workers are not instructed on proper handling methods</li> <li>?? Ergonomic consideration from material handling</li> <li>?? Fall exposure during sheeting placement adjacent to fascia</li> <li>?? Scaffolding or ladder exposures</li> <li>?? Fall exposure during placement of remaining sheeting - both sliding off roof edge and falling into structure</li> <li>?? Slip hazard due to dampness on plywood if operation is not completed same day</li> <li>?? Pneumatic nailer concerns for roof worker and crews working underneath operation</li> <li>?? Fall exposure for worker trimming gable end sheeting at roof edge</li> <li>?? Material falling to ground striking workers or public</li> <li>?? Fall exposure if roof openings are cut for chimney or skylights etc.</li> </ul>	<ul style="list-style-type: none"> <li>?? Qualified operator, rigger and signal person</li> <li>?? Good supervision to evaluate environmental conditions.</li> <li>?? Train workers on proper lifting and carrying methods</li> <li>?? Adequate work force</li> <li>?? Utilize scaffold or ladder jacks or install from inside building.</li> <li>?? Qualified personnel to install roof jacks or manufactured bracket and hand rail systems</li> <li>?? Setup scaffold as a catch platform.</li> <li>?? Inspection of roof conditions by supervision before allowing crew to access roof</li> <li>?? Plan and coordinate subcontractor and other crews work to keep them from working under roofing operations</li> <li>?? Install surveyor's tape and create a limited access zone</li> <li>?? Tie off to roof ridge to a manufactured anchor point</li> <li>?? Remind crews to look before dropping materials – mark area with surveyor's tape</li> <li>?? Coordinate work to make cuts only when necessary</li> <li>?? Install wooden handrails or manufactured bracket and handrail system, or cover with proper hole cover</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Personal Protective Equipment</li> <li>?? Fall Protection</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Tie or Die Program</li> <li>?? Scaffolds and Ladders</li> <li>?? Fall Protection on Residential and Wood Frame Buildings</li> </ul>

## Roof Systems

This unit deals with roof framing systems applicable to various styles of residential and light buildings. Conventional rafter layout, rafter placement problems, truss systems and sheathing installation will be presented. Construction of roofs and placement of trusses is work that takes above ground where workers often rely on scaffolds and ladders as work platforms. Hydraulic cranes are often used to set roof trusses. Workers are exposed to numerous hazards associated with work above ground, with cranes, and other equipment necessary to build roof systems for light building construction projects.

**Introduction** - Roof construction entails working above ground and ladders and scaffolds are used as points of access and egress from the roofs. Additionally, ladders and scaffolds often serve as work platforms for setting roof framing members or placing roofing materials. Pre-engineered roof trusses are delivered to the site and generally placed by boom trucks or hydraulic cranes.

**Risk Control Focus 1: Working above ground requires extra care in building and placement of ladders and scaffolds. Fall arrest systems must be worn in conjunction with this equipment.**

### Resources

- ?? *Success at the Top: Stairway and Ladder Safety.* AGC, Tape
- ?? *Tool Box Talks: Ladder Safety.* AGC, Tape 187
- ?? *Tool Box Talks: Working Safely on Scaffolds.* AGC, Tape 180.8
- ?? *100 % Fall Protection.* St. Paul, Technical Guide
- ?? *Fall Protection.* St. Paul, Technical Guide
- ?? *Safety Belts and Harnesses for Fall Protection.* St. Paul, Group Meeting Report
- ?? *Fall Protection for Residential and Wood Framed Roof Construction.* St. Paul, Technical Guide
- ?? *Tie or Die.* St. Paul program

**Risk Control Focus 2: Working with boom trucks and hydraulic cranes requires special attention to set-up, electric lines, rigging and overhead loads.**

### Resources

- ?? *Take Charge: An Overview of Crane Safety.* AGC, Tape 142

### OSHA References

- ?? 1926 Subpart N - Cranes, Derricks, Hoists, Elevators and Conveyers

**Risk Control Focus 3: Working on scaffolds, elevated work platforms or other above grade work areas requires significant preplanning and operational follow-through.**

### Resources

- ?? *Tool Box Talks: Working Safely on Scaffolds*. AGC, Tape 180.8
- ?? *Heightened Awareness: Fall Protection in the Construction Industry*. AGC, Tape 179
- ?? *Step By Step: Job Safety Analysis*. AGC, Tape 156
- ?? *The Fall Awareness Set*. Construction Safety Council
- ?? *Rolling Tower Scaffolds*. St. Paul, Technical Guide
- ?? *Swing Stages*. St. Paul, Technical Guide

**OSHA References**

- ?? 1926 Subpart L - Scaffolding
- ?? 1926 Subpart M - Fall Protection

# Commercial, Industrial and Highway Construction

## Risk Control Curriculum

### INTEGRATION GUIDE

This Guide has been developed by

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# COMMERCIAL, INDUSTRIAL AND HIGHWAY CONSTRUCTION

**Description** - This guide is designed to introduce construction students to the methods, techniques and equipment used in the commercial, industrial and highway construction process. Students typically develop skills that enable them to analyze, plan, and carry out various facets of commercial, industrial and highway construction. They become familiar with systems and processes typically used in these types of construction.

**Risk Control Integration Focus** - This guide is divided into 6 distinct units that represent a specific phase or type of construction. Each unit studies various methods, materials, and equipment necessary to complete each aspect of the work. As students engage in learning these practices, they simultaneously analyze each step of the processes to identify associated risks and hazards that are part of the work. Students apply general job site and specific task activity assessments as risk control procedures. As the associated risks are identified, they plan appropriate avoidance and elimination techniques consistent with best practices. Emphasis is on planning, managing operations, and enforcing safety policy and procedures that create risk-free job sites.

**Guide Outline** - There are 6 units presented in this guide. The units are:

Unit 1	Site Preparation and Mobilization
Unit 2	Foundations
Unit 3	Concrete Structural Systems
Unit 4	Metal Structural Systems
Unit 5	Heavy and Highway Construction
Unit 6	Underground Construction

The following pages present an overview of the work associated with the identified phase of construction, risks commonly associated with the type of work, suggested risk controls and resources to help integrate risk control competencies into construction practices.

In the lab portions of classes, students are required to follow all safety regulations, policies, and procedures. Wearing of personal protective gear while in work areas is mandatory. Specific risk control practices associated with various aspects of work are identified before the lab activities begin. Students disregarding safety policies and procedures are removed from the work environment.

## Site Preparation and Mobilization

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Site Preparation and Mobilization</b>	?? Demolition of existing structures containing processes piping and charged or contaminated utilities	?? Engineering survey of structure for potential weak surfaces ?? Hygiene survey of existing utilities for contamination ?? Training of workers in hazardous material response and handling	<b>AGC Videos</b> ?? Demolition ?? Hazardous Waste ?? Heavy Equipment Hazards
	?? Demolition of pretensioned concrete	?? Confined space entry training for workers designated to perform these tasks	?? Construction Sites ?? New Worker Orientation
	?? Soil contamination from industrial processes	?? Phone the one-call system to identify underground utilities ?? Use as-build drawings to identify potential underground utilities on industrial property/contact plant engineering to determine additional underground utilities	<b>Construction Safety Council</b> ?? Power lines ?? Hazard Communication
	?? Heavy equipment movement	?? Contact power company in advance to de-energize, move overhead lines or install protective sleeves/covers	
	?? Confined space entry into manholes, vaults, tanks	?? Coordinate with plant engineering to de-energize, move, blanket overhead utilities	<b>St. Paul Technical Guides</b>
	?? Falls from elevated surfaces	?? Assure certified blaster is performing any explosives work	?? Underground Utilities
	?? Falls into holes	?? Coordinate storage of explosives with plant security	?? Excavations
	?? Poisonous plants/insects	?? Erect construction fence around perimeter of project	
	?? Falls through roofs	?? Contract with a security contractor to provide 24 hour security	
	?? Underground and overhead utilities	?? Alert local police that you are beginning a project and there will be open excavations, heavy equipment and job trailers on site	
	?? Blasting	?? Worker training on evacuation routes and plant alarm systems	
	?? Industrial workers interfering or exposed to construction equipment	?? Trained flaggers	
	?? Vandalism of equipment and tools	?? Construction signs warning public of construction areas	
	?? Movement of plant transportation including semi's and trains	?? Fall arrest when working off of leads	
	?? Truck and equipment access off public roadways	?? Lock-out hammers before working on leads	
	?? Pile driving operations for foundations		

## Site Preparation and Mobilization

This unit deals with the basics of site preparation and mobilization. Contractors have a busy schedule during this phase. Many hazards exist that require contractors and workers to be vigilant and protect themselves, the site, and the public.

**Introduction** - When contractors mobilize on site a great deal of planning for future work must take place. Careful site layout, positioning of job trailers, access and egress roads, material storage, and site security needs to be accomplished before construction begins. Once the site has been laid out and the dirt work begins, additional planning for future construction activities takes place. Soil testing, layout, scrapping, and excavation work are major concerns at this phase. Additionally, many new workers will be hired and need orientation to company safety policies and procedures.

**Risk Control Focus 1: Secure the site and limit public access. Once the contractors take possession of the site, they assume responsibility for public safety. Control traffic on and around job site.**

### Resources

- ?? *Public Liability on Construction Sites*. St. Paul, Technical Guide
- ?? *Job Site Security*. St. Paul, Technical Guide
- ?? *Tool Box Talks: Warning Signs*. AGC, Tape 180.18
- ?? *Traffic Control for Work Zones*. St Paul, Technical Guide

### OSHA Reference

- ?? 1926 Subpart C - General Safety and Health Provisions
- ?? 1926 Subpart G - Signs, Signals and Barricades

**Risk Control Focus 2: Contact utility companies for locating underground utilities and protecting overhead utilities.**

### Resources

- ?? *Power Line Hazard Awareness*. Chicago Safety Council, CSC Video Elect 6
- ?? *Power Line Hazard Awareness Manual*. CSC Elect 2
- ?? *Underground Utilities*. St. Paul, Technical Guide

**Risk Control Focus 3: Become oriented to the general areas of on-the-job safety and company safety policies and procedures.**

### Resources

- ?? *Getting the Job Done Safely: Worker Safety Orientation*. AGC, Tape 183

**Risk Control Focus 4: Plan the site layout to allow for best traffic patterns, trailers, and material storage. Remember hazard communication requirements.**

### Resources

- ?? *Hazard Communication: The System That Works*. AGC, Tape 112
- ?? *Hazard Communication Manual*. Construction Safety Council

### **OSHA References**

- ?? 1926 Subpart D - Occupational Health and Environmental Controls
- ?? 1926 Subpart H - Materials Handling, Storage, Use and Disposal
- ?? 1926 Subpart Z - Toxic and Hazardous Substances

## **Risk Control Focus 5: Beware of risks associated with excavations and working around heavy equipment.**

### **Resources**

- ?? *Tool Box Talks: Working Around Heavy Equipment*. AGC, Tape 180.12
- ?? *Hydraulic Excavator Safety*. St. Paul, Technical Guide
- ?? *Loader/Backhoe*. St. Paul, Technical Guide
- ?? *Construction Equipment - Heavy Earthmoving*. St. Paul, Group Meeting
- ?? *On Solid Ground: A Plan for Excavation and Trenching Safety*. AGC, Tape 136
- ?? *Excavation Safety: Student Manual*. Construction Safety Council
- ?? *Excavation Safety Checklist*. St. Paul, Technical Guide
- ?? *Excavation Safety: Soil Analysis*. St. Paul, Technical Guide
- ?? *Excavation and Safety*. St. Paul, Technical Guide
- ?? *Grading of Land*. St. Paul, Technical Guide
- ?? *Excavations*. St. Paul, Group Meeting

### **OSHA References**

- ?? 1926 Subpart O - Motor Vehicles, Mechanized Equipment, and Marine Operations
- ?? 1926 Subpart P - Excavations

## Foundations

Construction Phase	Identified Risks	Risk Controls	Resources
Caissons	<ul style="list-style-type: none"> <li>?? Confined space hazards due to low oxygen, CO, H2S or LEL</li> <li>?? Underground and overhead utilities</li> <li>?? Collapse of nearby structures</li> <li>?? Workers falling into unguarded holes</li> <li>?? Workers near drilling rig</li> <li>?? Vibration from drilling rig causing failure of nearby excavations</li> </ul>	<ul style="list-style-type: none"> <li>?? Workers trained in confined space hazards</li> <li>?? Use of tripod for rescue if workers must enter caissons</li> <li>?? Air monitoring of all caissons prior and during entry</li> <li>?? Proper guarding of holes with guardrails to prevent falls</li> <li>?? Inspections of all nearby excavations made more frequently during drilling operations</li> </ul>	<p><b>AGC Videos</b> ?? PPE</p> <p><b>Construction Safety Council</b> ?? Fall Protection</p> <p><b>St. Paul Technical Guides</b> ?? Concrete Construction</p>

## Foundations

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Piers</b>	?? Excavation failure ?? Contaminated soil ?? Underground utilities causing injury and/or plant systems disruption (Electrical, gas, O2, EMS phone system) ?? Falls off of forms and pier tops ?? Road impairment for EMS vehicles to access plant / construction areas.	?? Proper soil analysis and protection from cave-in ?? Coordinate with plant engineering to determine location of underground utilities ?? Proper Fall protection systems in place (Full body harness w/ positioning systems for working off of rebar and forms) ?? Standard guardrails on all pier tops ?? Coordination with plant for road impairment permitting	<b>AGC Videos</b> ?? Fall Protection ?? Excavations  <b>Construction Safety Council</b> ?? Fall Protection  <b>St. Paul Technical Guides</b> ?? Excavations

## Foundations

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Continuous Walls – Concrete</b>	?? Manual material handling ?? Heavy equipment backing into workers or falling into trenches ?? Powered equipment ?? Concrete burns ?? Silica exposure when cutting or grinding ?? Excavations – Soil collapse on form side and when removing ties and formwork ?? Underground/overhead utilities ?? Concrete handling system hazards (rigging failure on overhead loads, hose coupling failure, boom truck hitting overhead powerlines, pinch points on conveyor systems)	?? Training workers in proper lifting/carrying techniques ?? Protective barriers/stoplogs/spotters when equipment is working near excavations ?? Proper PPE designed for the tool being used ?? Fresh water available for washing eyes and skin ?? Wet methods for sawing concrete ?? Proper soil analysis and slope for excavations ?? Inspection of all concrete systems prior to use and on a daily basis by a competent person ?? Training workers to keep clear of moving parts	<b>AGC Videos</b> ?? Excavations ?? Heavy Equipment ?? Cranes  <b>Construction Safety Council</b> ?? Concrete and Masonry Construction  <b>St. Paul Technical Guides</b> ?? Excavations ?? Concrete Work ?? Cranes

## Foundations

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Continuous Walls – Masonry</b>	?? Scaffolds with weather protection in winter blowing down ?? Ladders ?? Falls off leading edges when erecting exterior walls in tiered buildings ?? Workers impaled and injured by rebar ?? Walls blowing down ?? Heavy lifting/twisting ?? Extremely heavy/unbalanced loads on scaffolds due to mud trays and block. ?? Overturning high lift fork trucks ?? Falling block on other workers below	?? Use weather reports to indicate wind loads and increase supports for green walls ?? Engineered scaffold tie-ins when using weather protection (poly) ?? Rebar protection - caps for cutting injuries, 2 x 4 on top of rebar or bent over for impalement protection ?? Planned material handling to limit overloading scaffolds with mud and block ?? Train fork truck operators on hazards of soft ground and operating with forks extended ?? Use fall arrest such as retractable lifelines during the first 4 courses ?? Use overhead attachment points for lifelines ?? Erect limited access zone to keep out other trades.	<b>AGC Videos</b> ?? Scaffolding  <b>Construction Safety Council</b> ?? Concrete and Masonry

## Foundations

This unit presents foundation systems and their relationships to the rest of the building process. Excavating, concrete forming systems, concrete placement, and masonry work require workers to plan construction actions that avoid hazard exposures.

**Introduction** - Excavation work requires extra care because of heavy equipment use, soil conditions and confined spaces. Assembling and climbing-up forms, working with power tools, and using equipment in the concrete placement process requires workers to carefully assess the worksite, equipment and procedures necessary to get the work done. Using personal protective equipment, fall arrest systems and awareness of the caustic nature of concrete and mortar are critical risk avoidance practices associated with this work. Also, be wary of masonry construction practices that require scaffolds, restricted access areas and handling heavy materials used in a repetitive process.

**Risk Control Focus 1: Protect your eyes and avoid prolonged exposure of bare skin when placing and consolidating concrete.**

### Resources

- ?? *Tool Box Talks - Eye and Face Protection*. AGC, Tape 180.2
- ?? *Concrete Mixing and Placement*. St. Paul, Technical Guide
- ?? *Concrete Pumping Operations*. St. Paul, Technical Guide

### OSHA References

- ?? 1926 Subpart Q - Concrete and Masonry Construction

**Risk Control Focus 2: Select the right equipment to accomplish the concrete placement process. Plan the placement process to avoid exposing workers to hazards associated with cranes and buckets, pump trucks, power buggies or other placement techniques.**

### Resources

- ?? *Take Charge: An Overview of Crane Safety*. AGC, Tape 142

### OSHA References

- ?? 1926 Subpart N - Cranes, Derricks, Hoists, Elevators and Conveyers

**Risk Control Focus 3: Avoid falls from walls and wall forms during the assembly, pouring and stripping of continuous walls.**

### Resources

- ?? *Fall Protection for Employees*. Construction Safety Council Video.
- ?? *Concrete Walls and Decks*. St Paul, Technical Guide
- ?? *Fall Protection*. St. Paul, Technical Guide
- ?? *100 % Fall Protection*. St. Paul, Technical Guide
- ?? *Let's Eliminate Falls on the Jobsite*. St. Paul, Group Meeting
- ?? *Safety Belts and Harnesses for Fall Protection*. St. Paul, Group Meeting

### **OSHA Reference**

?? 1926 Subpart M - Fall Protection. Fall Protection, Roof Perimeters.

**Risk Control Focus 4: Working on scaffolds, elevated work platforms or other above grade work areas requires significant preplanning and operational follow-through.**

### **Resources**

?? *Tool Box Talks: Working Safely on Scaffolds*. AGC, Tape 180.8

?? *Heightened Awareness: Fall Protection in the Construction Industry*. AGC, Tape 179

?? *Step By Step: Job Safety Analysis*. AGC, Tape 156

?? *The Fall Awareness Set*. Construction Safety Council

?? *Rolling Tower Scaffolds*. St. Paul, Technical Guide

?? *Swing Stages*. St. Paul, Technical Guide

?? *Concrete and Masonry Construction*. Construction Safety Council, Construction Safety and Health Pamphlet

### **OSHA References**

?? 1926 Subpart L - Scaffolding

?? 1926 Subpart Q - Concrete and Masonry

?? 1926 Subpart M - Fall Protection

**Risk Control Focus 5: Control access into areas where masons are working overhead. Restricted access areas are high-risk areas where extra caution is needed.**

### **Resources**

?? *Concrete and Masonry Construction*. Construction Safety Council, Construction Safety and Health Pamphlet

### **OSHA Reference**

?? 1926 Subpart L - Scaffolding

?? 1926 Subpart Q - Concrete and Masonry

**Risk Control Focus 6: Pay special attention to hazards associated with forklifts and other heavy equipment used to load scaffolds and supply materials to mason crews.**

### **Resources**

?? *Rough Terrain Forklift*. St. Paul, Technical Manual

?? *Skid-Steer Loader Safety*. St. Paul, Technical Manual

?? *On the Go: Forklift Safety*. AGC, Tape 176

?? *Concrete and Masonry Construction*. Construction Safety Council, Construction Safety and Health Pamphlet

### **OSHA Reference**

- ?? 1926 Subpart O - Motor Vehicles, Mechanized Equipment, and Marine Operations
- ?? 1926 Subpart W - Rollover Protective Structures; Overhead Protection

## Concrete Structural Systems

Construction Phase	Identified Risks	Risk Control	Resources
<b>Cast-in-Place</b>	<ul style="list-style-type: none"> <li>?? Manual material handling</li> <li>?? Heavy equipment backing into workers or falling into trenches</li> <li>?? Powered equipment</li> <li>?? Concrete burns</li> <li>?? Silica exposure when cutting or grinding</li> <li>?? Excavations – Soil collapse on form side and when removing ties and form work</li> <li>?? Underground and overhead utilities</li> <li>?? Concrete handling system hazards (rigging failure on overhead loads, hose coupling failure, boom truck hitting overhead power lines, pinch points on conveyor systems, cranes, pump trucks)</li> </ul>	<ul style="list-style-type: none"> <li>?? Training workers in proper lifting and carrying techniques</li> <li>?? Protective barriers, stoplogs and spotters when equipment is working near excavations</li> <li>?? Proper PPE designed for the tool being used</li> <li>?? Fresh water available for washing eyes and skin</li> <li>?? Wet methods for sawing concrete</li> <li>?? Proper soil analysis and slope for excavations</li> <li>?? Inspection all concrete systems prior to use and on a daily basis by a competent person</li> <li>?? Train workers to keep clear of moving parts</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? PPE</li> <li>?? Heavy Equipment</li> <li>?? Excavations</li> </ul>

## Concrete Structural Systems

Construction Phase	Identified Risks	Risk Control	Resources
<b>Pre-Cast</b>	<ul style="list-style-type: none"> <li>?? Workers crushed by falling or sliding pre-cast slabs while off-loading trailers</li> <li>?? Falling loads due to rigging failure</li> <li>?? Wind pushing loads into workers or building structures</li> <li>?? Falls during placement of pre-cast members</li> <li>?? Exposure of other workers to suspended loads.</li> </ul>	<ul style="list-style-type: none"> <li>?? Pre-plan where trucks will off-load; level designated areas to prevent panels from tilting or sliding off of trucks</li> <li>?? Inspect all rigging before using</li> <li>?? Inspect attachment points in pre-cast panels to assure they will hold during placement</li> <li>?? Train workers in the use of personal fall arrest systems</li> <li>?? Use eye bolts of panels as attachment points for retractable lifelines to prevent workers from nearing the leading edge</li> <li>?? Use a controlled access zone as a last option for fall prevention.</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Cranes</li> <li>?? Fall Protection</li> <li>?? Scaffolds</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Fall Protection</li> <li>?? Cranes</li> <li>?? Scaffolds</li> </ul>

## Concrete Structural Systems

Construction Phase	Identified Risks	Risk Control	Resources
<b>Slab-on-Grade</b>	<ul style="list-style-type: none"> <li>?? Manual material handling</li> <li>?? CO problems during interior pours and finishing</li> <li>?? Structural collapse of decking</li> <li>?? Power saws (noise, chips causing eye or face injury)</li> <li>?? Electrical injuries due to temporary power and lights</li> <li>?? Low light (trips causing falls)</li> <li>?? Overhead hazards from other trades performing work above</li> <li>?? Fire due to faulty heaters, wind blown tarps, heaters set too close to other materials</li> <li>?? Post-tensioning of slabs</li> </ul>	<ul style="list-style-type: none"> <li>?? Proper use of guardrails on forms</li> <li>?? PPE for power tools</li> <li>?? Use of GFCI on all electrical equipment</li> <li>?? Coordination of work activities of all trades so no trades are performing work above another</li> <li>?? Fire watch when heaters are left on overnight.</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Cranes</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Stairs and Ladders</li> </ul>

## Concrete Structural Systems

This unit presents building design and erection using concrete structural systems. The use of pre-cast and poured-in-place members is discussed. Erecting the superstructure of a building exposes workers to risks associated with scaffolds, falls, cranes and rigging loads.

**Introduction** - The instructor will review the avoidance practices learned in the last unit about working with concrete and fall protection. Additional focus should be on risks associated with concrete construction, hazardous works zones, crane safety, rigging loads and working above ground.

**Risk Control Focus 1: Review precautionary practices when working with concrete.**

### Resources

?? Overview the resources from the last unit.

### OSHA References

?? 1926 Subpart Q - Concrete and Masonry Construction

**Risk Control Focus 2: Avoid falls from work environments at elevations and leading edges. Practice ladder safety when climbing to reach work areas above ground.**

### Resources

?? Review Fall Protection from Unit 2, Foundations

?? *Success at the Top: Stairway and Ladder Safety*. AGC, Tape

?? *Tool Box Talks: Ladder Safety*. AGC, Tape 187

?? *Stairways and Ladders*. St. Paul, Technical Guide

### OSHA References

?? 1926 Subpart M - Fall Protection. Fall Protection, Roof Perimeters.

?? 1926 Subpart X - Stairways and Ladders.

**Risk Control Focus 3: Follow risk avoidance procedures when erecting, working on and tearing down scaffolds. Be sure to incorporate fall arrest systems and restricted access into planning and operations of work that requires scaffolding.**

### Resources

?? *Tool Box Talks: Working Safely on Scaffolds*. AGC, Tape 180.8

?? *Putting It All Together: Scaffold Safety*. AGC, Tape 439

?? *Tubular Welded Frame Scaffold Safety Rules*. St. Paul, Technical Guide

?? *Scaffolds*. St. Paul, Group Meeting Report

### OSHA References

?? 1926 Subpart L - Scaffolding.

**Risk Control Focus 4: Working with cranes and rigging loads exposes workers to multiple sources of risk through crane failure, electrocution, and improper rigging and loading.**

**Resources**

- ?? *Play it Safe: An Overview of Crane Safety.* AGC, Tape 142
- ?? *Controlling the Load: Crane Rigging Safety.* AGC, Tape 146
- ?? *Tool Box Talks - Working Safely with Crane Rigging.* AGC, Tape 180.9
- ?? *Crane Safety Rules.* St. Paul Technical Guide
- ?? *Power Lines and Cranes.* St. Paul Technical Guide

**OSHA References**

- ?? 1926 Subpart N - Cranes Derricks, Hoists, Elevators and Conveyors
- ?? 1926 Subpart v - Power Transmission and Distribution

**Risk Control Focus 5: Be wary of working on wall systems in windy conditions.**

**Resources**

- ?? *Protection from Wind Hazards in Construction.* St. Paul, Technical Guide.
- ?? *Temporary Bracing for Freestanding Masonry Walls.* St. Paul, Technical Guide.

## Metal Structural Systems

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Column and Beams</b>	<ul style="list-style-type: none"> <li>?? Offloading trucks with loads that may have shifted during transport</li> <li>?? Improper rigging</li> <li>?? Use of damaged rigging</li> <li>?? Cranes</li> <li>?? Falls due to swinging loads, slippery conditions, untrained workers</li> <li>?? Scaffolds, manlifts</li> <li>?? Welding operations creating fire hazard and worker injury below</li> <li>?? Dropped tools, welding stubs, bolts</li> </ul>	<ul style="list-style-type: none"> <li>?? Inspect loads for shifted materials before unbinding</li> <li>?? Stand clear of side of flatbeds before unbinding</li> <li>?? Inspect rigging daily by competent person and before each use</li> <li>?? Use proper personal fall arrest equipment and consult manufacturers for products to provide anchor points</li> <li>?? Attach lifelines to beams on ground to be used by raising gangs</li> <li>?? Assure scaffolds have guardrails</li> <li>?? Use personal fall arrest systems</li> <li>?? Train workers on hazards of steel erection</li> <li>?? Level ground prior to using manlifts</li> <li>?? Rope off areas below operations</li> </ul>	<p><b>ACG Video</b> ?? Steel Erection</p> <p><b>Construction Safety Council</b> ?? Fall Protection Manual</p> <p><b>Coastal Video</b> ?? Fall Protection for Iron Workers</p> <p><b>St. Paul</b> ?? Tie or Die Program</p>

# Metal Structural Systems

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Decking</b>	<ul style="list-style-type: none"> <li>?? Flying metal particles when cutting</li> <li>?? Noise from abrasive saws</li> <li>?? Storage problems if decking is left unsecured in open areas due to wind</li> <li>?? Welding sparks and slag dropping on workers or equipment below-injury potential and fire hazard</li> <li>?? Falls (major hazard) due to unsecured decking, leading edges, open and partially open holes cut in preparation for piping, ducts, conduit, etc</li> <li>?? Decking pieces cut too short which can fall between supports and pull worker into hole</li> <li>?? Slippery conditions in winter, rain and in industrial facilities where stacks may emit various particulate that falls onto decking</li> <li>?? Cranes flying in decking</li> <li>?? Scaffolding used to get to work area</li> <li>?? Manlifts on uneven ground and used on lower decks where holes/debris accumulate</li> <li>?? Electrical hazards with screw guns</li> <li>?? Dropped fasteners, tools, decking, welding stubs, etc., onto workers below</li> </ul>	<ul style="list-style-type: none"> <li>?? Use appropriate eye, face and hearing protection</li> <li>?? Check whether reports for potential windy conditions/secure loose decking</li> <li>?? Rope off areas below operations</li> <li>?? Use fall restraint systems, retractable lifelines, engineered anchor points and lifeline systems</li> <li>?? Cut holes for penetrations only when necessary</li> <li>?? Train workers to use controlled access zone</li> <li>?? Clear slippery conditions before work begins</li> <li>?? Assure scaffolding guardrails or other personal fall arrest systems are in use</li> <li>?? Inspect manlifts daily for proper function of controls</li> <li>?? Prepare ground prior to working with manlifts</li> <li>?? Use GFCI for electrical tools</li> </ul>	<p><b>Construction Safety Council</b></p> <ul style="list-style-type: none"> <li>?? Fall Protection Program</li> </ul> <p><b>St. Paul</b></p> <ul style="list-style-type: none"> <li>?? Tie or Die Program</li> <li>?? Ladders and Stairs</li> </ul> <p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Cranes</li> <li>?? Scaffolds</li> </ul>

## Metal Structural Systems

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Curtain Wall and Siding</b>	?? Suspended scaffolds ?? Welded Frame scaffolds ?? Manlifts ?? Damaged rigging ?? Power tools -flying particles, noise ?? Jobmade attachments for rigging ?? Falling materials ?? High winds ?? Exterior falls to other trades due to workers removing guardrails to install curtain wall/siding and leaving gaps in walls ?? Cranes	?? Train workers on installing and use of suspended scaffold ?? Use personal fall arrest systems for suspended scaffolds including independent lifelines and full body harnesses ?? Inspect rigging ?? Use appropriate PPE for cutting materials ?? Reinstall exterior guardrails in open areas each day ?? Rope off areas below operations ?? Inspect manlifts daily	<b>AGC Video</b> ?? Suspended Scaffolds  <b>St. Paul</b> ?? Tie or Die Program

## Metal Structural Systems

This unit presents building design and erection using metal structural systems. Erecting steel frame buildings exposes workers to risks associated with falls, cranes and rigging loads.

**Introduction** - The instructor will review the avoidance practices learned in the last unit about working with concrete structural systems. Strong emphasis should be on risks associated with crane safety, rigging loads, working above ground, welding and cutting.

**Risk Control Focus 1: Avoid falls from work environments at elevations and leading edges. Practice ladder safety when climbing to reach work areas above ground.**

### Resources

- ?? Review Fall Protection from Unit 2, Foundations
- ?? *Success at the Top: Stairway and Ladder Safety*. AGC, Tape
- ?? *Tool Box Talks: Ladder Safety*. AGC, Tape 187
- ?? *Stairways and Ladders*. St. Paul, Technical Guide
- ?? *How to Wear and Use a Full Body Harness*. St. Paul, Technical Guide
- ?? *100% Fall Protection*. St. Paul, Technical Guide
- ?? *Tie or Die Program*. St Paul

### OSHA References

- ?? 1926 Subpart M - Fall Protection. Fall protection, Roof Perimeters.
- ?? 1926 Subpart X - Stairways and Ladders.

**Risk Control Focus 2: Working with cranes and rigging loads exposes workers to multiple sources of risk through crane failure, electrocution, and improper rigging and loading.**

### Resources

- ?? *Play it Safe: An Overview of Crane Safety*. AGC, Tape 142
- ?? *Controlling the Load: Crane Rigging Safety*. AGC, Tape 146
- ?? *Tool Box Talks - Working Safely with Crane Rigging*. AGC, Tape 180.9
- ?? *Crane Safety Rules*. St. Paul Technical Guide
- ?? *Power Lines and Cranes*. St. Paul Technical Guide

### OSHA References

- ?? 1926 Subpart N - Cranes Derricks, Hoists, Elevators and Conveyors
- ?? 1926 Subpart v - Power Transmission and Distribution

**Risk Control Focus 3: Control the hazards associated with welding cutting and bolting metal structural systems.**

### Resources

- ?? *Tool Box Talks - Eye and Face Protection*. AGC, Tape 180.2
- ?? *Hot Work: Welding and Cutting Safety*. AGC, Tape 175

- ?? *Tool Box Talks - Compressed Gas Safety*. AGC, Tape 180.3
- ?? *Oxygen and Acetylene*. St. Paul, Technical Guide
- ?? *Oxygen and Acetylene Cylinders*. St. Paul, Technical Guide

**OSHA References**

- ?? 1926 Subpart R - Steel Erection

# Heavy and Highway Construction

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Site Preparation</b>	<ul style="list-style-type: none"> <li>?? Underground utilities</li> <li>?? Public traffic when working on existing roads or adding lanes</li> <li>?? Water contamination or stream runoff</li> <li>?? Heavy equipment turnover when working on hills and gullies</li> <li>?? Heat exhaustion</li> <li>?? Medical facilities located far from site</li> <li>?? Poisonous plants, insects, reptiles</li> <li>?? Excavations</li> <li>?? Confined spaces when installing utilities</li> <li>?? Overhead power lines</li> <li>?? Falling debris onto cars, trains, boats during demolition work</li> <li>?? Falls off of overpasses or bridges</li> <li>?? Using barges for crane platforms</li> <li>?? Cofferdams</li> <li>?? Drowning of workers</li> <li>?? Cranes on unstable surfaces</li> <li>?? Unknown forces in bridge beams</li> <li>?? Damaged rigging</li> <li>?? Silica exposure when cutting concrete</li> <li>?? Lead exposure when cutting steel structures</li> <li>?? Mechanics getting crushed by falling dump bodies and equipment parts</li> </ul>	<ul style="list-style-type: none"> <li>?? Use one-call system for locating utilities</li> <li>?? Initiate lane closures and speed zone reductions with state and city officials before work begins</li> <li>?? Contact supplier of work zone protective barriers to install barricades sufficient for jobsite conditions</li> <li>?? Use certified and trained flaggers</li> <li>?? Train workers on first aid and CPR</li> <li>?? Have a competent person trained in soil analysis and protective systems on jobsite during excavation work</li> <li>?? Train workers in confined space hazards and assure that controls such as air monitoring equipment is on-site and maintained</li> <li>?? Have power company remove and protect overhead lines</li> <li>?? Make sure an engineer has designed all lifting from barges and operators are trained in working from barges</li> <li>?? Use lifejackets on all</li> <li>?? All cofferdams engineered for river and lake currents</li> <li>?? Use crane mats or compacted aggregate to stabilize crane work areas</li> <li>?? Check engineering survey of bridge beams for loads and forces</li> <li>?? Lead protection program in place and workers trained in protective methods</li> <li>?? Mechanics use LOTO methods</li> </ul>	<p><b>Construction Safety Council</b></p> <ul style="list-style-type: none"> <li>?? Work Zone Protection for Engineers</li> <li>?? Lead in Construction</li> <li>?? Silica-It's Not Just Dust</li> </ul> <p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Street and Road Work</li> <li>?? Heavy Equipment</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Excavations</li> <li>?? Heavy Equipment</li> </ul>

## Heavy and Highway Construction

Construction Phase	Identified Risks	Risk Control	Resources
<b>Blacktop and Bituminous Application</b>	?? Heat stress from hot tar ?? Burns ?? Public traffic ?? Sunburn when workers allowed to go shirtless	?? Train workers to recognize signs of heat stress ?? Allow for adequate water breaks during periods of high heat ?? Watch new workers not acclimated to conditions ?? Require all workers wear T-shirts preferable light colored	<b>AGC Video</b> ?? Street and Road Work
<b>Concrete Pavement</b>	?? Close work zone to public traffic ?? Ergonomic stresses when finishing and pushing concrete ?? Construction equipment backing into workers ?? Rollover of equipment	?? Use proper work zone protection including cones, barricades, arrow boards, flaggers and speed reduction signs ?? Inspect back-up alarms on equipment ?? Train operators about hazards of working near soft edges	<b>AGC Video</b> ?? Street and Road Work  <b>St. Paul Technical Guides</b> ?? Paving Operations

## Heavy and Highway Construction

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Concrete Structures</b>	?? Workers falling off form work, piers, columns, abutments, retaining walls ?? Lifting concrete loads over workers ?? Ergonomic hazards (back injuries) from workers handling rebar and form work ?? Cranes lifting load ?? Cranes working on unstable surfaces ?? Damaged rigging ?? Unsafe attachment of rigging to loads ?? Scaffolds ?? Ladders	?? Use personal fall arrest devices including static lines, harnesses, retractable lifelines ?? May use a controlled access zone but only as last resort for fall prevention ?? Use guardrails on pier tops and open edges, assure inspect of all guardrails to maintain integrity ?? Train workers to lift loads properly ?? Cordon off areas when flying loads to keep workers out ?? Inspect rigging ?? Train workers on proper methods of rigging ?? Train workers in proper erection of scaffolds and ladders ?? Assure fall protection is used on scaffolds	<b>St. Paul</b> ?? Tie and Die Program ?? Cranes  <b>Construction Safety Council</b> ?? Fall Protection Manual

## Heavy and Highway Construction

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Bridges</b>	<ul style="list-style-type: none"> <li>?? Falls from heights over side and interior</li> <li>?? Cranes</li> <li>?? Rigging</li> <li>?? Public traffic</li> <li>?? Scaffolds</li> <li>?? Manlifts</li> <li>?? Ladders</li> <li>?? Excavations for pier</li> <li>?? Exposure to lead and silica during demolition operations</li> </ul>	<ul style="list-style-type: none"> <li>?? Use personal fall arrest equipment</li> <li>?? Use safety nets - contract with supplier to install and test nets</li> <li>?? Use guardrails on all exterior edges</li> <li>?? Establish controlled access zone near leading edge and train workers in its use and limitation</li> <li>?? Assure competent person is on-site and familiar with fall protection used</li> <li>?? Inspect all manlifts</li> <li>?? Pre-plan for adequate surfaces on which manlifts will operate on level compacted ground</li> <li>?? Assure lead and silica programs are in place and workers trained in hazards and controls</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Cranes</li> <li>?? Scaffolds</li> <li>?? Fall Protection</li> </ul> <p><b>St. Paul</b></p> <ul style="list-style-type: none"> <li>?? Tie and Die Program</li> <li>?? Cranes</li> <li>?? Concrete Bridge Work</li> </ul>

## Heavy and Highway Construction

This unit presents information about heavy and highway construction. As in other building processes, site work operations involve public safety, heavy equipment operations and excavation hazards. This unit also deals with pouring concrete or applying asphalt materials onto roadway surfaces and bridge building operations. Hazard identification and planning controls for concrete bridge structures, concrete pavements and blacktop applications will eliminate high-risk operations.

**Introduction** - When heavy and highway contractors mobilize to begin road and street work, a major concern usually involves exposure to existing traffic and public liability in highway construction zones. Additionally, movement of heavy equipment and using cranes in restricted workspace needs to be controlled. Pay particular attention to the trenching aspects part of the work. Review the risk control measures employed when working with concrete; when working in traffic zones; and working at elevations. Falls from bridgework and struck-bys in traffic zones happen too frequently when working in these environments. Identifying risk control measures for paving surface operations will help protect workers, contractors and the public.

### **Risk Control Focus 1: Control traffic through and around work areas.**

#### **Resources**

- ?? *Work Zone Ahead: Highway Work Zone Safety*. AGC, Tape 193
- ?? *Tool Box Talks - Traffic Control*. AGC, Tape 180.16
- ?? *Traffic Control for Work Zones*. St Paul, Technical Guide
- ?? *Public Liability on Construction Sites*. St. Paul, Technical Guide
- ?? *Tool Box Talks: Warning Signs*. AGC, Tape 180.18

#### **OSHA Reference**

- ?? 1926 Subpart C - General Safety and Health Provisions
- ?? 1926 Subpart G - Signs, Signals and Barricades

### **Risk Control Focus 2: Contact utility companies for locating underground utilities and protection of overhead utilities.**

#### **Resources**

- ?? *Power Line Hazard Awareness*. Construction Safety Council, Video Elect 6
- ?? *Power Line Hazard Awareness Manual*. Construction Safety Council, Elect 2
- ?? *Underground Utilities*. St. Paul, Technical Guide

#### **OSHA References**

- ?? 1926 Subpart V - Power /Transmission and Distribution

### **Risk Control Focus 3: Beware of risks when working around heavy equipment.**

#### **Resources**

- ?? *Tool Box Talks: Working Around Heavy Equipment*. AGC, Tape 180.12
- ?? *Hydraulic Excavator Safety*. St. Paul, Technical Guide
- ?? *Loader/Backhoe*. St. Paul, Technical Guide
- ?? *Construction Equipment -Heavy Earthmoving*. St. Paul, Group Meeting
- ?? *On Solid Ground: A Plan for Excavation and Trenching Safety*. AGC, Tape 136
- ?? *Excavation Safety: Student Manual*. Construction Safety Council
- ?? *Excavation Safety Checklist*. St. Paul, Technical Guide
- ?? *Excavation Safety: Soil Analysis*. St. Paul, Technical Guide
- ?? *Excavation and Safety*. St. Paul, Technical Guide
- ?? *Grading of Land*. St. Paul, Technical Guide
- ?? *Excavations*. St. Paul, Group Meeting

### **OSHA References**

- ?? 1926 Subpart O - Motor Vehicles, Mechanized Equipment, and Marine Operations
- ?? 1926 Subpart P - Excavations

**Risk Control Focus 4: Pay special attention to trenching operations. Be sure trench boxes and other cave-in controls are in place.**

### **Resources**

- ?? *Excavation Series*. Construction Safety Council, Soil 1, 2, 3
- ?? *Excavation and Trenching*. St. Paul, Technical Guide
- ?? *On Solid Ground: A Plan for Safe Excavation and Trenching*. AGC, Tape 136
- ?? *In the Trenches: Excavation Safety for Workers*. AGC, Tape, 440

### **OSHA References**

- ?? 1926 Subpart P - Excavations

**Risk Control Focus 5: Review hazards associated when working with concrete. Use the resources and references found in Unit 3 of this guide.**

### **Resources**

- ?? *Concrete Paving*. St. Paul, Technical Guide
- ?? *Concrete Pumping Operations*. St. Paul, Technical Guide
- ?? *Pave Your Way to Safety: Concrete Paving Safety*. AGC, Tape 153

**Risk Control Focus 6: Identify hazards associated with bridgework. Apply fall arrest systems to the bridge work operations. Review crane safety.**

### **Resources**

- ?? *A Safe Span: Bridge Construction Safety*. AGC, Tape 174

### **OSHA References**

?? 1926 Subpart M - Fall Protection

**Risk Control Focus 7: Identify and eliminate the hazards associated with blacktop operations.**

**Resources**

?? *Asphalt Hot Plant Safety*. St. Paul Technical Guide

?? *Avoid Hot Mix Hazards: Working Safely with Hot Mix*. AGC, Tape 152

# Underground Construction

Construction Phase	Identified Risks	Risk Controls	Resources
<p><b>Underground Construction</b></p>	<ul style="list-style-type: none"> <li>?? Emergencies including fire, wall collapse, methane exposure, ventilation malfunction</li> <li>?? Falls off jumbos</li> <li>?? Heavy manual lifting of drilling equipment</li> <li>?? Use of explosives</li> <li>?? Poorly lighted area</li> <li>?? Falls into ventilation or secondary shafts by workers and public</li> <li>?? Formwork collapse</li> <li>?? Falling rock</li> <li>?? Electrocutions</li> </ul>	<ul style="list-style-type: none"> <li>?? Reference OSHA 1926.800 for requirements of rescue teams or off-site rescue</li> <li>?? Must have Certified Safety Professional to implement programs</li> <li>?? Ventilation system requirements must be maintained at 200cfm per worker</li> <li>?? Maintain guardrails on jumbos</li> <li>?? Utilitize qualified person (geologist) to determine fissures in rock to be rock bolted</li> <li>?? Train workers to handle drills</li> <li>?? Use PPE suited for eye, face and foot protection</li> <li>?? Maintain adequate barricades around all shafts</li> <li>?? Alert local law enforcement of location of shafts</li> <li>?? Use explosion proof lighting and electrical connection consistent with National Electric Code and OSHA</li> <li>?? Air monitoring equipment located at tunnel face</li> </ul>	<p><b>National Utility Contractors Association Video</b></p> <ul style="list-style-type: none"> <li>?? Tunneling</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Confined Spaces</li> </ul> <p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Confined Spaces</li> </ul>

## Underground Construction

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Tunneling and Soft Boring</b>	?? Underground and overhead utilities ?? Public Traffic ?? Ergonomic stresses due to lifting heavy equipment and working in tight areas ?? Silica exposure ?? Air contamination in tunnel lining ?? Difficult rescue of downed worker due to tight area ?? Excavation collapse in boring pit ?? Boring equipment becoming disengaged and crushing workers ?? Cranes lifting muck carts over workers ?? Cold or hot climate resulting in hypothermia or heat stress	?? Contact utility to move, de-energize or protect line ?? Maintain proper workzone protection for public vehicles ?? Use flaggers when moving equipment ?? Use air monitoring equipment by workers entering linings to remove rock or other obstructions ?? Use ankle cuff on workers entering lining to aid in emergency removal ?? Train workers to stay clear of boring equipment	<b>National Utility Contractors Association Video</b> ?? Auger boring <b>St. Paul Technical Guides</b> ?? Tunneling Program

## Underground Construction

The last unit in this section covers underground construction. This construction industry specialization requires thorough planning to control a high-risk environment.

**Introduction** - Tunneling and underground work is a highly specialized aspect of the construction industry. A significant hazard in these operations is working in confined spaces. Emphasize the importance of rescue operations from confined spaces. Many would-be rescuers become victims.

### **Risk Control Focus 1: Plan for confined space work.**

#### **Resources**

- ?? *Clearing the Air: Confined Space Entry*. AGC, Tape 133
- ?? *Rescue Planning*. St. Paul, Technical Guide
- ?? *Confined Space Entry*. St. Paul, Technical Guide
- ?? *Confined Space Entry and Rescue*. St. Paul, Technical Guide

### **Risk Control Focus 2: Identify and plan to avoid hazards associated with tunneling.**

#### **Resources**

- ?? *Tunneling: Electrical Hazards*. St Paul, Technical Guide
- ?? *Tunneling: General Safety Precautions*. St Paul, Technical Guide
- ?? *Tunneling: Pre-job*. St. Paul, Technical Guide
- ?? *Tunneling: Terminology*. St Paul, Technical Guide

Concrete and  
Masonry  
Technology

# Risk Control Curriculum

## **INTEGRATION GUIDE**

This Guide has been developed by

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# CONCRETE AND MASONRY TECHNOLOGY

**Description** - This guide is designed to present the fundamentals and principles of concrete and masonry construction while working below, at, and above grade. This guide contains basic information about masonry terminology, tools, materials and design. It is intended to provide the opportunity to examine concrete and masonry materials as they are used in the construction process.

**Risk Control Integration Focus** - This guide is divided into five units of instruction that represent various aspects of concrete and masonry technology. Some of the units deal with concrete and masonry materials, others study concrete and masonry construction practices. Students will learn to analyze work practices and procedures to identify associated risks. Focus in these units will be on identifying hazards and planning avoidance strategies to control all aspects of the risks encountered in concrete and masonry construction.

**Course Outline** - There are five units of instruction presented in this course. The units are:

Unit 1	Basic Concrete Ingredients
Unit 2	Work Below Grade
Unit 3	Work At Grade
Unit 4	Work above Grade
Unit 5	Masonry

The following pages present an overview of the work associated with the identified phase of construction, risks commonly associated with the type of work, suggested risk controls and resources to help integrate risk control competencies into construction practices.

In the lab portions of classes, students are required to follow all safety regulations, policies, and procedures. Wearing of personal protective gear while in work areas is mandatory. Specific risk control practices associated with various aspects of work are identified before the lab activities begin. Students disregarding safety policies and procedures are removed from the work environment.

## Basic Concrete Ingredients

This unit is designed to introduce basic information about the design and control of cement and concrete materials. Construction personnel should have an understanding of the basic properties and characteristics of the aggregates, cement and water. American Society of Testing Materials (ASTM) and American Concrete Institute (ACI) tests are performed to assure the quality of the ingredients used in the concrete mixes. Planning work activities, practicing material handling techniques and using personal protective equipment will help workers avoid unnecessary risk exposures while working with cement and concrete products.

**Introduction** - Understanding the characteristics and properties of the basic ingredients of fresh and hardened concrete are foundational to designing and using concrete mixes. Each of the

ingredients need to be tested to meet ASTM and ACI standards so that designed mixes meet engineered specifications. Working with these materials exposes workers to risks associated with hazardous materials, material handling, and situations requiring personal protective equipment. Current concrete technology uses various chemical admixtures to enhance the performance of concrete products. Care should be taken when working with admixtures.

**Risk Control Focus 1: Understand the materials used for making concrete. Prolonged exposure to cements and other raw concrete materials can be hazardous. Develop material safety data sheets and files for the material being used. Be sure containers, bins or other holding devices are labeled and marked according to OSHA standards.**

#### **Resources**

- ?? *Hazard Communication: The System That Works*. AGC, Tape 112
- ?? *Hazard Communication for Construction Reference Manual*. Construction Safety Council
- ?? *Construction Safety and Health Pamphlets*. Construction Safety Council

#### **OSHA Reference**

- ?? 1926 Subpart D - Occupational Health and Environmental Controls
- ?? 1926 Subpart F - Fire Protection and Prevention
- ?? 1926 Subpart H - Materials Handling, Storage, Use and Disposal

**Risk Control Focus 2: Use personal protective equipment when handling, mixing, testing and working with concrete, concrete ingredients and concrete mixing equipment.**

#### **Resources**

- ?? *Breathing Easier: The Basics of Respiratory Protection*. AGC, Tape 172
- ?? *Breathing Easier: Selecting, Fitting and Maintaining Respirators*. AGC, Tape 173
- ?? *Tool Box Talks-Eye and Face Protection*. AGC, Tape 180.2
- ?? *Eye and Face Protection*. St. Paul, Group Meeting Report
- ?? *Tool Box Talks-Hearing Protection*. AGC, Tape 180.6
- ?? *Sound Advice: Hearing Conservation on the Job*. AGC, Tape 178
- ?? *The Best Strategy: Personal Protective Equipment*. AGC, Tape 181
- ?? *Personal Protective Equipment*. St Paul, Technical Guide
- ?? *Mixing Concrete*. St Paul, Technical Guide

#### **OSHA Reference**

- ?? 1926 Subpart E - Personal Protective and Lifesaving Equipment

**Risk Control Focus 3: Avoid injuries associated with handling heavy materials.**

#### **Resources**

- ?? *Back to Basics: Back Injury Prevention*. AGC Tape 149
- ?? *Make the Right Move: Material Handling Safety*. AGC, Tape 150

?? *Heavy Lifting*. St. Paul, Group Meeting Report

### **OSHA References**

?? 1926 Subpart H - Materials Handling, Storage, Use and Disposal

**Risk Control Focus 4: Handle chemical admixtures with care. Review MSDS information regarding every chemical used. Compile a file containing MSDS information for others to review.**

### **Resources**

Gather hazardous communication information from admixture manufactures.  
Create MSDS information file of the chemicals that workers are exposed to in this unit.

### **OSHA Reference**

?? 1926 Subpart D - Occupational Health and Environmental Controls

?? 1926 Subpart F - Fire Protection and Prevention

?? 1926 Subpart H - Materials Handling, Storage, Use and Disposal

## Work Below Grade

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Forming Operations Below Grade</b>	<ul style="list-style-type: none"> <li>?? Public liability exposure</li> <li>?? Underground and overhead utility hazards</li> <li>?? Heavy equipment and truck operation</li> <li>?? Cave-in exposure</li> <li>?? Ergonomic considerations when handling material</li> <li>?? Power tool issues</li> <li>?? Access and egress from excavation</li> <li>?? Fall exposure</li> <li>?? Compactor use</li> <li>?? Possible hazardous atmospheres</li> </ul>	<ul style="list-style-type: none"> <li>?? Notify police and schools if applicable</li> <li>?? Utilize barricades and/or surveyor's tape around excavation</li> <li>?? Contact utility companies in advance to locate protect or remove power lines</li> <li>?? Plan movement to minimize backing, verify backup alarms are working, utilize spotter</li> <li>?? Classify soil type from soil boring reports or use OSHA, Subpart P Appendix A</li> <li>?? Select appropriate cave-in protection system</li> <li>?? Specify in bid documents the required slope such as 1:1 etc.</li> <li>?? Provide adequate manpower and mechanical assistance</li> <li>?? Organize lay down area and designate cutting areas</li> <li>?? Slope excavation at least 1:1 or provide ladders</li> <li>?? Use proper PPE</li> <li>?? Use only trained operators</li> <li>?? Use equipment that is in good condition</li> <li>?? Monitor site atmosphere with test meter</li> </ul>	<p><b>AGC Tapes</b></p> <ul style="list-style-type: none"> <li>?? Heavy Equipment</li> <li>?? Material Handling</li> <li>?? Excavations</li> <li>?? Personal Protective Equipment</li> <li>?? Traffic Control</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Hand Tool Safety</li> <li>?? Material Handling</li> </ul>

# Work Below Grade

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Concrete Placement Below Grade</b>	<ul style="list-style-type: none"> <li>?? Cave-in exposure</li> <li>?? Concrete trucks entering excavation</li> <li>?? Ergonomic considerations</li> <li>?? Using various finishing tools</li> <li>?? Concrete placement, pumps or chute use</li> <li>?? Hygiene issues with concrete burns</li> <li>?? Public liability issues after pour</li> </ul>	<ul style="list-style-type: none"> <li>?? Evaluate cave-in protection system according to OSHA, Subpart P, Appendix A</li> <li>?? Utilize spotter, stop logs</li> <li>?? The risk of repetitive motion type injuries can be minimized by employee rotation</li> <li>?? Only experienced workers should steer chutes</li> <li>?? Pumps operated by qualified operator</li> <li>?? Pipe fittings need to be inspected by a qualified person</li> <li>?? Only experienced workers should place concrete</li> <li>?? Employees handling pump hose end should wear face shield and gloves</li> <li>?? Area should be barricaded or use surveyor's tape to mark excavation edges (place back at least 6 feet from edge)</li> </ul>	<p><b>AGC Tapes</b></p> <ul style="list-style-type: none"> <li>?? Cranes Safety</li> <li>?? Traffic Control</li> <li>?? Tool Box Talks - PPE</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Concrete Mixing and Placement</li> <li>?? Concrete Pumps</li> <li>?? Mixing Concrete</li> </ul> <p><b>Construction Safety Council</b></p> <ul style="list-style-type: none"> <li>?? Concrete and Masonry</li> </ul>

## Work Below Grade

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Stripping Forms Below Grade</b>	?? Cave-in exposure ?? Ergonomic considerations when material handling ?? Impairment exposure on anchor bolts ?? Accessing excavation fall exposure	?? Evaluate cave-in protection system according to OSHA subpart P, appendix A ?? Provide adequate workforce ?? Utilize mechanical assistance ?? Wear proper PPE ?? Cover with rebar cap rated for penetration prevention ?? Cover with lumber by making a California corner using a 2x6 and a 2x4 ?? Provide a slope at least 1:1, or a ladder for access and egress	<b>AGC Tapes</b> ?? Material Handling

## Work Below Grade

This unit examines the practices of forming, placing concrete, and stripping forms while working below grade. The emphasis in transporting, pouring, placing and finishing is on protecting the integrity of the concrete's design mix while it is handled in each of these operations. Concrete workers are exposed to many hazards while performing these operations. Not only are the operations themselves hazardous, but equipment and materials place additional risk considerations into work planning and execution.

**Introduction** - Workers engaged in concreting practices are required to understand and plan for the execution of the work. Considerations include planning for the efficient placing of the concrete; maintaining the integrity of the fresh concrete while it is poured, consolidated, struck and floated into place; and ensuring concrete workers do not overwork the concrete while it is being finished. Construction managers must also plan to protect the temperature and moisture content of the hardened concrete through its 28-day curing period. Weather conditions can significantly affect the concrete. Protection against adverse climatic conditions is to be considered in all phases of the concreting operations. Careful planning of the concreting operations also includes techniques and mechanism that remove hazards and risks encountered during the execution of the work in below grade applications.

**Risk Control Focus 1: Working in excavations requires workers to recognize cave-in hazards, know where access and egress points are, as well as use care when placing and setting concrete forms in an excavation.**

### Resources

- ?? *Tool Box Talks: Working Around Heavy Equipment*. AGC, Tape 180.12
- ?? *Hydraulic Excavator Safety*. St. Paul, Technical Guide
- ?? *Loader/Backhoe*. St. Paul, Technical Guide
- ?? *Construction Equipment - Heavy Earthmoving*. St. Paul, Group Meeting
- ?? *On Solid Ground: A Plan for Excavation and Trenching Safety*. AGC, Tape 136
- ?? *Excavation Safety: Student Manual*. Construction Safety Council
- ?? *Excavation Safety Checklist*. St. Paul, Technical Guide
- ?? *Excavation Safety: Soil Analysis*. St. Paul, Technical Guide
- ?? *Excavation and Safety*. St. Paul, Technical Guide
- ?? *Grading of Land*. St. Paul, Technical Guide
- ?? *Excavations*. St. Paul, Group Meeting

### OSHA References

- ?? 1926 Subpart O - Motor Vehicles, Mechanized Equipment, and Marine Operations
- ?? 1926 Subpart P - Excavations

**Risk Control Focus 2: Selecting the right equipment for pouring concrete into place requires that construction managers carefully review site conditions, location of pour, and**

**access/egress of the ready mix trucks. Construction managers must also select equipment that can most effectively move the concrete from the trucks to its structural location. At each of these stages, managers must identify and plan avoidance techniques to remove worker risk exposure.**

#### **Resources**

- ?? *Play it Safe: An Overview of Crane Safety.* AGC, Tape 142
- ?? *Controlling the Field: Jobsite Safety Inspection.* AGC, Tape 131
- ?? *Tool Box Talks: Traffic Control.* AGC, Tape 180.1
- ?? *Concrete Mixing and Placement.* St. Paul, Technical Guide
- ?? *Concrete Pumping Operations.* St. Paul, Technical Guide
- ?? *Mixing Concrete.* St. Paul, Technical Guide
- ?? *Concrete and Masonry.* Construction Safety Council, Safety and Health Pamphlet
- ?? *Tool Box Talks: Working Safely on Scaffolds.* AGC, Tape 180.8
- ?? *Putting It All Together : Scaffold Safety.* AGC, Tape 439
- ?? *Tubular Welded Frame Scaffold Safety Rules.* St. Paul, Technical Guide
- ?? *Scaffolds.* St. Paul, Group Meeting Report

#### **OSHA References**

- ?? 1926 Subpart L - Scaffolding
- ?? 1926 Subpart Q - Concrete and Masonry Construction

**Risk Control Focus 3: Select the right equipment to accomplish the concrete placement process. Plan the placement process to avoid exposing workers to hazards associated with cranes and buckets, pump trucks, power buggies or other placement techniques.**

#### **Resources**

- ?? *Take Charge: An Overview of Crane Safety.* AGC, Tape 142
- ?? *Tool Box Talks - Eye and Face Protection.* AGC, Tape 180.2
- ?? *Concrete Mixing and Placement.* St. Paul, Technical Guide
- ?? *Concrete Pumping Operations.* St. Paul, Technical Guide

#### **OSHA References**

- ?? 1926 Subpart N - Cranes, Derricks, Hoists, Elevators and Conveyers

**Risk Control Focus 4: Placing, consolidating, striking and floating concrete requires workers to use PPE, avoid electrical hazards associated with certain types of equipment and use fall protection systems when working above grade.**

#### **References**

- ?? *Concrete and Masonry.* Construction Safety Council, Safety and Health Pamphlet
- ?? *Take Charge: Working Safely with Temporary Electricity.* AGC, Tape
- ?? *Tool Box Talks: Working around High Voltage.* AGC, Tape 180.19

- ?? *Tool Box Talks - Eye and Face Protection*. AGC, Tape 180.2
- ?? *Concrete Mixing and Placement*. St. Paul, Technical Guide
- ?? *Concrete Pumping Operations*. St. Paul, Technical Guide
- ?? Any of the AGC Tapes on Fall Protection
- ?? Any of the St. Paul Tech Guides on Fall Protection
- ?? Any of the Construction Safety Council information on Fall Protection

#### **OSHA Reference**

- ?? 1926 Subpart Q - Concrete and Masonry Construction
- ?? 1926 Subpart M - Fall Protection

### **Risk Control Focus 5: Avoid falls from walls and wall forms during the assembly, pouring and stripping of continuous walls.**

#### **Resources**

- ?? *Fall Protection for Employees*. Construction Safety Council Video.
- ?? *Concrete Walls and Decks*. St Paul, Technical Guide
- ?? *Fall Protection*. St. Paul, Technical Guide
- ?? *100 % Fall Protection*. St. Paul, Technical Guide
- ?? *Let's Eliminate Falls on the Jobsite*. St. Paul, Group Meeting
- ?? *Safety Belts and Harnesses for Fall Protection*. St. Paul, Group Meeting

#### **OSHA Reference**

- ?? 1926 Subpart M - Fall Protection

### **Risk Control Focus 6: Working with cranes and rigging loads exposes workers to multiple sources of risk through crane failure, electrocution, and improper rigging and loading.**

#### **Resources**

- ?? *Play it Safe: An Overview of Crane Safety*. AGC, Tape 142
- ?? *Controlling the Load: Crane Rigging Safety*. AGC, Tape 146
- ?? *Tool Box Talks - Working Safely with Crane Rigging*. AGC, Tape 180.9
- ?? *Crane Safety Rules*. St. Paul Technical Guide
- ?? *Power Lines and Cranes*. St. Paul Technical Guide

#### **OSHA References**

- ?? 1926 Subpart N - Cranes Derricks, Hoists, Elevators and Conveyors
- ?? 1926 Subpart v - Power Transmission and Distribution

### **Risk Control Focus 7: Working in adverse weather conditions requires that workers and materials be protected.**

#### **Resources**

- ?? *Cold Weather Dangers*. St. Paul, Technical Guide
- ?? *Cold Weather Tips*. St. Paul, Technical Guide

- ?? *Protection from Wind Hazards in Construction*. St. Paul, Technical Guide.
- ?? *Working in Hot Environments*. St. Paul, Technical Guide

**OSHA References**

- ?? 1926 Subpart Q - Concrete and Masonry Construction

## Work at Grade

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Forming Operations at Grade</b>	?? Underground and overhead utilities ?? Heavy equipment, truck operation and backing up ?? Ergonomic considerations when material handling ?? Compactor use ?? Reinforcing steel placement ?? Cranes	?? Contact one call system or utility company to locate, protect or move utilities ?? Utilize spotter, verify backup alarms are working ?? Select proper PPE (hearing protection, steel toed boots, etc.) ?? Make sure equipment is in good condition and has a qualified operator ?? Adequate lay down area ?? Use proper PPE ?? Adequate workforce ?? Place caps or covers over rebar as soon as it is placed	<b>AGC Tapes</b> ?? Heavy Equipment ?? Material Handling  <b>St Paul Technical Guides</b> ?? Personal Protective Equipment ?? Lifting Techniques

# Work at Grade

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Concrete Placement at Grade</b>	<ul style="list-style-type: none"> <li>?? Sub-base placement</li> <li>?? Silica exposure</li> <li>?? Chute, pump or conveyor issues</li> <li>?? Cranes and buckets</li> <li>?? Concrete pumps</li> <li>?? Ergonomic issues when material handling</li> <li>?? Ergonomic issues when hand finishing and hand striking</li> <li>?? Power screeds, power finishing machines (walk behind and riding type)</li> <li>?? Long aluminum handles (bull floats, brooms, jointing tools) around electric lines</li> <li>?? Impairment hazards - anchor bolts, dowels etc.</li> <li>?? Hygiene issues - concrete burns</li> </ul>	<ul style="list-style-type: none"> <li>?? Provide clear access zone</li> <li>?? Utilize appropriate respiratory protection</li> <li>?? Only experienced worker should steer chute or pump hose end</li> <li>?? Only a qualified operator should control conveyor system</li> <li>?? Workers steering pump end should wear a face shield</li> <li>?? Adequate workforce for shoveling</li> <li>?? Trained operator to minimize shoveling, rotate crew, good coordination on placement to minimize striking</li> <li>?? Use nonconductive handles around electrical equipment</li> <li>?? Use qualified operators</li> <li>?? Keep machinery in good condition</li> <li>?? Use torque converters to minimize carbon monoxide generation; if in- doors provide ventilation</li> <li>?? Cover anchor bolts or dowels over 4 feet in elevation with plastic cap, under 4 foot elevation cover with material that will be impenetrable (wood, California corner or metal reinforced caps)</li> <li>?? PPE including glasses, boots wash water</li> </ul>	<p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Concrete Mixing and Placement</li> <li>?? Concrete Operations</li> <li>?? Concrete Walls and Decks</li> <li>?? Crane Safety</li> </ul> <p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Personal Protective Equipment</li> <li>?? Material Handling</li> <li>?? Heavy Equipment</li> <li>?? Cranes</li> </ul> <p><b>Construction Safety Council</b></p> <ul style="list-style-type: none"> <li>?? Concrete and Masonry</li> </ul>

## Work at Grade

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Form Stripping</b>	?? Ergonomic consideration when material handling ?? Impairment hazard on anchor bolts or dowels ?? Silica issue when sawing joints	?? Provide adequate work force ?? Use proper PPE ?? Cover rebar with plastic caps if over 4 feet in elevation ?? Under 4 feet cover with wood, California corner or steel reinforced plastic caps ?? Wet saw ?? Use dust respirator	<b>AGC Video</b> ?? Material Handling  <b>St Paul Technical Guides</b> ?? Lifting Techniques

## Work at Grade

This unit examines the practices of forming, placing concrete, and stripping forms while working at grade. The emphasis on transporting, pouring, placing and finishing is on protecting the integrity of the concrete's design mix while it is handled in each of these operations. Concrete workers are exposed to many hazards while performing these operations. Not only are the operations themselves hazardous, but equipment and materials place additional risk considerations into work planning and execution.

**Introduction** - Workers engaged in concreting practices are required to understand and plan for the execution of the work. Considerations include planning for the efficient placing of the concrete; maintaining the integrity of the fresh concrete while it is poured, consolidated, struck and floated into place; and ensuring concrete workers do not overwork the concrete while it is being finished. Construction managers must also plan to protect the temperature and moisture content of the hardened concrete through its 28-day curing period. Weather conditions can significantly affect the concrete. Protection against adverse climatic conditions is to be considered in all phases of the concreting operations. Careful planning of the concreting operations also includes techniques and mechanism that remove hazards and risks encountered during the execution of the work.

**Risk Control Focus 1: Selecting the right equipment for pouring concrete into place requires that construction managers carefully review site conditions, location of pour, and access/egress of the ready mix trucks. Construction managers must also select equipment that can most effectively move the concrete from the trucks to its structural location. At each of these stages, managers must identify and plan avoidance techniques to remove worker risk exposure.**

### Resources

- ?? *Play it Safe: An Overview of Crane Safety*. AGC, Tape 142
- ?? *Controlling the Field: Jobsite Safety Inspection*. AGC, Tape 131
- ?? *Tool Box Talks: Traffic Control*. AGC, Tape 180.1
- ?? *Concrete Mixing and Placement*. St. Paul, Technical Guide
- ?? *Concrete Pumping Operations*. St. Paul, Technical Guide
- ?? *Mixing Concrete*. St. Paul, Technical Guide
- ?? *Concrete and Masonry*. Construction Safety Council, Safety and Health Pamphlet
- ?? *Tool Box Talks: Working Safely on Scaffolds*. AGC, Tape 180.8
- ?? *Putting It All Together : Scaffold Safety*. AGC, Tape 439
- ?? *Scaffolds*. St. Paul, Group Meeting Report

### OSHA References

- ?? 1926 Subpart L - Scaffolding
- ?? 1926 Subpart Q - Concrete and Masonry Construction

**Risk Control Focus 2: Select the right equipment to accomplish the concrete placement process. Plan the placement process to avoid exposing workers to hazards associated with cranes and buckets, pump trucks, power buggies or other placement techniques.**

**Resources**

- ?? *Take Charge: An Overview of Crane Safety.* AGC, Tape 142
- ?? *Tool Box Talks - Eye and Face Protection.* AGC, Tape 180.2
- ?? *Concrete Mixing and Placement.* St. Paul, Technical Guide
- ?? *Concrete Pumping Operations.* St. Paul, Technical Guide

**OSHA References**

- ?? 1926 Subpart N - Cranes, Derricks, Hoists, Elevators and Conveyers

**Risk Control Focus 3: Placing, consolidating, striking and floating concrete requires workers to use PPE. Avoid electrical hazards associated with certain types of equipment.**

**Resources**

- ?? *Concrete and Masonry.* Construction Safety Council, Safety and Health Pamphlet
- ?? *Take Charge: Working Safely with Temporary Electricity.* AGC, Tape
- ?? *Tool Box Talks: Working around High Voltage.* AGC, Tape 180.19.
- ?? *Tool Box Talks - Eye and Face Protection.* AGC, Tape 180.2
- ?? *Concrete Mixing and Placement.* St. Paul, Technical Guide
- ?? *Concrete Pumping Operations.* St. Paul, Technical Guide

**OSHA Reference**

- ?? 1926 Subpart Q - Concrete and Masonry Construction

**Risk Control Focus 4: Working with cranes and rigging loads exposes workers to multiple sources of risk through crane failure, electrocution, and improper rigging and loading.**

**Resources**

- ?? *Play it Safe: An Overview of Crane Safety.* AGC, Tape 142
- ?? *Controlling the Load: Crane Rigging Safety.* AGC, Tape 146
- ?? *Tool Box Talks - Working Safely with Crane Rigging.* AGC, Tape 180.9
- ?? *Crane Safety Rules.* St. Paul Technical Guide
- ?? *Power Lines and Cranes.* St. Paul Technical Guide

**OSHA References**

- ?? 1926 Subpart N - Cranes Derricks, Hoists, Elevators and Conveyors
- ?? 1926 Subpart v - Power Transmission and Distribution

**Risk Control Focus 5: Working in adverse weather conditions requires workers and materials be protected.**

**Resources**

- ?? *Cold Weather Dangers*. St. Paul, Technical Guide
- ?? *Cold Weather Tips*. St. Paul, Technical Guide
- ?? *Protection from Wind Hazards in Construction*. St. Paul, Technical Guide.
- ?? *Working in Hot Environments*. St. Paul, Technical Guide

**OSHA References**

- ?? 1926 Subpart Q - Concrete and Masonry Construction

## Work Above Grade

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Forming Above Grade</b>	<ul style="list-style-type: none"> <li>?? Ergonomic issues when material handling</li> <li>?? Boom truck, crane or forklift issues</li> <li>?? Rebar placement, impailment hazards</li> <li>?? Rebar cage stability</li> <li>?? Bracing issues</li> <li>?? Rebar placement fall exposure</li> <li>?? Form erection and placement hazards</li> <li>?? Fall exposure</li> <li>?? She-bolt or cross-tie placement</li> </ul>	<ul style="list-style-type: none"> <li>?? Adequate and skilled workforce</li> <li>?? Only qualified operators, riggers, and signal person</li> <li>?? Crane, boom truck, forklift, rigging inspection</li> <li>?? When rebar is installed protection must be provided for horizontal bar under 7 feet above grade</li> <li>?? All dowels over 4 feet in elevation can be covered with plastic caps, under 4 feet must have a cover that is impenetrable</li> <li>?? Bracing needs to be based on both dimensions and environmental conditions, provide adequate bracing so if there is a failure of one brace there isn't collapse</li> <li>?? When ironworkers are required to work more then 6 feet off the ground they shall use positioning equipment</li> <li>?? Work performed on building rebar cages over 6 feet above grade should have 4x4 lumber and scaffold plank for a work surface</li> <li>?? Operator and signal person needs to be experienced in flying forms in to connectors</li> <li>?? Rigging needs to be inspected</li> <li>?? Wind conditions evaluated by supervision</li> <li>?? Use appropriate tie off points</li> <li>?? Utilize aerial lifts or scaffold if possible</li> </ul>	<p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Heavy Equipment</li> <li>?? Fall Protection</li> <li>?? Material Handling</li> <li>?? Crane Safety</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Tie or Die Program</li> <li>?? Concrete Placement</li> <li>?? Concrete Pumping Operations</li> <li>?? Crane Safety</li> </ul>

# Work Above Grade

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Concrete Placement Above Grade</b>	<ul style="list-style-type: none"> <li>?? Pumping issues or chute use</li> <li>?? Cranes and buckets</li> <li>?? Fall exposure</li> <li>?? Form failure due to improper pour rates, excess vibration, or form components missing or damaged</li> <li>?? Hygiene issues including concrete burns, excess heat, etc.</li> </ul>	<ul style="list-style-type: none"> <li>?? Only qualified operators should steer chute or pump hose</li> <li>?? Experienced workers should handle and dump buckets</li> <li>?? Crane or boom truck must have qualified operators</li> <li>?? Rigging for buckets need to be inspected</li> <li>?? Use very experienced signal person on both pumps and buckets</li> <li>?? Scaffold systems (catwalks) need to be installed for striking and vibrating crews</li> <li>?? Provide work surface for workers placing and vibrating concrete inside rebar cages by installing 4x4 lumber and scaffold plank</li> <li>?? Do not exceed pour rates for types of forming system being used</li> <li>?? Have an engineer develop pour rate plan</li> <li>?? Allow only experienced workers to vibrate concrete</li> <li>?? Double check form components (use two different people)</li> <li>?? Workers should wear boots, glasses and gloves</li> <li>?? Rotate workers, utilize ice cooling vests, plan pours early in day</li> </ul>	<p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Concrete Placement</li> <li>?? Concrete Pumping Operations</li> <li>?? Crane Safety</li> <li>?? Working in Hot Environments</li> </ul> <p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Crane Safety</li> <li>?? Fall Protection</li> <li>?? Scaffolds</li> </ul> <p><b>Construction Safety Council</b></p> <ul style="list-style-type: none"> <li>?? Concrete and Masonry</li> </ul>

## Work Above Grade

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Form Stripping Above Grade</b>	<ul style="list-style-type: none"> <li>?? Fall exposure</li> <li>?? Materials falling on workers below</li> <li>?? Crane issues when breaking forms loose</li> <li>?? Laydown areas for re-oiling forms</li> <li>?? Eye injury exposure during form cleaning</li> </ul>	<ul style="list-style-type: none"> <li>?? Provide appropriate anchor or tie off points</li> <li>?? Plan the stripping operation to only remove form in a manageable sequence</li> <li>?? Provide a controlled access zone, minimize worker access</li> <li>?? Utilize experienced workers</li> <li>?? Check crane placement (side load considerations)</li> <li>?? Maintain a cleared out area free of trip hazards and other personnel</li> <li>?? Have workers evaluate wind direction or roll oil on forms if possible, refer to MSDS for other precautions</li> <li>?? Keep area clear</li> <li>?? Utilize long blow pipe, wear glasses, gloves and face shield</li> </ul>	<p><b>AGC Video</b></p> <ul style="list-style-type: none"> <li>?? Material Handling</li> <li>?? Crane safety</li> </ul> <p><b>St Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Lifting Techniques</li> <li>?? Crane Safety</li> <li>?? Tie or Die program</li> </ul>

## Work Above Grade

This unit examines the practices of forming, placing concrete, and stripping forms while working above grade. The emphasis on transporting, pouring, placing and finishing is on protecting the integrity of the concrete's design mix while it is handled in each of these operations. Concrete workers are exposed to many hazards while performing these operations. Not only are the operations themselves hazardous, but equipment and materials place additional risk considerations into work planning and execution when operations take place above grade.

**Introduction** - Workers engaged in concreting practices are required to understand and plan for the execution of the work. Considerations include planning for the efficient placing of the concrete; maintaining the integrity of the fresh concrete while it is poured, consolidated, struck and floated into place; and ensuring concrete workers do not overwork the concrete while it is being finished. Construction managers must also plan to protect the temperature and moisture content of the hardened concrete through its 28-day curing period. Weather conditions can significantly affect the concrete. Protection against adverse climatic conditions is to be considered in all phases of the concreting operations. Careful planning of the concreting operations also includes techniques and mechanism that remove hazards and risks encountered during the execution of the work that takes place above grade.

**Risk Control Focus 1: Selecting the right equipment for pouring concrete into place requires that construction managers carefully review site conditions, location of pour, and access/egress of the ready mix trucks. Construction managers must also select equipment that can most effectively move the concrete from the trucks to its structural location. At each of these stages, managers must identify and plan avoidance techniques to remove worker risk exposure. Care must be taken when working on scaffolds or elevated platforms during the concreting operations.**

### Resources

- ?? *Play it Safe: An Overview of Crane Safety*. AGC, Tape 142
- ?? *Controlling the Field: Jobsite Safety Inspection*. AGC, Tape 131
- ?? *Tool Box Talks: Traffic Control*. AGC, Tape 180.1
- ?? *Concrete Mixing and Placement*. St. Paul, Technical Guide
- ?? *Concrete Pumping Operations*. St. Paul, Technical Guide
- ?? *Mixing Concrete*. St. Paul, Technical Guide
- ?? *Concrete and Masonry*. Construction Safety Council, Safety and Health Pamphlet
- ?? *Tool Box Talks: Working Safely on Scaffolds*. AGC, Tape 180.8
- ?? *Putting It All Together : Scaffold Safety*. AGC, Tape 439
- ?? *Scaffolds*. St. Paul, Group Meeting Report

### OSHA References

- ?? 1926 Subpart L - Scaffolding
- ?? 1926 Subpart Q - Concrete and Masonry Construction

**Risk Control Focus 2: Select the right equipment to accomplish the concrete placement process. Plan the placement process to avoid exposing workers to hazards associated with cranes and buckets, pump trucks, power buggies or other placement techniques.**

**Resources**

- ?? *Take Charge: An Overview of Crane Safety.* AGC, Tape 142
- ?? *Tool Box Talks - Eye and Face Protection.* AGC, Tape 180.2
- ?? *Concrete Mixing and Placement.* St. Paul, Technical Guide
- ?? *Concrete Pumping Operations.* St. Paul, Technical Guide

**OSHA References**

- ?? 1926 Subpart N - Cranes, Derricks, Hoists, Elevators and Conveyers

**Risk Control Focus 3: Placing, consolidating, striking and floating concrete requires workers to use PPE, avoid electrical hazards associated with certain types of equipment.**

**Resources**

- ?? *Concrete and Masonry.* Construction Safety Council, Safety and Health Pamphlet
- ?? *Take Charge: Working Safely with Temporary Electricity.* AGC, Tape
- ?? *Tool Box Talks: Working around High Voltage.* AGC, Tape 180.19.
- ?? *Tool Box Talks - Eye and Face Protection.* AGC, Tape 180.2
- ?? *Concrete Mixing and Placement.* St. Paul, Technical Guide
- ?? *Concrete Pumping Operations.* St. Paul, Technical Guide

**OSHA Reference**

- ?? 1926 Subpart Q - Concrete and Masonry Construction

**Risk Control Focus 4: Working with cranes and rigging loads exposes workers to multiple sources of risk through crane failure, electrocution, and improper rigging and loading.**

**Resources**

- ?? *Play it Safe: An Overview of Crane Safety.* AGC, Tape 142
- ?? *Controlling the Load: Crane Rigging Safety.* AGC, Tape 146
- ?? *Tool Box Talks - Working Safely with Crane Rigging.* AGC, Tape 180.9
- ?? *Crane Safety Rules.* St. Paul Technical Guide
- ?? *Power Lines and Cranes.* St. Paul Technical Guide

**OSHA References**

- ?? 1926 Subpart N - Cranes Derricks, Hoists, Elevators and Conveyors
- ?? 1926 Subpart V - Power Transmission and Distribution

# Masonry

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Masonry Tools</b>	?? Eye injuries from flying pieces and chips ?? Ergonomic issues from trowel and other tool use ?? Eye injuries from mortar ?? Silica issues ?? Hand injuries from power mixers ?? Hygiene issues - burns on skin and eyes	?? Utilize full face shield while chipping ?? Use good, quality tools ?? Rotate work crews ?? Use full face shield when sawing and cutting ?? Use respirator when sawing ?? Use respirator when mixing ?? Make sure guards are in place on the mixer ?? Use only experienced operator on mixer ?? Have wash water handy	<b>AGC Videos</b> ?? Personal Protective Equipment ?? Respiratory Protection  <b>St. Paul Technical Guides</b> ?? Back Injuries  <b>Construction Safety Council</b> ?? Concrete and Masonry Construction

# Masonry

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Block and Brick Laying</b>	?? Ergonomic issues from back injuries ?? Ergonomic issues from hauling and handling block ?? Falling materials ?? Fall exposure ?? Forklift or lull issues ?? Hygiene issue during mortar mixing ?? Hygiene issue when acid washing ?? Collapse and cave-in exposures ?? Do not climb scaffold	?? Provide adequate workforce ?? Rotate crew if possible ?? Wear gloves ?? Use PPE - hardhats, safety glasses, etc ?? Fully deck scaffolds ?? Restrict access zone ?? Set-up control access zones (height of wall plus 4 feet) ?? Use toe boards ?? Brace walls opposite of scaffolds ?? Install top and mid rails ?? Use ladders ?? Use competent person to supervise scaffold erection ?? Tie scaffolds off using the 5:1 height to base ratio ?? Utilize a tagging system ?? Install end rails on outrigger brackets ?? Allowed only qualified operators on forklifts ?? Keep storage areas organized ?? Wear seatbelts when driving lift ?? Reference MSDS for material precautions ?? Wear PPE - goggles and gloves ?? Evaluate cave-in protection system ?? Reference OSHA for proper protection systems	<b>AGC Videos</b> ?? Scaffolding ?? Personal Protective Equipment ?? Heavy Equipment ?? Control Access Zones  <b>Construction Safety Council</b> ?? Concrete and Masonry Construction

# Masonry

This unit studies the various building components that are constructed using masonry construction, including tools and materials. Examination of masonry practices used to erect buildings and other masonry structures is included. Planning and executing masonry operations is a critical task of a construction supervisor. It is imperative that supervisors are familiar enough with the mason's work to identify, plan, and develop risk control measures to protect the contractor and the workers.

**Introduction** - Brick, concrete block and mortar are the most commonly used masonry materials. The ingredients used to produce these materials are caustic and long-term exposures should be avoided. Masonry units, particularly concrete block, tend to be heavy and the repetitious practice of spreading mortar and laying block on the line stress back, arms and wrists. Masons typically saw-cut and/or chop bricks and blocks to make them fit. PPE that protects eyes, face and breathing should be worn. Keep areas where mortar mixers and saws are in operation clear from intrusion by other workers and well ventilated.

Masonry construction can be used in both load bearing and non-load bearing situations. Various masonry designs can provide significant aesthetic value through arches, differing bond patterns, masonry unit coloration, textures and sizes, or in interior and exterior applications. Because of the variety of application for masonry, workers often find themselves working above grade on scaffolds; in areas of restricted access, in temporary enclosures during winter construction and around forklifts and other heavy equipment that supply materials to masonry crews. Care must be taken when planning the execution of the work to assure that risk control mechanisms are integrated into the scheduled work activities.

**Risk Control Focus 1: Mortar mixes contain lime and cementitious materials. Both are highly caustic. Avoid prolonged skin contact and splattering into eyes. Keep hands and hand tools out of mortar mixers and make sure safety guards are in place. Use PPE when working with mortars and mixers.**

## Resources

- ?? *Breathing Easier: the Basics of Respiratory Protection*. AGC, Tape 172
- ?? *Concrete and Masonry Construction*. Construction Safety Council, Construction Safety and Health Pamphlet
- ?? *Tool Box Talks: Eye and Face Protection*. AGC, Tape 180.2
- ?? *Personal Protective Equipment*. St. Paul, Technical Guide

## OSHA Regulations

- ?? 1926 Subpart Q - Concrete and Masonry

**Risk Control Focus 2: Use ergonomically correct lifting and bending practices.**

## Resources

- ?? *Back Injury Prevention*. St. Paul, Technical Guide
- ?? *Back to the Basics: Back Injury Prevention*. AGC, Tape 149

**Risk Control Focus 3: Working on scaffolds, elevated work platforms or other above grade work areas requires significant preplanning and operational follow-through.**

**Resources**

- ?? *Tool Box Talks: Working Safely on Scaffolds*. AGC, Tape 180.8
- ?? *Heightened Awareness: Fall Protection in the Construction Industry*. AGC, Tape 179
- ?? *Step By Step: Job Safety Analysis*. AGC, Tape 156
- ?? *The Fall Awareness Set*. Construction Safety Council
- ?? *Rolling Tower Scaffolds*. St. Paul, Technical Guide
- ?? *Swing Stages*. St. Paul, Technical Guide
- ?? *Concrete and Masonry Construction*. Construction Safety Council, Construction Safety and Health Pamphlet

**OSHA References**

- ?? 1926 Subpart L - Scaffolding
- ?? 1926 Subpart Q - Concrete and Masonry
- ?? 1926 Subpart M - Fall Protection

**Risk Control Focus 4: Control access into areas where masons are working overhead. Restricted access areas are high-risk areas where extra caution is needed.**

**Resources**

- ?? *Concrete and Masonry Construction*. Construction Safety Council, Construction Safety and Health Pamphlet

**OSHA Reference**

- ?? 1926 Subpart L - Scaffolding
- ?? 1926 Subpart Q - Concrete and Masonry

**Risk Control Focus 5: Pay special attention to hazards associated with forklifts and other heavy equipment used to load scaffolds and supply materials to mason crews.**

**Resources**

- ?? *Rough Terrain Forklift*. St. Paul, Technical Manual
- ?? *Skid-Steer Loader Safety*. St. Paul, Technical Manual
- ?? *On the Go: Forklift Safety*. AGC, Tape 176
- ?? *Concrete and Masonry Construction*. Construction Safety Council, Construction Safety and Health Pamphlet

**OSHA Reference**

- ?? 1926 Subpart O - Motor Vehicles, Mechanized Equipment, and Marine Operations
- ?? 1926 Subpart W - Rollover Protective Structures; Overhead Protection

Soils,  
Excavations  
And Mining

# Risk Control Curriculum

## **INTEGRATION GUIDE**

This Guide has been developed by

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# SOILS, EXCAVATION AND MINING

**Description** - This guide is designed to introduce construction students to soils and the methods, techniques and equipment used in excavations, trenching and mining. Workers typically develop skills that enable them to analyze, plan, and carry out various facets of this work. They become familiar with systems and processes typically used in these types of construction.

**Risk Control Integration Focus** - This guide is divided into 3 distinct units that represent a specific phase or type of construction. Each unit studies various methods, materials, and equipment necessary to complete each aspect of the work. As workers engage in learning these practices, they simultaneously analyze each step of the processes to identify associated risks and hazards that are part of the work. Supervisors apply general job site and specific task activity assessments as risk control procedures. As the associated risks are identified, they plan appropriate avoidance and elimination techniques consistent with best practices. Emphasis is on planning, managing operations, and enforcing safety policy and procedures that create risk-free job sites.

**Guide Outline** - There are 3 units presented in this guide. The units are:

Unit 1	Soils and Excavations
Unit 2	Excavations and Trenching
Unit 3	Mining Operations

The following pages present an overview of the work associated with the identified phase of construction, risks commonly associated with the type of work, suggested risk controls and resources to help integrate risk control competencies into construction practices.

In the lab portions of classes, students are required to follow all safety regulations, policies, and procedures. Wearing of personal protective gear while in work areas is mandatory. Specific risk control practices associated with various aspects of work are identified before the lab activities begin. Students disregarding safety policies and procedures are removed from the work environment.

## Soil Cave-ins

**Los Angeles Times, June 24, 1993, "Laguna Beach Man Killed in Trench Cave-In"**

*The survivor said "All day he had been asking me, 'If this caves in, where are you gonna go?' I asked him this morning, let's get some boards to shore this thing up and he said, 'We're almost done.' In five more minutes we would have been sitting at the table eating lunch." . . . . It took firefighters an hour to reach the man's wrist to determine he was dead. It took them another five hours to pull his body from the trench.*

**Cave-In, October 10, 1996, Cuyahoga Falls, OH**

*As some 50 rescuers worked with buckets and hand shovels to free him, a man buried up to his head talked with them and even joked a little about his predicament. However, after about four hours, the man suddenly quit talking, and died. Officials speculated he may have succumbed to internal injuries and bleeding. He was working in an unshored 15-foot-deep trench to install a sewer line when the accident happened.*

### **Buxton, NC, 1998**

*A man died on a beach when an 8-foot-deep hole he had dug into the sand caved in as he sat inside it. Beach-goers said Daniel Jones, 21, dug the hole for fun, or protection from the wind, and had been sitting in a beach chair at the bottom Thursday afternoon when it collapsed, burying him beneath 5 feet of sand. People on the beach on the Outer Banks used their hands and shovels, trying to claw their way to Jones, a resident of Woodbridge, VA., but could not reach him. It took rescue workers using heavy equipment almost an hour to free him while about 200 people looked on. Jones was pronounced dead at a hospital. "You just wouldn't believe the outpouring of concern, people digging with their hands, using pails from kids," Dare County Sheriff Bert Austin said.*

## **Statistics**

There are a number of statistics that support the need for increased awareness in excavation safety.

- ?? 50% of all excavation fatalities are rescuers
- ?? An excavation accident is 15 times more likely to result in death than any other construction accident
- ?? 8/10 of all deaths occur in less than 15 feet
- ?? 4/10 of all deaths occur in less than 10 feet
- ?? Between 100-400 people are killed per year in excavations
- ?? 1,000-4,000 workers are injured every year

There are a number of possible reasons that these kinds of accidents occur:

1. Attempting to save time and money by not properly sloping or shoring.
2. The boss has requested you get down into an unsafe trench. You don't want to "rock the boat" or get your boss mad by refusing.
3. It is "wimpy" to be afraid of dirt. This is the so-called "cowboy" effect. It is closely related to peer pressure to do the job and not worry about the safety aspects.
4. Not being educated on the hazards of a potential cave-in.

Co-workers may be consulted or assist professional emergency response personnel during a rescue. A problem arises when co-workers are emotionally connected to the victim and become rash and irresponsible when trying to rescue them.

A good bottom-line philosophy on excavation safety:

*It is very risky to cut corners on excavation safety. If one accident occurs, there will be law suits, fines, and penalties, even possible prison time. This does not even consider the personal grief and trauma of losing a co-worker or having one seriously injured. One accident can put you out of business. For the long-term financial and emotional health of your business and co-workers, it is best to follow safety regulations.*

## **OSHA Regulations for Excavations**

This document is not intended as a complete and comprehensive statement of all regulations. It is only an abbreviated summary of selected sections.

The Bureau of Labor Statistics reports (based upon claims made to workers compensation) that between 1976 and 1981 the deaths associated with work in excavations accounts for nearly 1% of all annual work related deaths. These statistics also indicate that excavation accidents caused about 1,000 work-related injuries each year and about 140 result in permanent disabilities and 75 in death. These statistics are rather old and have probably increased. If one takes this figure of deaths and assumes they are evenly distributed about the 50 states with about 50 excavation companies per state, then approximately one of your co-workers will die from an excavation accident in a 30 year construction career and many more will get injured.

By knowing and adhering to OSHA regulations, the risks can be greatly reduced. The OSHA standards regulate the use of support systems, sloping and benching systems and other systems of protection as a means of protection against excavation cave-ins. In addition, the standards regulate the means of access to and egress from excavations, and employee exposure to vehicular traffic, falling loads, hazardous atmospheres, water accumulation, and unstable structures in and adjacent to excavations.

## **Basic Terminology**

**Excavation:** Any artificial (man made) cut, cavity, trench, or depression in an earth surface, formed by earth removal.

**Trench:** A narrow excavation in which the depth is greater than the width, but the width of a trench is not greater than 15 feet.

**Shoring:** A structure or system (usually made of metal or timber) that supports the sides of an excavation and which is designed to prevent cave-ins. It is sometimes a pre-engineered shoring system comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (walers). It is used to prevent cave-ins.

**Failure:** This term refers to the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

**Competent Person:** A person who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them.

**Tabulated Data:** Tables and charts approved by a registered professional engineer and used to design and construct a protective system.

## Soil Terminology

**Cemented Soil:** A soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

**Cohesive Soils:** Clay, or a soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be (note: "can be" is not the same as "should be") excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

**Fissured:** A soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

**Granular:** A soil that is mainly composed of gravel, sand, or silt with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

## Soil Type

**Stable Rock:** A natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

**Type A:** A cohesive soil with an unconfined compressive strength of 1.5 ton per square foot (tsf) - in SI units, 144 kPa (1 Pa = 1N/m<sup>2</sup>), or greater. Examples: clay, silty clay, sandy clay, clay loam, hardpan, cemented soils. No soil will be considered Type A if: the soil is fissured, subjected to vibration, was previously disturbed, is part of a sloped layered system sloping into the trench, or is seeping water.

**Type B:** A cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa). Examples: angular gravel (similar to crushed rock), silt, silt loam,

previously disturbed soils unless otherwise classified as C, dry unstable rock, some sloped layered systems.

**Type C:** A cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less. Examples: granular soils including gravel, sand, and loamy sand; any submerged or soil with freely seeping water, and any soil not otherwise classified.

**Soil Layers:** Where soils are configured in layers, i.e. they have different geological structures, the soil must be classified on the basis of the soil classification of the weakest soil layer. Each layer may be classified individually if a more stable layer lies below a less stable layer.

## General Excavation Area Safety

Daily inspections of an excavation area shall be done by a competent person. This should be done prior to work and after a rainstorm, and as needed throughout the shift. The atmosphere shall not be (1) oxygen deficient, (2) Explosive/flammable/oxidizing, or (3) toxic (poisonous, corrosive, irritating). There are many situations where hazardous gases can build within an excavation (e.g. welding/burning, chemical usage)

**Surface Encumbrances:** All hazards shall be removed, secured, or safeguarded. This includes, but is not limited to, sharp, blunt, and heavy objects. Also included are holes, wells, pits, shafts, cables, and any equipment that could pose a hazard.

**Underground Installations:** Utilities must be located prior to excavations. Utility companies shall be contacted in advance. If work proceeds near the utility, the installation shall be located by a safe means. Unearthed utilities shall be supported.

**Access and Egress:** A ladder, ramp, or stairway shall be provided in trench excavations that are 4 feet or more in depth, so as to allow no more than 25 feet of lateral travel. Walkways/bridges that cross over excavations shall have standard guardrails. Ladders must be secured and extend at least 36 inches above the landing.

**Water Accumulation:** Surface water shall be diverted away from trench. Employees shall be removed from a trench during a rainstorm. All employees that are exposed to vehicular traffic shall wear warning vests. No one shall work underneath a suspended load.

**Mobile Equipment Approaching Edge of Excavations:** Warning signals (logs, hands or mechanical signals, barricades, etc.) must be used when the operator does not have a clear and direct view of the edge.

**Loose Rock or Soil:** The placement of excavated materials (spoil) shall be a minimum of 2 feet from the edge of excavation or have a sufficient retaining device.

## Soil Classification and Sloping

Each employee in an excavation shall be protected from cave-ins by an adequate protective system. One has the following options to provide this protection: sloping and benching, sloping with supports and shields in lower portion, timber shoring, aluminum hydraulic shoring, trench shields. OSHA guidelines say:

- ?? **A competent person must make one visual and one manual analysis of the soil.**
- ?? **Layered systems should be classified according to their weakest layer.**
- ?? **Reclassification must be done if conditions change.**

## Visual Tests

**Excavated soil and soil in excavation sides:** Fine-grained soil is cohesive, sand or gravel is granular.

**Soil as it is excavated:** Clumps indicate cohesive soils. Easily broken soil is granular.

**Sides of excavation and adjacent area:** Fissured material, layered systems, surface water or seepage, sources of vibration, previously disturbed soil, etc.

## Manual Tests

**Plasticity (or ribbon test):** Cohesive soils stick together.

**Dry strength:** dry, granular soil crumbles easily; dry soil which is difficult to break is probably clay. A drying test is used to determine if soil is fissured, unfissured, or granular.

**Thumb penetration:** Type A soil is readily indented by thumb with great effort; Type B if the only the thumbnail penetrates; Type C soil is easily penetrated several inches by thumb and can be molded by light finger pressure.

**Pocket penetrometer:** Determines unconfined compressive strength.

**Shearvane:** Determines soil cohesion

# Excavations and Trenching

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Excavation and Trenching</b>	<ul style="list-style-type: none"> <li>?? Cave-ins</li> <li>?? Equipment rollover</li> <li>?? Hazardous atmospheres</li> <li>?? Rocks, structures and other materials falling into excavations</li> <li>?? Water that softens soil and increases soil movement</li> <li>?? Vibration from pile driving and heavy equipment</li> <li>?? Underground utilities</li> <li>?? Removal of soil causing building structural or roadway failure</li> <li>?? Building earth and concrete dikes and dams to divert or contain water or other products</li> <li>?? Containment of spills in petrochemical facilities</li> <li>?? Heavy equipment</li> <li>?? Material handling ergonomics</li> <li>?? Working on steep slopes at heights causing potential falls</li> <li>?? Using ladders</li> <li>?? Blasting operations</li> <li>?? Formwork and rebar</li> <li>?? Excavations</li> <li>?? Contaminated ground</li> <li>?? Power tools</li> <li>?? Noise exposure</li> <li>?? Confined space inside of dikes</li> </ul>	<ul style="list-style-type: none"> <li>?? Trained Competent Person per OSHA 1926.650- Excavation standard</li> <li>?? Training all workers to recognize specific hazards of excavations</li> <li>?? Engineer underpinning of structures for support</li> <li>?? Understanding soil pressure and how this relates to shoring, shoes and other protective systems</li> <li>?? Sheet piling protection, soldier piles and lagging designed by an engineer in excavations that cannot be sloped back</li> <li>?? Soil nailing for embankments</li> <li>?? Use of material handling equipment reducing human material handling</li> <li>?? Inspection of ladders and tools</li> <li>?? Pre-work soil testing especially in existing facilities where spills and contamination may be present</li> <li>?? Maintenance of equipment/back-up alarms operational</li> <li>?? Use of certified blaster</li> <li>?? Fall protection specific for forming systems</li> <li>?? Excavation protection consistent with depth and soil type</li> <li>?? Maintaining tool guards</li> <li>?? Use of hearing protection and other PPE</li> <li>?? Use of air monitoring equipment inside of dykes, especially in existing facilities</li> </ul>	<p><b>Construction Safety Council</b></p> <ul style="list-style-type: none"> <li>?? Safety for the Competent Person-8 hr. Program</li> <li>?? Excavation</li> </ul> <p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Excavations</li> <li>?? Pile Driving</li> <li>?? Heavy Equipment</li> <li>?? Trenching Efficiency Production, Inc</li> <li>?? Video "Aluminum Modular Trench Shield Systems"</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Excavations</li> <li>?? Trenching</li> <li>?? Personal Protective Equipment</li> </ul>

## Excavation and Trenching

This section deals specifically with the risk control associated with trenching and excavating work. There should be a thorough review of OSHA regulations and safe work practices for those engaged in this type of work.

**Risk Control Focus: Follow OSHA prescribed procedures for trenching and excavation work. Be able to analyze soil in order to determine sloping benching, shoring and/or trench box requirements. Plan the work carefully in order to provide a safe work environment for workers.**

### Resources

- ?? *On Solid Ground: A Plan for Safe Excavating and Trenching*. AGC, Tape 136
- ?? *In the Trenches: Excavation Safety for Workers*. AGC, Tape 440
- ?? *Excavation Competent Person Manual*. Construction Safety Council
- ?? *Excavation Instructor Set*. Construction Safety Council
- ?? *Excavation Instructor Video*. Construction Safety Council
- ?? *Excavation Safety Video*. Construction Safety Council
- ?? *Excavation Checklists*. St. Paul, Technical Guide
- ?? *Excavating and Trenching*. St. Paul, Technical Guide

### OSHA References

- ?? 1926 Subpart P - Excavations

# Mining Operations

Construction Phase	Identified Risks	Risk Controls	Resources
<b>Mining Operations</b>	<ul style="list-style-type: none"> <li>?? Take from actual mining of earth/rock to end use</li> <li>?? Bedding materials, aggregate, sand and gravel operations</li> <li>?? Cement and lime plants</li> <li>?? Underground and surface mining</li> <li>?? Rock drilling</li> <li>?? Blasting</li> <li>?? Falls when working next to face of surface mines</li> <li>?? Falling rock</li> <li>?? Heavy Equipment</li> <li>?? Rigging failure</li> <li>?? Hazardous atmospheres due to methane, hydrogen sulfide</li> <li>?? Silica</li> <li>?? Moving machinery in plants</li> <li>?? Confined space entry into vessels containing product</li> <li>?? Engulfment hazards</li> <li>?? High heat conditions</li> </ul>	<ul style="list-style-type: none"> <li>?? Introduce MSHA requirements that are specific to mining/quarry operations</li> <li>?? Proper use of eye protection, hearing protection, foot protection, respiratory protection identified for the hazard (silica, lime dust)</li> <li>?? Understand the MSHA requirements for blasting (certified blaster, pre-blast warning system)</li> <li>?? Proper storage of explosives, blasting cap and cord</li> <li>?? Survey of area after blast to determine loose rock on face</li> <li>?? Scaling of rock face to remove loose rock</li> <li>?? Geological survey to determine if gases are present or could be present</li> <li>?? Proper maintenance of heavy equipment</li> <li>?? Inspection by operator for brakes, horn, tire pressure, hydraulic levels</li> <li>?? Confined space entry program must be specific for the hazards of engulfment and heat conditions</li> <li>?? Use of ice vests and ventilation for cooling workers</li> </ul>	<p><b>Mining Safety and Health Administration</b></p> <ul style="list-style-type: none"> <li>?? Web site at - <a href="http://199.115.12.200/">http://199.115.12.200/</a></li> <li>?? MSHA videos and training materials</li> </ul> <p><b>AGC Videos</b></p> <ul style="list-style-type: none"> <li>?? Heavy Equipment</li> <li>?? Fall Protection</li> <li>?? Personal Protective Equipment</li> </ul> <p><b>St. Paul Technical Guides</b></p> <ul style="list-style-type: none"> <li>?? Personal Protective Equipment</li> <li>?? Heavy Equipment</li> <li>?? Fall Protection</li> </ul>