AN ANALYSIS OF THE PREVALENCE OF MUSCULOSKELETAL DISORDERS IN HEAVY, CIVIL CONSTRUCTION OPERATIONS AND THE IMPACT OF JOB, AGE, AND EXPERIENCE

by
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ABSTRACT

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The following discussion will present the importance of performing an ergonomic study in construction, some benefits that can be expected, and an explanation of the link between this study and research findings. The purpose of this study was to determine the exposures to musculoskeletal disorder (MSD) hazards or risk factors and the highest areas of prevalence and monetary loss with regard to MSD claims. A focused study was conducted on a heavy civil contractor and included an analysis of the impacts and prevalence of MSD's in relation to trades, employee ages, and experience with the

company. Data from formulated job hazard analyses and workers' compensation records for the years 1997 through 2000 served as the basis of the study. Conclusions of the study followed by recommendations on how to address the high incidence of MSD's conclude the study.

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CHAPTER 1

Statement of the Problem

Introduction

With the recent proposal of a new Occupational Safety and Heath Administration (OSHA) standard, the term "ergonomics" has become a dirty word. On November 14, 2000, OSHA proposed an ergonomics standard, which attracted nearly 8,000 public comments before it was issued on January 26, 2001, surprising many people (Associated General Contractors of America [AGC], 2000). This comes from the fact that the term ergonomics has such wide implications and definition along with the highly controversial and confusing provisions of the standard (Lund, 2000). The standard was developed with the intent to reduce the number of physical injuries experienced by workers due to repetitive motions, application of force, contact stress, vibration, static and awkward postures, and cold exposure (Bauer, 2000).

Although the developed standard did not apply to the construction industry, all of the above mentioned ergonomic risk factors are prevalent in virtually all construction trades and activities. In an issue of Washington Newsline, published by the American Road and Transportation Builders Association (ARTBA), Dave Bauer (2000) stated, "while construction activities are not part of the regulation, a subsequent rule that includes construction work is anticipated." The reluctance to pass an ergonomic standard to regulate construction along with the regulation of general industry stems from the widespread and dynamic nature of occupations in the construction industry compared to the more repeatable activities in general industry. Occupations in general industry are easier to measure ergonomically. "In these occupations [general industry] work activities and worksites are generally predictable and job tasks involving ergonomic risks are usually limited to one or

two body areas. By contrast, employment in the construction trades entails the handling of hand and power tools, constant movement in awkward positions, and repetitive, forceful use of the back and upper extremities; all of which are known risk factors for work related musculoskeletal disorders "(Lemasters et al., 1998; Bhattacharya, Mueller, and Putz-Anderson, 1985; Bhattacharya, Greathouse, and Warren, 1997; Atterbury, Limke, and Lemasters, 1996; and Armstrong, Buckle, and Fine, 1993, p. 421).

There are other risks factors that add to the ergonomic exposure construction workers are faced with. A report from the National Research Council (J.J. Keller & Associates, Inc. [Keller], 2000) stated that a rapid work pace, monotonous work, low job satisfaction, little decision-making power, and high levels of job stress are associated with back disorders. A prosperous economy has led to a boom in the construction industry. With this surge comes the increased need for infrastructure to support it, often at a demanding rate. Thus, the result is compressed construction schedules and a more rapid work pace. Furthermore, this need to complete more projects in a shorter amount of time adds to job stress. Being overconfident and using shortcuts to save time is the mentality that can lead to ergonomic mistakes. "'It'll never happen to me' is an attitude that can lead to improper procedures, tools, or methods in your work. Any of these can lead to an injury" (Hirsch, 1998).

Stress caused from various life issues can also be carried to work (Hirsch, 1998). Stephen Sandherr, executive vice president and CEO of the Associated General Contractors of America (AGC), stated that the regulation failed to differentiate between possible work related injuries and stress from everyday life activities (AGC, 2000). It is difficult at times to leave mind-consuming issues at home, but personal problems brought to the workplace can

become extremely dangerous. Reduced attention and concentration levels hinder our awareness regarding the hazards that may be present (Hirsch, 1999).

Studies have also shown that many factors including the type of work activities, adverse environmental conditions, improper work procedures, poorly designed tools, and the aging workforce contribute to disease. As a person ages, the body's resilience to chronic wear and tear is reduced (Putz-Anderson, 1997; Hanson and Roos, 1981; Muckart, 1964). In a study conducted with Japanese construction workers, the results showed that musculoskeletal pain (MSP) was significantly associated with age, and that the odds ratios for relatively severe MSP increased almost linearly with age (Ueno et al., 1999). Another study indicated that age was the most obvious risk factor for severe lower back pain in construction workers (Holmstrom, Lindell, and Moritz, 1992).

Noticing that ergonomic disorders (or more accurately stated musculoskeletal disorders) have continued to produce a high magnitude of loss, OSHA has taken steps to help certify the seriousness of the problem by proposing a standard. This standard was recently nullified on March 7, but "the battle over ergonomics is not over" (Sweeney, 2001).

Edward Kraemer & Sons, Inc., (EKS) a heavy civil contractor, employs roughly 500-750 employees per year. These employees are hourly craftspeople that work as concrete finishers, carpenters, laborers, heavy equipment operators, welders, and mechanics. They are exposed to the numerous risk factors associated with musculoskeletal disorders (MSD's). As a result of the ensuing problem of the high prevalence and resulting cost of MSD's in the construction industry, Edward Kraemer & Sons, Inc. has taken a proactive step to address this problem realizing that "world class" companies do not simply base their activities on minimum compliances. EKS, a third generation company, believes that in order to stay

competitive they must be willing to continuously change and improve. EKS recently made a large change by going self-insured. The potential for savings under this plan is great, if they continue to minimize loss.

Purpose of the Study

The purpose of this study was to better define the problem of MSD's and to recommend controls at Edward Kraemer & Sons, Inc. by first determining exposures, followed by the determination of the incidence of MSD's along with related costs and impact of age and experience. This was determined by the analysis of EKS loss (workers' compensation) records from 1997-2000. The review of accident reports, observation of EKS tradespeople, and the formulation of job hazard analyses, also assisted in analysis of exposure.

Goals of the Study

The goals of this study were as follows:

1. To determine the various activities and conditions that may be contributing to Edward Kraemer & Sons' exposure to work-related MSD's.
2. To determine the prevalence of MSD's at EKS with an emphasis on the impact of age and experience in the respective trades of those affected.
3. Analyze the total losses (i.e., worker compensation costs) incurred (paid indemnity and medical and reserves in indemnity and medical) as a result of MSD's at EKS.

Background and Significance

According to OSHA (1999), work-related MSD's currently account for 1/3 of all occupational injuries/illnesses reported to the Bureau of Labor Statistics (BLS) and are the largest job-related injury and illness problem in the United States today. Workers with severe MSD's can face permanent disability, which not only effects work activities, but also can prevent the performance of everyday activities like combing hair or picking up a baby. The

Hamburg construction worker study found that of the subjects having a lower back disorder, 60.4% had a reduction of mobility, 27.6% had paravertebral muscle spasms, 24.4% had pain during movement, and 10.7% had signs of sciatic nerve compression (Sturmer et al., 1997).

The cost of work-related musculoskeletal disorders is another indication of the importance of this study. (Damkot, Pope, Lord, and Frymoyer, 1984) stated that the amount of lost work time in the United States due to lower back pain (LBP) results in four billion dollars in lost wages per year. Worker's compensation costs alone, according to the Bureau of Labor Statistics, are tremendous. 1988 statistics are shown in Table 2 in the appendix. An analysis of nearly 360,000 workers' compensation claims for construction industries discovered that 24% of these injuries, which mainly consisted of strains and sprains, were due to overexertion (Hunting et al., 1994)

A more recent statistic according to a report from the National Research Council and the Institute of Medicine of the National Academies (Keller, 2000) stated that MSD disorders affect about 1 million workers and costs the U.S. between $45 billion and $54 billion in compensation expenditures, lost wages, and decreased productivity. These statistics, along with many others previously stated, can be found in Appendix A. It is made up of several points reported by Charles Jeffress (Director of OSHA under the Clinton Administration) and will further emphasize the significance of this problem.

Musculoskeletal pain (MSP) is one of the most common occupational health problems, and certainly includes workers in the construction industry. In a 1996 study, the Japanese Ministry of Labor reported that low back pain (LBP) is the primary (about 60%) cause of occupational sick leave for 4 days or more. It was also stated that the construction industry has the second largest business area in terms of number of patients (Ueno et al., 1999

and Yamamoto, 1997). Furthermore, a nationwide U.S. health survey indicated that construction workers are the highest risk group for work-related LBP (Guo et al., 1995).

Edward Kraemer & Sons, Inc. is no exception when it comes to the significance of the problem. MSD's are considered the largest exposure to workers' compensation losses the company experiences to date.

Limitations of the Study

This study will focus on the activities and resulting risk factors associated with heavy, civil construction. This study is not intended to be an exhaustive discussion of ergonomics. It should be realized that varying construction trades and specialties will be exposed to different risk factors at varying degrees.

Definition of Terms

The following terms used in this study have been adapted from definitions presented in the Federal Register of the proposed Ergonomic standard 29 CFR 1910.900.

Abduction – movement away from the central axis of the body – away from the median plane. (Putz-Anderson, 1997)

Administrative controls – changes in the way that work in a job is assigned or scheduled that reduces the magnitude, frequency, or duration of exposure to ergonomic risk factors. Examples of administrative controls for MSD hazards include:

(1) Employee rotation;
(2) Job task enlargement;
(3) Alternative tasks;
(4) Employer-authorized changes in work pace. (OSHA, 1999)

Ergonomics – the science of fitting jobs to people; encompasses the body of knowledge about physical abilities and limitations as well as other human characteristics that are relevant to job design. (OSHA, 1999)

Ergonomic risk factors – (1) Ergonomic risk factors are the following aspects of a job that pose a biomechanical stress to the worker:

(i) Force (i.e., forceful exertions, including dynamic motions);
(ii) Repetition;
(iii) Awkward postures;

(iv) Static postures;
(v) Contact stress;
(vi) Vibration; and
(vii) Cold temperatures.

(2) Ergonomic risk factors are elements of MSD hazards that must be considered in light of their combined effect in causing or contributing to an MSD. Jobs that have multiple risk factors have a greater likelihood of causing or contributing to MSD's, depending on the duration, frequency, and magnitude of employee exposure to each risk factor are to a combination of them. Ergonomic risk factors are also called ergonomic stressors and ergonomic factors. (OSHA, 1999)

Elimination – eliminate employee exposure to the ergonomic risk factors associated with the covered MSD, or to reduce employee exposure to the risk factors to such a degree that a covered MSD is no longer reasonably likely to occur. (OSHA, 1999)

Engineering controls – are physical changes to a job that eliminate or materially reduce the presence of MSD hazards. Examples of engineering controls for MSD hazards include changing, modifying, or redesigning the following:

(1) Tools;
(2) Equipment;
(3) Materials;
(4) Processes;
(5) Facilities;
(6) Workstations. (OSHA, 1999)

Incidence – the number of new cases that come into being during a specific period of time. For occupational disorders, time is usually measured in terms of exposure hours to a job, in addition to calendar time. (Putz-Anderson, 1997)

Musculoskeletal Disorders (MSD's) – injuries and disorders of the muscles, nerves, tendons, ligaments, joints, cartilage, and spinal discs. Exposure to physical work activities and conditions that involve risk factors may cause or contribute to MSD's. MSD's do not include injuries caused by slips, trips, falls, or other similar accidents. Examples of MSD's include:

(1) Carpal tunnel syndrome;
(2) Rotator cuff syndrome;
(3) De Quervain's disease;
(4) Trigger finger;
(5) Tarsal tunnel syndrome;
(6) Sciatica;
(7) Epicondylitis;
(8) Tendonitis;
(9) Raynaud's phenomenon;
(10) Carpet layers knee
(11) Herniated spinal disc;

(12) Low back pain. (OSHA, 1999)

MSD hazards – physical work activities and/or physical work conditions, in which ergonomic risk factors are present, that are reasonably likely to cause or contribute to a covered MSD. (OSHA, 1999)

MSD signs – objective physical findings that an employee may be developing an MSD. Examples of MSD signs include:
(1) Decreased range of motion;
(2) Deformity;
(3) Decreased grip strength;
(4) Loss of function. (OSHA, 1999)

MSD symptoms – physical indications that an employee may be developing an MSD. Symptoms can vary in severity, depending on the amount of exposure to MSD hazards. Symptoms often appear gradually as muscle fatigue or pain at work that disappears during rest. Symptoms usually become more severe as exposure continues (e.g., tingling continues after work ends, numbness makes it difficult to perform the job, and finally pain is so severe the employee cannot perform the job). Examples of MSD symptoms include:
(1) Numbness;
(2) Burning;
(3) Pain;
(4) Tingling;
(5) Cramping;
(6) Stiffness. (OSHA, 1999)

Prevalence – a dimensionless unit that gives the frequency of a disorder, or the proportion of a population that experiences it, at a specified point in time. (Putz-Anderson, 1997)

Psychosocial Factors – 1) involving aspects of social and psychological behavior (www.dictionary.com) 2) relating social conditions to mental health (www.m-w.com)

Risk factor – any attribute, experience, or exposure that increases the probability occurrence of a disease or disorder, though it is not necessarily a causal factor (Last, 1983)

Summary

Ergonomics is a serious issue in today's workplace whether there is a passed OSHA standard or not. Edward Kraemer & Sons has realized the impact of musculoskeletal disorders (MSD's) on their bottom line and worker morale and is looking to make improvements. Chapter two will begin with an explanation of musculoskeletal disorders. This

will be followed with an analyses of the risk factors and prevalence of MSD's in industry pertaining to the trades EKS is involved in, the various costs associated with loss and expected compliance, and will conclude with a discussion of various controls that could be beneficial to EKS.

CHAPTER 2

Review of Literature

Introduction

The effects of musculoskeletal disorders on the human body have resulted in staggering statistics. "Musculoskeletal disorders (MSD's) are of great individual, social, and economic concern (Sturmer et. al., 1997, p. 2558)." "Moreover, during the working years (ages 18 to 64) more people are disabled from musculoskeletal problems than from any other category of disorder" (Putz-Anderson, 1990; Kelsey, 1982; Haber, 1971, p. 3). The purpose of the review of literature was to examine existing information in order to understand, explain, and make recommendations about the science of ergonomics as it relates to the construction industry. The outline below indicates the topics to be discussed:

I. Musculoskeletal Disorders Defined

A. MSD's Common to the Construction Industry
1.) Back Pain
2.) Strains and Sprains
3.) Degenerative Disc Disease
4.) Tendonitis
5.) Raynaud's Syndrome
6.) Thoracic Outlet Syndrome
7.) Carpal Tunnel Syndrome
8.) Carpet Layer's Knee

B. MSD Risk Factors in Construction

1.) Force or Muscle Effort
2.) Awkward Body Postures
3.) Repetitive Work
4.) Contact Stress
5.) Vibration from Hand Tools
6.) Temperature

C. Risk Factors Related to Upper Extremity MSD's

D. Risk Factors of the Back

1.) Lifting
2.) Pushing, Pulling, Tugging, and Sliding
3.) Twisting, Reaching, Sideways Bending, Unequal Lifting
4.) Working in a Single Position
5.) Whole Body Vibration

E. Other Risk Factors to Consider
1.) Floor surfaces and obstacles in the work area (housekeeping)
2.) Working Beyond Capacity
3.) Lifting Techniques
4.) Tool Belts

F.Non-Work-Related Risk Factors for MSD's

II. The Magnitude of the Problem

A. Prevalence in the Construction Industry
1.) Carpenters
2.) Concrete Finishers
3.) Laborers
4.) Welders
5.) Heavy Machine Operators

B. The Cost of MSD's

III. Ways to Address the Problem

A. Engineering Controls
1.) Tools
2.) Equipment
3.) Materials
4.) Processes

B. Administrative Controls

1.) Medical Management
a. Employee Rotation
b. Worker Placement Evaluation
c. Stretching and Strengthening Program
d. Wellness Programs
e. Return to Work Programs

2.) Education and Training
a. New-Hire and Per-Project Orientation
b. Annual Training
c. Job Hazard Analysis

d. Daily Pre-Task Planning
e. Weekly Safety Letters

3.) Behavior Reinforcement
a. DuPont S.T.O.P.

4.) Hazard Assessment
a. Checklists

5.) PPE

IV. The Ergonomic Standard

V. Summary

I. Musculoskeletal Disorders Defined

The National Institute for Occupational Safety and Health (NIOSH) recognizes that "ergonomics" is a wide-ranging term with various applications. NIOSH has recommended that the term "ergonomic disorders" be replaced with the term "work related musculoskeletal disorders." Various terms that have been used to refer to these disorders include "chronic trauma disorder," "repetitive strain injuries," "repetitive motion injuries," "cumulative trauma disorders," "overuse syndrome," and "degenerative joint diseases." (U.S. Department of Health and Human Services, 1995). The term work related musculoskeletal disorder is prefered (Lemasters et al., 1998).

As explained by Vern Putz-Anderson (1997), cumulative trauma disorders or CTD's are the result of episodes of work requiring high repetition, forceful and awkward postures, and extended periods without rest. There are many symptoms associated with CTD's including pain, restriction of joint movement, and soft tissue swelling. Furthermore, because of the slow onset and often innocuous character of the micro trauma, the condition is often ignored until the symptoms become chronic therefore resulting in permanent injury.

Numerous investigators have surveyed construction workers for symptoms of musculoskeletal pain, aching, stiffness, burning, numbness, or tingling, and have found considerable symptom prevalence (Hunting et. al., 1994; Wickstrom, Hanninen, Lehtinen, & Riihimaki,1978; Herberts, Kadefors Andersson & Petersen 1981; Bygghalsan Stockholm Region, 1991; Eastern Iowa Construction Alliance, 1991; Holmstrom et al., 1992 a,b)

Musculoskeletal disorders or MSD's, are defined as injuries and disorders of the muscles, nerves, tendons, ligaments, joints, cartilage, and spinal discs. They occur when there is a mismatch between the physical requirements of the job and the physical capacity of the human body (OSHA, 1999). Exposure to physical work activities and conditions that involve risk factors may cause or contribute to MSD's. MSD's do not include injuries caused by slips, trips, falls, or other similar accidents. Examples of MSD's include: (1) Carpal tunnel syndrome; (2) Rotator cuff syndrome; (3) De Quervain's disease; (4) Trigger finger; (5) Tarsal tunnel syndrome; (6) Sciatica; (7) Epicondylitis; (8) Tendonitis; (9) Raynaud's phenomenon; (10) Carpet layers knee; (11) Herniated spinal disc; and (12) Low back pain (OSHA, 1999).

A. MSD's Common to the Construction Industry

"More than 100 different injuries can result from repetitive motions that produce wear and tear on the body" (OSHA, 1999). The following explanation will expand on MSD's commonly experienced in the construction industry including back pain, sprains and strains, degenerative disc disease, tendonitis, Raynaud's Syndrome or (white finger disease), thoracic outlet syndrome, carpal tunnel syndrome, and carpet layer's knee.

1.) Back pain

Back pain is common among workers who perform jobs where heavy lifting and carrying is common. More than 90 percent of back pain occurs in the lower three lumbar discs. Peak occurrence takes place from ages 30-55 years of age (Johanning, 2000). Examples of trades include laborers, form carpenters, drywall installers, and scaffold erectors. The causes of back pain include repeated lifting of materials, sudden movements, whole body vibration, lifting and twisting at the same time, and bending over for long periods of time.

2.) Sprains and Strains

Sprains and strains contribute 70 percent to the amount of lost-time injuries in the construction industry. Sprains are injuries to ligaments, while strains are injuries to muscles. Strained muscles and sprained ligaments both irritate the muscles around them, adding to pain and discomfort.

3.) Degenerative Disc Disease

Degenerative disc disease results in damage to the gel-like cushions that are found between the vertebrae in the spine. A release of gel causes a lack of "cushion" which leads to pain when spinal nerves are contacted. Common symptoms experienced with this disorder include numbness, pain, and weakness, which usually occur in the legs and hips, but sometimes in the arms and upper back.

4.) Tendonitis

Tendonitis is the result of repeated movement of a joint, which results in inflammation and soreness in the tendons. Common activities associated with tendonitis include the repeated motions of using a staple gun, rotating or twisting motions (screw driving), or from

prolonged use of tools that are too small or too large for the hand. Tendonitis is most prevalent among roofers, sheet metal workers, and masons. There are different names for tendonitis depending on where the injury takes place. Tenosynovitis usually takes place in the wrist, Trigger finger can occur on the palm side of any finger, De Quervain's Disease affects the tendons in the thumb, and Epicondylitis is also known as tennis elbow. Symptoms of these disorders include a burning pain or dull ache, swelling or puffiness, snapping or jerking movements. Ganglionic cysts (often called bible bumps) are a thick mucous fluid that can form within a tendon sheath and are often reported in ironworkers or rebar tyers who constantly twist wire ties.

5.) Raynaud's Syndrome

Raynaud's Syndrome (or White Finger Disease) is often caused by the use of vibrating hand tools such as power hand tools, grinding wheels, chain saws, power snips, needle guns, jackhammers, torque wrenches, and impact tools. The disorder is the result of damage to the nerves and blood vessels in the hands and causes numbness and weakness in the hands and fingers. Raynaud's Syndrome can also cause a whitening of the fingers, hand, and sometimes the forearm to the elbow following vibration or cold exposure.

6.) Thoracic Outlet Syndrome

Thoracic Outlet Syndrome is a disorder of the shoulder that occurs when work is done overhead or heavy items are carried in the hands with the arms extended straight down causing reduced blood flow. Construction workers who are at risk of this disorder include welders, painters, and insulators. Rotator cuff tendonitis and bursitis are also common MSD's of the shoulder.

7.) Carpal Tunnel Syndrome

Carpal Tunnel Syndrome is a result of the pinching of median nerve in the carpal tunnel (Putz-Anderson, 1997). Repeated bending of the wrist, holding tools or materials tightly, or constantly pressing the wrist against a hard object, causes the syndrome. Common symptoms experienced include numbness, tingling, burning, and pain. In the most severe cases, there may be wasting of the muscles at the base of the thumb, dry shiny palm, or clumsiness of the hand. Carpal Tunnel Syndrome has been reported in carpenters, sheet metal workers, and electricians.

8.) Carpet Layer's Knee

Carpet Layers' Knee is caused by the repeated use of knee kickers while laying carpeting. Bursitis and fractures are other MSD's of the knees reported in construction workers. Tile setters, floor layers, carpenters, roofers, electricians, sheet metal workers, and insulators commonly report the syndrome. (Advisory Committee on Construction Safety and Health [ACCSH], 1999).

B. MSD Risk Factors in Construction

Complications in determining the causes of CTD's are often a result of personal factors or individual susceptibility. Factors such as worker's physical size, strength, prior injuries, and joint alignment may add to injury or contribute to the adverse effects of repeated micro trauma. Activities linked with the onset of CTD's arise from ordinary movements that may include repetitive gripping, twisting, reaching, moving, etc. These activities are often harmless by themselves until they are associated with chronic repetition in a forceful and awkward manner without rest or recovery time (Putz-Anderson, 1997).

Other risk factors that have been described by Ueno et. al. (1999) include age, physical fitness, smoking, psychosocial factors, and physical environment. As stated, workers are assumed to become more susceptible to musculoskeletal burdens in their senior years because bone mineral density and muscle strength decrease as aging proceeds. Increased levels of stress gradually increased the prevalence of lower back pain (Holmstrom, Lindell, and Moritz, 1992). Smoking has been hypothesized to reduce the body's blood flow and nutrition supply, negatively effecting tissue metabolism, thus increasing one's proneness to injury. Interestingly enough, it was stated that while smoking may be a cause of musculoskeletal pain, it might also be an effect of musculoskeletal pain (Ueno, et. al., 1999). Again, this poses large considerations on an industry where smoking is prevalent and whose workforce is aging.

There are some differences in the factors associated with MSD's of the upper and lower extremities. The hands, wrist, neck and shoulder are considered upper extremities, while the back, hips, knees, ankles and feet are the lower extremities. Risk factors for MSD's of the upper extremities may include force or muscle effort, awkward body postures, repetitive work, contact pressure, vibration, and temperature (ACCSH, 1999). Each of these risk factors will be discussed further.

1.) Force or Muscle Effort

The amount of effort it takes to perform an activity or work is considered force. Examples of activities that require exerting force or muscle effort include lifting, pushing, pulling, and gripping a tool. These are daily elements of the tasks required in construction jobs (Johanning, 2000). Recovery time can actually exceed work time for jobs with high force requirements (Putz-Anderson, 1997). Keeping the body in one position for a period of time

(for example, doing overhead work) also requires muscle effort. In general, the more force that is exerted on the body, the greater the stress will be.

2.) Awkward Body Postures

Work in non-neutral body postures (i.e. stooped positions, kneeling, lifting, and twisting) increases the likelihood of back disorders. Specifically, awkward body posture as a result of too much bending (force and lateral) and twisting (trunk rotation or torsion) increases the stress placed on the spine by disproportionately loading the spinal structures. The result can be temporary or chronic spinal postural defects and neurological compression syndromes (Johanning, 2000).

In general, a neutral position is the most comfortable working posture. This is typically when the shoulders are down and relaxed, the arms are close to the sides, elbows are bent and wrists and hand straight, similar to the posture used to shake hands with someone. When the working posture is out of the neutral position, the stress on joints, muscles, tendons, nerves and blood vessels is increased as well as the amount of muscle effort. The result is added risk of fatigue and injury. Research has indicated that posture is a significant factor in the onset of MSD's (Putz-Anderson, 1997; Armstrong, 1985).

In relation to the upper extremities, working with arms raised is an awkward posture that places stress on the muscles, tendons and joints of arms, hands and shoulders. It takes more muscle effort to work at eye height than to work at elbow height. Working at elbow height allows the body weight to push the tool being used (ACCSH, 1999).

Examples of work in construction situations that put workers into awkward positions along with ways to avoid them can be found in Appendix B – Sample Safety Meetings (Example #1).

3.) Repetitive Work

Tasks that require the worker to perform highly repetitive motions also contribute to the development of MSD's (Putz-Anderson, 1997; Hymovich and Lindholm, 1966). Performing the same motions over and over again puts stress on muscles, tendons and joints. It has been shown that even when the forces of a task are minimal, high repetition can lead to injury (Putz-Anderson, 1997; Kaplan, 1983). Carpal tunnel syndrome is an example that supports this hypothesis (Putz-Anderson, 1997; Armstrong, Fine, and Silverstein, 1985). Tying rebar, nailing a deck, and trowelling concrete are examples of repetitive tasks.

4.) Contact Stress (Tools and Sharp Objects)

Contact stress can add to the exposure of work-related MSD's. This type of exposure can result from the use of poorly designed or sharp-edged tools and construction materials. The stress experienced results from compressed soft blood vessels and nerves in the hand when tools and materials are pressed against the soft part of the palm of the hand or other soft tissues of the body. The amount of blood that gets through to the tissues is reduced when blood vessels are compressed; compressed nerves can also cause numbness and tingling. "Continuous compression may cause irreversible damage to the blood vessels, nerves and surrounding tissue" (ACCSH, 1999, p.4).

5.) Vibration from Hand Tools

Grinders, jackhammers, hammer drills (rotary hammers), and chainsaws are examples of tools that transmit vibration through the hands. Using these tools can damage the blood vessels and nerves of the hand and fingers. Cold exposure coupled with powered hand tool use increases the risk of conditions such as Raynaud's Syndrome, as cold causes the hand to grip much tighter on the tool (ACCSH, 1999).

6.) Temperature

As previously mentioned, cold can increase the risk of muscle strain because muscles tend to tense when it is cold (ACCSH, 1999). Cold weather construction is obviously more common in the northern states, but can also take place in cold indoor environments (i.e. cold storage facilities).

C. Risk Factors Related to Upper Extremity MSD's

Factors that affect the amount of force exerted on the hands, arms, and wrists include handgrip, the position of hands and arms, and the surface of objects manipulated. In relation to grip, a pinch grip or precision grasp, which uses only the fingers to hold an item, requires more muscle effort than a power grip and can cause fatigue or injury. On the other hand (no pun intended), a power grip (full-hand grip) uses the larger muscles of the arm and has about four times the strength of a pinch grip (Putz-Anderson, 1990; ACCSH, 1999).

The position of hands and arms in relation to the body is also important. The hand and wrist are affected if the use of a tool, causing the wrist to bend downward, backward, or to one side or the other. The shoulder becomes affected when the arms are extended above shoulder level. Finally, the elbow is affected most when the forearm rotates in an inward or outward rotation along with a bent wrist (Putz-Anderson, 1990; ACCSH, 1999).

The surface of objects or materials and whether or not handles are inadequate also adds to the risk of injury. A handle that is too large, too small, or too slippery for the hand is hard to hold. This causes the user to grip the handle more tightly and apply more force.

Gloves can sometimes be of assistance, but can also be a hindrance. Improper fitting gloves or gloves made of certain materials (some chemical-resistant gloves) also cause the user to grip tools more tightly. However, for certain applications, properly fitted gloves are crucial and should be worn when required (ACCSH, 1999).

D. Risk Factors of the Back

There are many common risk factors associated with injuries to the back including lifting; pushing, pulling, and tugging; twisting, reaching, sideways bending, and unequal lifting; working in a single position; and whole body vibration. These risk factors will also be further explained.

1.) Lifting

As the demands (force and frequency) of the lifting task increase, the risk of lifting-related LBP increases. A job becomes increasingly hazardous as the imposed loads (forces) exceed the individual's strength and endurance. For example, frequent lifting may only be tolerated for light loads and lifting heavy loads may only be tolerated for a very short time (Johanning, 2000). Factors such as reaching, twisting, holding the object away from the body, using one arm to lift an object, and carrying an object on one shoulder or hip also places added (and uneven) stress on the spine (ACCSH, 1999).

2.) Pushing, pulling, tugging and sliding

These are all activities that add strain to the lower back as well as the muscles, tendons and joints of shoulders, arms, upper back, and legs. Factors that should be considered include the amount of friction between surfaces, the slope of the work surface, and the weight and position of the object.

3.) Twisting, Reaching, Sideways Bending, Unequal Lifting

Any amount of twisting, reaching, or bending while lifting increases stress on the back. When the trunk is twisted while bending sideways, added stress is placed on the back. Upward and forward reaching also adds stress. Reaching upward usually causes the back to arch. Forward reaches that are longer than the length of the arm requires bending or stretching. Carrying an object on one shoulder, arm, hand or hip also requires bending or stretching. All these activities add to the stress on the spine.

4.) Working in a Single Position (static postures)

Working in one position for an extended period of time causes muscle fatigue whether it be bending over, leaning forward, working with arms above shoulder height for a period of time or even sitting for long periods. Moving around, changing positions, and resting muscles as often as possible are important activities that can help.

5) Whole Body Vibration

"Whole body vibration is mainly a problem for heavy equipment operators and truck drivers. Over time, certain types of vibration can cause little changes (cumulative trauma) in

the spine that can build up until there is permanent damage" (ACCSH, 1999, p. 9). Whole body vibration is discussed further under heavy machinery operator risk factors.

E. Other Risk Factors to Consider

Other risk factors that contribute to the development of MSD's include floor surfaces and obstacles in the work area (housekeeping practices), height of the work, working beyond the body's capacity, lifting techniques, and tool belts.

1.) Floor surfaces and obstacles in the work area (housekeeping practices)

If trash removal and orderly maintenance of the work area is neglected, accidents are almost certain to happen. "Accidents in search of places to happen seek out rubbish like vultures looking for carrion" (Fullman, 1984, p. 207). One of the simplest ways to improve safety and productivity is to plan for effective housekeeping. A slip or trip resulting from materials, wires, power cords, or tools can easily cause a back injury.

2.) Working beyond your capacity

Being physically fit has many advantages, but strong muscles and fitness do not necessarily protect the spine from injury. Lifting affects spinal discs no matter how fit or strong you are" (ACCSH, 1999, p. 10).

3.) Lifting techniques

Lifting techniques will vary depending on the size and shape of the object, the weight, and the level at which it will take place. Lifting from the ground to waist level involves leg and thigh muscles, while lifting between the waist and shoulder uses mostly back muscles. Lifting above the shoulder uses muscles of the upper back and shoulder. Using the leg

muscles to squat when lifting requires more energy, but drastically reduces the stress placed on the back. A good explanation of proper lifting techniques can be found in Appendix D.

4.) Tool Belts

Tool belts can be very heavy and result in hip and back stress. A loaded belt can weigh between 25 and 60 pounds, but the use of suspenders or integrating the tool belt into a fall protection harness can redistribute the weight. In cases where extreme weight causes subsequent shoulder discomfort, only the minimum number of tools should be carried.

F. Non-Work-Related Risk Factors of MSD's

The development of MSD's is not an exclusive result of occupational activities; non-occupational activities can produce the same types of disorders (Putz-Anderson, 1997; Cannon, Bernacki, and Walter, 1981). It has been found that athletic activity (i.e., tennis, softball); hobbies (i.e., knitting, sewing and other fine precision work), traumatic accidents (i.e., bone fractures), various systemic diseases (i.e., rheumatoid arthritis, diabetes, hormone imbalances and pregnancy), and general health and age are contributing factors (Putz-Anderson, 1990; OSHA, 1999; Armstrong and Chaffin, 1979; Ellis, 1951; Barnes and Currey, 1967; Sabour and Fadel, 1970). Free time activities, although very different from work activities, may involve similar risk factors, such as repetitive actions, mechanical stress or awkward postures (OSHA, 1999).

Individual susceptibility based on the above-mentioned factors causes difficulty in determining the difference between occupational and non-occupational MSD's. As stated by Vern Putz-Anderson (1990, p. 25), the discovery that co-workers performing similar tasks do not experience MSD symptoms "does not preclude an occupational basis for the condition due

to differences in individual susceptibility and work history." Putz-Anderson (1997) and McGlothlin, Armstrong, Fine, Lifshitz, and Silverstein (1984) stated that counseling employees on these non-occupational factors coupled with the control of occupational stresses, can reduce the frequency of disorders.

There are a number of non-physical factors that have also been described by Eckardt Johanning, MD (2000). Factors listed include monotonous work, perception of intensified workloads, limited job control and job satisfaction, low job clarity, low social support, and low morale (see Table 1). All in all, the greater number of risk factors one is exposed to and the longer the exposure, the higher the risk of developing MSD's (OSHA, 1999).

Table 2-1 Risk Factors for Low Back Disorders and Pain

Occupational
Heavy lifting and forceful movements
Whole body vibration
Awkward body posture
Job control and satisfaction
Motivation
Monotonous work load
Other
Psychological health (depression and anxiety)
Psycho-social status and support (family, friends, and work)
Socio-economic status and support (income and benefits)
Genetics and family history
Attitudes and beliefs about LBP
Age (Johanning, 2000)

Table 2-2 Risk Factors Associated with Manual Material Handling Injuries

Individual-social factors	Environmental factors	Job factor
Gender	Climate	Weight of object (mass)
Age	Vibration	Frequency and duration of lifting

Genetics/family history	Foot traction	Location of load relative to body
Body weight/height		Transport distance
Fitness/fatigue		Bending, twisting
Medical problems • Smoking, lifestyle • Psycho-social		Postural conditions and requirement (asymmetrical lifting)
Socio-economic status • Benefits/contractual arrangements		Bad coupling (contact/distance of object from workers' hands)
		Sagittal lifting angle

Note: From "Evaluation and Management of Occupational Low Back Disorders" by Ekardt Johanning, MD, 2000, American Journal of Industrial Medicine. 37: 94-111. Permission pending.

II. The Magnitude of the Problem

A. Prevalance in the Construction Industry

1.) Carpenters

Carpenters take part in all phases of residential and commercial building construction, the construction of roads, bridges, and tunnels. Thus, they are exposed to numerous chemical and physical factors (Lemasters et al., 1998). During these phases, carpenters are involved in framing and interior finishing activities, fabricating wooden forms for pouring concrete, and drywall and ceiling installation. During these activities, they will often work with tools held overhead or below waist levels, use hand held power tools in a forceful manner, perform manual hammering, grasp heavy lumber, and fasten forms. Installation of drywall and ceilings requires the repetitive grasping, lifting, forceful operation of screwguns (often above the shoulder or below the knees), and carrying gypsum boards usually weighing between 5-10 kg (11-22 lb.), but up to and over 40 kg (88.2 lb.). Activities such as these are precisely the reason why carpenters experience abuse to almost every area of the body during the performance of their jobs (Lemasters et al., 1998).

Lemasters et al. conducted a study consisting of 522 union carpenters in order to ascertain the prevalence and risk factors for work related musculoskeletal disorders.

Carpenters surveyed showed prevalence in the upper extremities. Notably, drywall or ceiling and formwork subspecialties affected the shoulders and hands or wrists (20-21%), while concrete form tasks had the highest incidence of shoulder (23.8%) and elbow (22.9%) disorders. The subjects were predominantly white males with a mean (SD) duration of employment as a carpenter of 18 (10.3) years and a mean (SD) age of 42.3 (10.6) years. In general, it was found that there was a positive relationship between the duration of employment and the prevalence of symptoms.

The effect of job related psychosocial stresses and work organization in the occurrence of work related MSD's in construction workers is also important to take into account (Lemasters et al., 1998). Carpenters along with others in the trades are constantly under the pressure of contractor and project deadlines and the contractor governs the availability of materials, tools, and material handling devices. It is also common for multiple subcontractors to be on site. This reduces the control a carpenter has on the jobsite. Previous studies have hypothesized that a worker is at greatest risk when control over a task is low, but the demands of a job are high (Lemasters et al., 1998; Karasek, 1989; Leino 1989).

2.) Concrete Finishers

Concrete workers and finishers are exposed to numerous ergonomic risk factors in their line of work. The risk factors of force (pushing and pulling), repetition, awkward postures, static postures, and vibration are all present to a varying degree based on different situations. Concrete workers, namely finishers, will most frequently experience the factors of awkward and static postures, force, and repetition.

Concrete finishers spend a great amount of time on their knees and other awkward postures. While on their knees (or sometimes crouching) finishing slabs, the finisher will

reach out over the concrete and use wide, sweeping motions with the trowel until the surface reaches the desired finish. This trowelling action exposes the worker to another risk factor - repetition. During this time, not only are the knees bent, but also the spine is deviated from side to side and the shoulders are outreached or abducted. The deviation of the wrist should also be noted while performing trowelling activities.

During the pouring of concrete slabs, the concrete finisher will often be in a crouched and bent over position while screeding the concrete. After the concrete is poured from the chute of the truck, pump truck, wheelbarrow, concrete bucket, etc., the concrete needs to be leveled. Laborers will often rake and shovel the concrete to a rough height before screeding is performed. Manual screeding is usually done with a long, straight, 2x4 or 2x6 made of wood or aluminum. This process involves two people that work together to push and pull the screed, which levels the concrete and brings the "cream" to the top. Screeding can also be done by a power screed, which also spans the width of the slab. The power screed is mechanically pulled by a motor and cable system, while it vibrates at the same time. The power screed is fast and efficient, especially in larger jobs. Because of its size and weight, care must be taken when lifting the screed in order to prevent back injuries.

Concrete finishers can also be exposed to risk factors while floating concrete. A bullfloat is used to smooth the concrete and bring the cream to the top before the brooming or trowelling stage. Although the bullfloat is usually made of lightweight aluminum, certain situations will often put the finisher in awkward and overreaching positions. For example, if a bullfloat weighs 20 pounds while holding at the center of the handle, the same float would weigh considerably more (lever arm) when outstretched and held at the very end of the handle.

The concrete finisher experiences less fatigue to the back when the pour is set up with the proper planking system. A planking system is best utilized while pouring walls and other elevated concrete structures and allows the finisher to work in a standing or slightly bent-over position. It should be noted that awkward postures and repetitive motions are still present in this case. A study conducted by Holmstrom, Lindell, and Moritz (1992), which included 206 concrete workers, indicated that longer duration of stooping and kneeling increased the prevalence rate ratio for both lower back pain and severe lower back pain. Stooping and kneeling was the most important physical risk factor for severe lower back pain, showing a dose-response relationship.

3.) Laborers

The variety of manual material handling activities and use of tools is probably the greatest for construction laborers. This wide range of activities results in large exposure to MSD hazards. In most companies, especially non-union shop contractors, laborers can be asked to assist in virtually all of the activities associated with completing a project. The term "grunt-work" is often heard when describing the duties of a laborer, which throws up a red flag ergonomically.

Construction laborers are often exposed to the risk factors of force, repetition, awkward postures, static postures, and vibration. An activity such as shoveling is an example. Shoveling is hard work that requires a lot of bending, twisting, and lifting and can be especially difficult in awkward spaces or poor weather conditions, adding to the potential for injury (WorkSafe Online, 2001).

An activity such as drilling can include all of the mentioned risk factors. Users of pneumatic drills have been reported to have degenerative arthritis of the elbow, wrist, and

shoulders (Fam & Kolin, 1986; Copeman, 1940; Hunter, McLaughlin, Perry, 1945; Schumacher, 1972, Hunter, 1978). For example, if drilling into concrete to place dowels for a construction joint, it will take force to drive the bit into the concrete, repetition because numerous holes are likely, awkward postures because the holes are probably near the ground, static postures because of the duration of drilling, and finally vibration, caused from the rotary, hammering motion. It should also be noted that older models of hammer-drills are known to "bind" while drilling, causing a violent twisting on the wrists. This will often occur when the bit contacts steel or super-hard rock.

Jack hammering, which is often performed by laborers, can have similar risks. The compressed air in pneumatic or air-driven tools acts alternately at each end of a piston, producing a vibratory effect. Pneumatic drills have a similar action, but have an added mechanism that translates the reciprocating movement into a rotary one (Fam & Kolin, 1986; Hunter, McLaughlin, and Perry, 1945). A case report, conducted by Fam and Kolin (1986), involved the study of a laborer who had been working as a jackhammer operator for 27 years. The man was forced to stop working because of increasing pain in the metacarpophalangeal joints causing a weakening of handgrip.

Other clinical effects have been associated with localized occupational vibration from the use of pneumatic tools. These effects include radiographic carpal bone cysts, soft tissue injuries (including traumatic tenosynovitis), Dupuytren's contracture, and Raynaud's phenomenon (vibration-induced white fingers) (Fam & Kolin, 1986; Hunter, McLaughlin, and Perry, 1945; Hunter, 1978).

Vibration causes the muscles to work harder. "Working with vibratory tools involves not only vibration exposure but also hard physical effort" (Bovenzi, Fiorito, and Volpe, 1987,

p.197). Based on the findings of a study by Bovenzi, Fiorito, and Volpe (1987), vibration-induced disorders in the upper extremities depends upon the factors of vibration exposure (frequency, amplitude, direction, exposure time), ergonomic factors (posture of the hands and arms, handgrip force), and on individual vulnerability to vibration. They began their discussion by stating that bone and joint disorders are prevalent among workers who use vibrating, hand-held tools.

The use of pneumatic chipping hammers also poses a large threat on the lower back. "The jackhammer is a heavy pneumatic tool" (Fam & Kolin, 1986, p.1287) that can cause repetitive or chronic strain to the back if used improperly. For example, an operator that works a jackhammer through a suspended or floating slab will experience the weight of the hammer on the back as the heavy tool falls, unless proper measures are taken/techniques used.

A study conducted by Ueno et al. (1999) consisted of 74 laborers with a mean age of 47.1 (11.4 SD). The prevalence of total pain resulted in about 25% having hand/arm pain (HAP), 27% having shoulder pain (SP), and 53% experiencing lower back pain (LBP). Data also indicated that age is a risk factor in the prevalence of symptoms.

4.) Welders

Arc welding is an occupational activity that involves static loading of the muscles, especially in the shoulder region. To add to the problem, the activity usually involves awkward working positions and heavy welding equipment (Herberts, Kadefors, Hogfors, and Sigholm,1984).

In construction activities involving field welding, it is common for welders to be perched on structures, inside elevated lifts, or on the ground and reaching above or below the body. Welders may be called upon to perform arc welding during steel erection activities or

spot welding on prefabricated concrete panels, along with the installation of fixed metal stairways and railings, mechanical equipment, the splicing of piling or sheeting, et cetera. Welding can be characterized almost exclusively as static work (Herberts, Kadefors, Andersson, and Petersen, 1981).

Studies involving electromyographic (EMG) measures have shown that localized muscle fatigue is prevalent in many shoulder muscles in a variety of work situations with the hand at or above shoulder level (Herberts et al., 1984; Hagberg, 1981; Kadefors, Petersen, and Herberts, 1976). The most important factor influencing shoulder muscle load has been shown to be repetitive arm elevations and the degree of upper arm elevation (Herberts et al., 1984; Hagberg, 1981; Sigholm, Herberts, Almstrom, and Kadefors, 1984).

Studies have shown that the prevalence of musculoskeletal pain and disorders is common. In a study conducted by Kadefors et al. (1976), it was discovered that in general, inexperienced welders showed fatigue in a greater number of muscles than did experienced welders. A similar study conducted by Herberts et al. (1981), surveyed that 35 out of 131 welders (27%) reported shoulder pain.

This study also concluded that age plays an important role in relation to diagnosed MSD's, especially supraspinatus tendonitis. "Age is most likely an important factor in terms of the progress of the disorder." (Herberts et al., 1984, p. 176). Following the study it was found that the younger welders experienced a relief in pain after rest or change of work while these same changes tended to become irreversible with the more elderly workers.

5.) Heavy Machinery Operators

Heavy machine operators are commonly found on construction sites operating a variety of machinery. Examples include backhoe loaders, graders, road rollers, scrapers, off-road truck dumpers, off-road forklifts, wheel and track-type loaders, bulldozers, excavators,

and cranes. Motor vehicle driving and prolonged sitting have been found to be risk indicators of lower back pain (Sturmer et al., 1997; Hildebrant, 1987; Riihimaki, 1991).

Among seated vehicle operators, lower back pain and back injuries are common. When an operator is in a seated position, disk pressures in the spine are higher and the changes in the motion of spinal segments result in a disengagement of the facets. Furthermore, poor body posture, inadequate seat support, and muscle fatigue have been described as contributors to the onset of MSD's of the spine in operators/drivers (Johanning, 2000; Troup, 1978; Sandover, 1981; Griffin, 1990; Dupuis and Zerlett, 1986). Other factors involved include: poor design of controls making them difficult to operate; poor driver visibility making twisting and stretching necessary when driving; other work activities that might put a strain on the back, for example handling and lifting heavy objects, and; personal factors such as level of general fitness, being overweight, and choice of leisure pursuits. Finally, age has an impact. Because the strength of muscles are still developing and the bones have not fully matured, young workers may be at greater risk of damage to the spine (Health & Safety Executive [HSE], 2001).

Adding to the ergonomic problems of operation heavy equipment is whole-body vibration (WBV). WBV can be passed through the seat to the driver's body through the buttocks or from the platform of a vehicle or machine to the operator through the feet, causing back damage (HSE, 2001). International investigators have agreed that long-term WBV resulting from engines and vehicles is an important mechanical stressor adding to early and accelerated degenerative spine diseases, leading to prolapsed discs and back pain (Johanning, 2000; Heide, 1977; Dupuis and Zerlett, 1986). The earlier mentioned construction machinery

(i.e., backhoe loaders, graders, road rollers) produce potentially hazardous levels of vibrations and shocks (Johanning, 2000).

The exposure to MSD hazards to the neck is also a concern for crane operators and operators that are frequently required to look behind them (i.e. sheepsfoot roller operator). When a crane operator constantly has to watch the boom, the load and/or the signal person, the neck is always bent back in a static posture. This constant looking up can result in headaches, sore necks, pinched nerves, and sore muscles (Electronic Library of Construction Occupational Safety and Health [ELCOSH], 2001).

B. The Cost of MSD's

Hundreds of thousands of workers are injured severely enough each year to require time away from work to recover. Nearly one hundred million workdays are sacrificed each year due to back disabilities. 5.4 million Americans are disabled from lower back pain (LBP) per year and it is the most frequent reason for filing a workers' compensation claim (Johanning, 2000). The costs incurred by industry in relation to these injuries are astronomical. According to OSHA, the workers' compensation costs that result soak up one out of every three dollars paid out from the various state industrial insurance systems. A total of $15 billion to $18 billion in direct workers' compensation costs for claims related to MSD's are paid annually by employers (Scott, 2000).

The cost of MSD's has ballooned in a matter of seven years. The average cost of a workers' compensation claim in 1986 for LBP was $8,300 and the total compensable cost was estimated to be $11.1 billion for LBP in the United States. The average cost per claim was

about twice the average cost for all other claims combined (Johanning, 2000; Webster and Snook, 1994). As reported by Johanning (2000), the cost for compensation coverage in the US was stated to be about $57 billion in 1993 with about 60% going to indemnity costs alone. In its economic analysis during the promulgation of the ergonomics standard, OSHA predicted $9.1 billion in annual savings by preventing future MSD's throughout the nation (Scott, 2000).

The incidence and prevalence of this problem is also astonishing. According to Johanning (2000), nearly 85% of Americans develop LBP at least once in their lifetime. Of all the American workers in industry, about one third are employed in jobs that may significantly increase their probability of developing aggravating back disorders and disabilities. It should be noted that most of these statistics refer only to LBP and do not include the multitude of other MSD's that are popular in today's workforce. The National Institute for Occupational Safety and Health (NIOSH) has set MSD's as their top priority for research and disease prevention efforts since 1989 (Johanning, 2000).

Based on the high prevalence and associated high costs of MSD's, companies must strive to limit their exposure to this problem. Companies operate in order to make money or profit, but expenses occupy a big chunk of income and competition limits the amount firms can charge for the goods or services they provide. Profits are usually 1% to 5% at best and each time a loss occurs, the cost of the injury must be subtracted from profits. According to Mark Stice of Eagle Insurance Companies (1996), "industrial back injuries average about $5,000 in expenses." Based on this information, each time a worker strains his back, in order to achieve necessary production levels other employees must work longer and harder to

recoup losses. For example, if a back injury occurs and does cost $5000, $100,000 dollars in additional sales are needed to recover if operating on a 5% profit margin (Stice, 1996).

III. Ways to Address the Problem

A. Engineering Controls

OSHA (1999) defines engineering controls as physical changes to a job that eliminate or materially reduce the presence of MSD hazards. Examples of engineering controls for MSD hazards include changing, modifying, or redesigning the following tools, equipment, materials, and processes.

1.) Tools

There are many ways to increase the efficiency and effectiveness of tools in order to reduce or eliminate exposure to MSD hazards. For example, hand tools should have comfortable handles with good grips (rubber or spongy) and should be the correct size for the worker's hand. They should be designed to: utilize a power grip for heavy work and a pinch grip for fine work; maintain the wrist in a neutral position; and reduce the amount of force needed (e.g., long handled bolt cutter). They should also be designed for torque reduction and use in either hand.

Vibration exposure can be limited by equipping tools such as pavement breakers, tampers, torque wrenches, and pad sanders with vibration absorbing padding on grips/handles.

Tools should be as light as possible through design and/or maintenance. For example, an aluminum concrete chute weighs considerably less than the steel ones that are most commonly used. A poorly maintained concrete shovel (or other tools) that is not properly

cleaned will become loaded with concrete and will add burden to the worker. Cutting tools should be sharpened for the same reason.

Whenever possible, power tools should be used. Numerous tools are available that drastically increase productivity and reduce repetitive motions. Examples include nail guns, cordless drills, standing rebar tyers, electric saws (circular, reciprocating, band), etc. (ACCSH, 1999).

2.) Equipment

Rely on equipment, not backs, for heavy or repetitive lifting (OSHA, 1999). Many different types of equipment can be used including carts, dollies, hoists, mechanical handling devices, ladder hoists, gin poles, daisy chains, cranes and slings/chains/hooks, on/off-road forklifts, motorized buggies, carrying handles, and extension handles (ACCSH, 1999).

Equipment that can be used to reduce exposure to awkward postures includes scissors lifts and aerial work platforms, extension poles/stands for operating tools overhead, drywall lifts, stilts, material lifts, and jacks. Exposure to heavy equipment operators can be reduced by better cab design, adjustable seats, ergonomically designed levers, pedals and foot rests, wrap around windshields, multiple, properly positioned mirrors, and tinted windows.

Steps can be taken to limit the exposure to whole body vibration that is experienced by heavy equipment operators as well. Improvements can be achieved through vibration-dampened seating, a dampened and/or well-tuned engine, cutting or power-head vibration dampening, chassis isolation, and vibration dampening flooring. (ACCSH, 1999, Health & Safety Executive (2001).

3.) <u>Materials</u>

The handling of materials is going to depend on the resources available and the scope of the job. For example, if rebar tyers are placing reinforcement for a small concrete pour it is possible they may handle the bar manually. In this case, it becomes obvious that the bundle of rebar should be split up into a manageable load for one or two people to carry. If there is a large job or the transport distance is large, a crane with slings or forklift would be a better option.

The weight of the construction materials themselves can be reduced in order to ease handling. Examples include light-weight concrete blocks, fiberglass ladders, or three foot wide drywall which is currently used in Europe. Cement mix companies can offer cement in smaller (47 lb) packages (ACCSH, 1999).

4.) Processes

It is important to find ways to reduce repeated motions, forceful hand exertions, prolonged bending or working above shoulder height (OSHA, 1999). Determining ways to bring work within reach is important. Tables/stands/saw horses can bring work to waist height. Other examples include adjustable height scaffolding for bricklayers, pipe stands for steam-fitters/plumbers, and mechanical carpet stretchers for carpet layers. An example of a process solution to avoid the forceful, repetitive, awkward/static postures, and vibration exposures involved with drilling is to avoid drilling by casting sleeves in concrete (ACCSH, 1999).

B. Administrative Controls

Vern Putz-Anderson (1997) describes administrative controls as those actions taken by management or medical professionals in order to limit the potentially harmful effects of a physically stressful job on individual employees. Administrative controls focus on personnel

solutions such as worker training, job rotation, and matching employees to job assignments. OSHA (1999) describes them as changes in the way that work in a job is assigned or scheduled that reduces the magnitude, frequency, or duration of exposure to ergonomic risk factors. Examples of administrative controls for MSD hazards that will be discussed include medical management, education and training, behavior reinforcement, and hazard assessment. Included in medical management will be employee rotation, worker placement evaluation, stretching and strengthening, wellness programs, and return to work programs. Education and training will include new-hire and per project orientation, annual training, job hazard analysis, daily pre-task planning, and weekly safety letters. Behavior reinforcement will include discussion of the DuPont S.T.O.P program and hazard assessment will consist of a checklist discussion.

1.) Medical Management

The early reporting of MSD's or MSD symptoms along with the proper detection and management of current problems can drastically reduce the pain and suffering experienced by employees along with the subsequent reduction in excessive workers' compensation costs.

As stated by Charles Jeffress at the BEACON Biodynamics and Ergonomics Symposium (2000) (can be found in Appendix A), "the key to preventing serious disability as a result of MSD's lies in early reporting. And more than any other OSHA standard, the ergonomics proposal depends upon individual workers coming forward promptly to report their injuries." Jeffress went on to point out the problem of the reluctance that workers often have in reporting problems. Workers who assume that reporting MSD symptoms will result in lost pay will often put up with the pain, which invariably leads to problems. Workers

should be provided paid sick time and encouraged to report problems early, before irreversible damage occurs.

Other MSD controls that will be discussed under medical management include employee rotation; worker placement evaluation; stretching/strengthening, wellness, stress management, and return to work programs.

a.) Employee Rotation

Employee rotation can be an effective control against MSD's, but there are some issues to consider. The goal of worker rotation is to limit the exposure to MSD hazards by reducing the duration of exposure to tasks that require stressful postures, forces, and highly repetitive activities. Employee rotation will vary depending on the strengths and limitations of each worker and the degree of risk the job/task presents from an ergonomic standpoint. It is also important to realize the MSD hazards of the rotating tasks to ensure that similar hazards are not encountered when a switch is made, thus failing to provide improvement (Putz-Anderson, 1997).

As mentioned earlier, the activities that take place in the construction industry are more dynamic and widespread as compared to the often-repeatable tasks of general industry. As a result, rotation may vary and be more spontaneous in the construction industry. To apply an example, say one employee is required to grind the imperfections from a freshly poured and stripped retaining wall that is 150 feet long. This task could invariably be performed for the whole duration of a few days, which could create stress to the wrists and shoulders. A good practice would be to pull a laborer from another task to "break up" the day by rotating jobs.

Unions also have implications on job rotation. Unionized construction companies will have employees that are more likely to have repeated activities because workers are

specifically trained and contracted to perform a specific trade. On the other hand, non-unionized companies are more flexible with work assignments. For example, a non-union contractor may decide to allow a crane operator to assist in something like concrete pouring if there is currently an excess of operators and a shortage of concrete workers in relation to the amount of work available at one point in time. With this comes the issue of training. Employees switching trades should be aware of the specific hazards and internal work standards in place for the activity they are about to perform.

b.) Worker Placement Evaluation

Worker placement evaluation has been promoted as another way to address the risk of overexertion injuries and musculoskeletal disorders. The basic premise is to match workers to the job based on their capabilities. Thus, a revisit to the definition of ergonomics becomes necessary. Ergonomics is the science of fitting the job to the worker. It encompasses the body of knowledge about physical abilities and limitations as well as other human characteristics that are relevant to job design (OSHA, 1999).

From a legal standpoint, the U.S. Federal Rehabilitation Act of 1973 and the more recent Americans with Disabilities Act of 1990, prohibit worker selection based solely on physical capacities. However, following a job offer, but prior to job placement, workers can be tested to determine capabilities (U.S. Department of Health and Human Services [DHHS], 1995).

The first step of this process is establishing job description, which accurately describes the job. "The success of any placement program is dependent on obtaining accurate information on actual job demands as well as with the accuracy of measurements of worker capacities as they relate to the key job demands" (DHHS, 1995, p. 42). Job factors and demands include the intensity of effort; duration of effort; frequency of repeating the effort,

along with the presence of mental or environmental stressors such as time pressure, heat, humidity and the physical characteristics of age, fitness, and skill level (DHHS, 1995; Rodgers, 1988).

It was also stated that epidemiological studies have shown that strength testing could be a useful means of lowering back injury rates. Notably, it was also stated that a worker's maximum strength might have little correlation to his or her ability to exert effort frequently or for long durations, limiting effectiveness (DHHS, 1995).

Michael Barkowski MD, MDH (1999), stressed the importance of thorough training and follow-up, adequate coworker assistance/mentorship, substance abuse testing, symptom surveys, and necessary strengthening or conditioning in the early stages of placement. He pointed out that certain job modification to better fit the workers' capabilities is another option.

c.) Stretching and Strengthening Program

Stretching and strengthening programs have proven to be successful in the reduction of work related MSD's. Cianbro Corporation, one of the East Coast's largest and most diversified heavy civil and industrial construction companies, has illustrated this point. Cianbro realized that muscle pulls and back strains were a major contributor to back injuries back in the late 1980's and started to take a closer look at injury management through stretching and strengthening. "The results have far exceeded expectations, beyond the safety numbers" (Adamchik, 2000, p. 2).

"Although the stretching program was not the only safety initiative Cianbro implemented during this period, it was the most unique" (Adamchik, 2000, p. 1). Along with

this initiative, Cianbro implemented a "back school" and used stretching to enhance their "daily huddle" meetings. The results of the initiatives is shown in the following table:

Table 2-3 **Cianbro Corporation Loss Statistics**

Year	Recordable Injuries	Lost-Time Injuries	Lost Days	Recordable Injury Rate	Lost-Time Injury Rate
1988	435	66	777	4.16	30.40
1993	146	9	263	.64	10.32
1998	67	2	4	.13	4.24
1999	67	2	4	.13	4.2

Note: From "It's a Stretch" by Walter Adamchik, 2000, Job-Site Supervisor. Permission pending.

Cianbro recently instituted behavioral based safety training (BST) and a safety-trained supervisor (STS) programs to assist in risk control.

Basically, a job supervisor organizes the workers in the morning to perform group stretching while discussing safety and planning issues along with production goals. Data has indicated that mobility and trunk flexibility are significantly lower in the morning than later in the day. Injuries can be avoided by performing a few minutes of stretching to warm up cold, stiff muscles and tendons (Stice, 1998).

One may call a construction worker and industrial athlete. The fact is no athlete would exert him or herself fully without a proper warm-up, but workers often jump into a difficult job to start off the day hoping to get done with it while feeling rested. MSD's can be attributed to this cause (Fullman, 1984).

Muscle strength has also proven to be important in the prevention of injury. Strong muscles are important to move vertebrae, protect joints and ligaments, and to provide a balance of flexibility and stability. Examples of stretching and strengthening activities suited for both home and on the job can be found in Appendix D.

Cianbro's program has become increasingly popular and has experienced expanded participation. Some employees go as far as to perform stretching at lunch break, which also allows supervisors to re-emphasize topics that were discussed in the morning. It has been found that stretching should also be performed following workday activities to assist in the body's recovery (The St. Paul, 2000). Furthermore, Cianbro's stretching program has extended to employees on the executive committee along with the maintenance and fabrication shop at its Pittsfield, Maine region (Adamchik, 2000).

Employees at Cianbro have obviously embraced the idea of stretching and strengthening to reduce exposure to work related MSD's though skeptical at first. "..the stretching program at Cianbro is no laughing matter and has become part of the fabric of the company" (Adamchik, 2000, p.1).

d.) Wellness Programs

The basic idea of wellness programs is to encourage employees to take responsibility for their lifestyle and habits and not to rely on the medical community to "fix" problems with pills or surgery. Again, Peterson (1989) gets into the issue of symptoms versus causes. The medical profession works to resolve illness and not just numb the effects.

Estimates have suggested that as high as 70 percent of illness and over 50 percent of medical costs are attributed to our lifestyle. Coronary heart disease, the leading cause of death in America, is an example. Factors such as cigarette smoking, family history, high blood pressure, obesity, diabetes, sedentary habits, and personality all contribute to the disease.

The following elements could make up a wellness program:

- An exercise/fitness program
- A health appraisal program

- A substance abuse program
- Smoking cessation programs
- Nutrition programs
- Stress control
- Asymptomatic approaches
- Employee Assistance Programs (Peterson, 1989)

e.) Return-to-Work (RTW) Programs

Return-to-work programs are an effective way to reduce the costs associated with MSD's. "A recent review of the studies about accelerated RTW and modified work programs showed positive effects in most cases in the reduction of long-term disability" (Johanning, 2000, p. 105). When an employee is off of work for back or carpal tunnel problems for example, the costs are immense. Under workers' compensation law, employers are not only required to pay 100% of the medical fees, but are also required to pay temporary total disability payments. Temporary total disability benefits are equal to 66 2/3% of the average weekly wage up to the state's average weekly wage per the employee's work classification. The fact that the average recovery time for carpal tunnel syndrome is 28 days (more time than necessary for amputations or fractures), presents large implications on cost (Jeffress, 2000).

Effective return-to-work programs usually contain some variation of job analysis, functional capacities evaluation, job/capacity matching, program design, work hardening, and internal transfer. The costs of injuries or illnesses can be reduced under RTW programs because (1) the duration of the claim is reduced, (2) the claim becomes a temporary partial, rather than a temporary total claim, (3) a properly structured RTW program projects a sense of employer concern for workers, and (4) can help employees feel productive and useful, and (5) the employer can reduce the indirect costs associated with worker injuries (i.e. hiring temporary help) (Johanning, 2000). Johanning went on to say that RTW success may be

improved with better pain reduction, improved strength and endurance, and better psychological health and life satisfaction with regard to patients with lower back pain.

Return-to-work programs are not foolproof. It is important to realize that rushing an employee back to work might lead to re-injury or complications. A properly designed RTW program will not present itself as a way for employees to "freeload." Finally, the fact that some employees will not want to return to work is common, especially when work is uninteresting or if the employer-employee relationship is poor (U.S. Department of Health and Human Services, 1995).

2.) Education and Training

Education and training is a vital component in controlling MSD's. Education is basically the acquiring of knowledge, while training is a means of obtaining knowledge through performance-based learning (Taylor, 2001). Outside resources such as insurance companies and other ergonomic consultants can provide effective assistance with ergonomic training. Many of the materials provided in Appendix B show examples from The St. Paul and Eagle Insurance companies.

Training on MSD prevention should focus on reducing the number and types of awkward wrist, arm, shoulder, and back postures, minimize the levels of mechanical forces applied, and reduce the number of repetitive motion patterns. Training should not only be informative, but should be effective (Putz-Anderson, 1997).

According to Putz-Anderson (1997), a number of factors can reduce the effectiveness of training:

7.) The accustomed way of doing things may be an ingrained habit.

8.) There may be production pressures to take shortcuts.

9.) The new way may be more difficult or more time-consuming.

10.) The threat of developing MSD's may seem remote.

11.) The work process, (job layout as designed) may not permit the prescribed actions needed to reduce MSD risk factors.

12.) The weight and shape of the materials handled are usually beyond the worker's control.

Kiley Taylor, Manager of Training Services at Zephyr Environmental Group, stated that the five steps to effective training include: (1) tell them what to do, (2) show them what to do, (3) let them try it, (4) observe the behavior, and (5) praise the progress or redirect behavior. He stated that learning is most effective (90%) when people see what to do and then practice. A Chinese proverb that is related reads "I hear, I forget, I see, I remember, I do, I understand" (Taylor, 2001).

Basically, the work behavior depends on the priority. A supervisor that is always pushing production will likely have a workforce that takes shortcuts. The priority of safety must be supported by upper management and portrayed to the employees. Risk control must be part of the culture. Dan Peterson (1989, p. 32) had a fitting quote in relation to this idea: "We do not want production and a safety program, or production and safety, or production with safety – but rather, we want safe production."

There are many ways to provide training to employees. Employees should receive repeated training both before and during hire or the performance of activities. Such training methods to be discussed include new-hire and per-project orientation, annual training, job hazard analysis, daily pre-task planning, and weekly safety letters.

a.) New-Hire and Per-Project Orientations

The employee should be introduced to the risk factors and safe work procedures that that affect them ergonomically during the new-hire orientation. "One out of five serious injuries or deaths involve workers who have been employed on the job site from zero to thirty days" (The St. Paul, 2000. p. 3). This statistic is based on new or "green" employees as well as "veterans" and illustrates the importance of effective new hire safety orientations. An improper lift can easily result in serious injury.

The new hire safety orientation should consist of a statement of the company's commitment to safety, requirements for personal protective equipment and clothing, an explanation of substance abuse policy, a review of typical hazards present on construction sites, procedures for reporting accidents and injuries, training on safe work practices, and more (The St. Paul, 2000).

Orientation should not be limited strictly to new-hires as proven in the above statistic. Employees arriving on site for the first time should receive an explanation from a project supervisor as well as a tour to point out job-site specific hazards. Something as simple as a colored sticker on a hard hat can indicate to supervisors and co-workers those who have completed the project orientation.

b.) Annual Training

It is critical to get employees involved during training. The more they take part in and contribute during training, the more empowered they will feel. They should be asked to identify the specific tasks that they feel contribute to pain and lost workdays. The employees should then be asked what changes can be made that would make a difference (OSHA, 1999).

c.) Job Hazard Analysis

A job hazard analysis (JHA) is a procedure used to identify the basic steps of a job, uncover the hazards associated with these steps, and recommend safe work procedures to eliminate or control the hazards. The primary steps in completing a JHA include:

1. Determine the jobs to be analyzed
2. Break the job down into a sequence of steps.
3. Identify the hazards associated with each step.
4. Recommend safe work procedures, controls, or safeguards to minimize or eliminate the hazards.

Once a specific job has been selected for analysis, it must be broken down into basic sequential steps. Determining job sequences is best accomplished by direct observation of the job being performed, along with employee input. The average job can be expected to fall in the range of five to eight steps. If more steps are needed to accurately describe the work, consideration should be given to split the job into segments and analyze each segment separately.

After the steps are listed, hazards relating to the steps are determined. All actual and potential hazards are identified whether they could result from an unsafe act or condition or both.

The next phase of the JSA is the development of recommended procedures or safeguards. Basically, it is determined whether the job could be performed in another way to eliminate hazards or whether safety equipment and precautions are needed to reduce the hazards. It is important to be specific; merely writing, use caution or be careful is not useful information. The action should be listed in a way that will help a worker who is learning the job. After the JHA is completed, it should be reviewed with the employees performing the job to make sure each step has been included in all hazards identified (The St.Paul, 1996).

The benefit of performing JHA's is that it serves as a tool to train employees how to carry out the specific tasks that make up a job and establishes a level of performance that is expected. The process can be used as a control to measure the performance of employees, management, and supervisors as to how an organization is performing in relation to their internal set standards.

The downside of the JHA that must be realized is that it is a tool to be used for long-range commitment. The process is not something that happens in a short period of time. In order to get started, there must be total management commitment and teamwork. The process involves an enormous amount of paperwork. Ideally, a system should be developed so that the JHA process becomes part of everyday operations without becoming a burden. When performed correctly the JHA results in efficient and effective operations with a minimization in loss (Olson, 1994; Petersen, 1989, Roughton, 1992).

d.) Daily Pre-Task Planning

Whether you call it daily pre-task planning, safety huddles, safety day-by-day, or the like, the main concept is preplanning. Daily planning is not only effective from a safety/risk control standpoint, but also production. As previously mentioned in stretching and strengthening above, Cianbro Corporation has found this to be true. "The huddle builds a sense of teamwork and camaraderie while enhancing productivity" (Adamchik, 2000).

People have brought up a couple drawbacks to the idea that can easily be addressed. The first argument is that the meeting takes too long and will cut into production time. The fact is, these meetings last only five to 10 minutes and "companies who regularly meet with workers at the beginning of the work day often see an increase in productivity" (The St. Paul, 2000, p. 5).

The other argument could be the difficulty of arranging large groups of employees on large jobs, all in varying locations. Each foreman can perform a huddle with their crew with topics that pertain to the project as a whole and topics specific to the crew.

Cianbro instructs their field supervisors to ask three questions at a huddle:

1. Are there any safety issues that we must correct to avoid injury?
2. Is there a better way to do what we are planning to do?
3. How much production are we going to achieve today?

(Adamchik, 2000)

Other important issues may include:

1. Welcoming new-hires (or transferred employees) if any, and briefly reinforcing company safety policies.
2. Review the huddle of the previous day as well as safety issues noted by supervisors.
3. Encourage worker discussion of ways to increase productivity.
4. Assign tasks or review ongoing tasks.
5. Discuss safety issues related to task assignments.

(The St. Paul, 2000)

Another important aspect of the pre-job meeting is to evaluate the condition of employees. The supervisor conducting the meeting can assess behaviors that may indicate influences of drugs or alcohol or personal issues that may make them a danger to themselves or others on the job (Const. Safety Mgmt Day by Day, pamphlet; Adamchik, 2000). "A good supervisor notes little signs that a worker is not up to his [or her] usual self and keeps and eye on [them]" (Fullman, 1984). A supervisor who encourages participation from the employees may be able to get a more accurate assessment. The degree of fitness can be judged to decide if the employee needs to be started out in a low risk activity up to removal from the job.

e.) Weekly Safety Letters

Weekly safety letters or tool box talks can be a very effective way to relay important material that is relevant to the work the employees are performing. Information on new or changing standards, or simple reminders about how to perform a certain process or use tools

in a safe manner. According to James J. Keller, Executive Vice President of J.J. Keller & Associates (2000), a safety letter is an excellent way to keep employees informed about critical safety issues, prevent accidents and injuries, avoid stiff fines for non-compliance, and build employee morale.

In order for weekly safety letters to be effective, some considerations need to be made. In the absence of daily pre-task meetings, the effectiveness of the weekly safety letter diminishes. First, anticipating all the safety issues to be encountered for the week is unreasonable. Second, the common, "canned" safety messages may have little or nothing to do with the actual work that is being performed for the week (Const. Safety Mgmt Day by Day, pamphlet).

Nonetheless, it was stated by St. Paul Construction (1996) that toolbox talks can make an impact by offering the opportunity to cover broader topics, introduce new safety procedures, reinforce current company practices, or discuss upcoming safety issues in depth. Numerous examples of safety letters pertaining to ergonomics and back safety can be found in Appendix B.

3.) Behavior Reinforcement

a.) DuPont S.T.O.P. Program

Behavioral based safety is a hot topic in today's safety world that can be utilized as another tool to control ergonomic or MSD hazards. The DuPont Safety Training Observation Program (STOP) is an example of a system based on behavior modification through employee observation. Employees are trained to decide, stop, observe, act, and report on a daily basis as part of regular work in an effort to enhance safety performance (DuPont, 1992).

STOP observations can provide both negative and positive reinforcement, although it is a nonpunitive tool. The tracking and trending of STOP observations can provide an accurate picture of the high problem areas relevant to PPE and the positions and reactions of people in order to direct efforts for improvement. Trend charts can also be used to determine the percentage of unsafe acts based on the time of year, type of project, or other relevant information.

According to DuPont, unsafe acts contribute to lost workdays and restricted workday injuries by 96%. For example in 1996, 1,026 construction workers died from on-the-job accidents and 923 (90%) were attributed to worker errors (Const. Safety Mgmt Day by Day, pamphlet). As previously illustrated, many of these unsafe, injury causing, acts, are attributed to poor lifting procedures, working in awkward postures, using the wrong tool for the job, etc.

Safety management principles discussed by Petersen (1989), show a different viewpoint on human behavior. Petersen stresses the need to look past the symptoms or "proximate" causes of accidents and look for "root" causes. Simply placing blame will only result in adversity between the employee and the supervisor. For example, if employees are commonly putting themselves at risk by lifting improperly, it is likely that the management system lacks effective education and training or do not provide effective lifting aids. Petersen's first principle (modified by Olson) states that an unsafe act/condition, an accident, an injury/illness; a loss, are all symptoms of operational errors within the management system (Olson, 2001; Petersen, 1989).

4.) Hazard Assessement

a.) Checklists

A checklist is a useful tool that can assist supervisors and other management personnel in the detection of hazards on the work-site and help to identify solutions. Checklists serve as reminders to look at the most important activities related to MSD's and afford consistency in data collection. A number of checklists have been developed by the ACCSH and can be seen in Appendix C. These checklists can be customized to fit the specific needs of the contractor (ACCSH, 1999).

5. Personal Protective Equipment (PPE)

OSHA has suggested personal protective equipment (PPE) as the least preferred intervention strategy for controlling ergonomic hazards (DHHS, 1995; OSHA, 1990), but may prove to be necessary and effective in many situations where engineering and/or administrative controls are not feasible. PPE assists in reducing exposure to an acceptable level, although seldom provides complete protection from exposure to significant hazards (DHHS, 1995; Moran and Ronk, 1987).

As stated by the U.S. Department of Health and Human Services (1995), braces, wrist splints, back belts, etc., do not provide a barrier between the worker and the ergonomic hazard. Thus, they are not considered PPE. "There is little research evidence to demonstrate that these devices limit the risk of injury" (DHHS, 1995, p. 44).

PPE that could be considered effective in the construction industry includes kneepads or pants with kneepads, shoe inserts/insoles or floor mats, anti-vibration gloves, shoulder pads, and tool belts with suspenders. Shoulder pads could be effective for people who often carry materials on their shoulders. Adding suspenders to a tool belt or integrating the tool belt with the full body harness can reduce the stress placed on the back and hips. Finally,

depending on composition and construction, vibration-attenuating gloves have been shown to be effective at absorbing much of the vibration energy that would otherwise be transmitted to the hand (DHHS, 1995; Goel and Rim, 1987).

IV. The Ergonomic Standard

To the relief of many, on Wednesday, March 7, 2000, Congress rejected the proposed standard. Prior to the decision, Sandherr of the AGC (2000) went on to say, "the Ergonomic standard is a clumsy safety tool that will not improve worker safety. The standard is a political prescription to a medical problem and it creates more uncertainty than certainty. It creates an uncertain baseline for compliance, an uncertain diagnosis of injury, an uncertain remedy for injuries, an uncertain impact on state workers' compensation plans all under the uncertain legality of the rule itself." Dave Bauer (2000) of the American Road & Transportation Builders Association (ARTBA) buttressed the statement by stating that the standard could require employers to spend extensive resources to change their work environment because of a single employee injury, force an employer to pay for medical visits for an injury that may not be work related, and could supersede existing workers' compensation benefits.

Congress, along with the new presidential administration, has intervened and prevented the standard from becoming law. Prior to this ruling, Lund (2000) released an article stating that even if the standard were to be revised or repealed, "an ergonomic standard which includes the prevention of and response to MSD's is likely to be the subject of some form of OSHA rule." As a result they advised employers to become better informed and take steps toward improving workplace ergonomics and employee training to prevent MSD's.

Further discussion of many of the relevant points that were discussed on the proposed ergonomic standards is explained by Charles Jeffress and can be found in Appendix A.

V. Summary

This review of literature examined information from existing research that applies to musculoskeletal disorders (MSD's) in the construction industry. This review began with an explanation of MSD's along with common MSD's that are diagnosed in the industry. Next, the review explained the risk factors that are prevalent in the construction industry followed by specific examples of trades common to Edward Kraemer & Sons, Inc. Ways to address the problem were given, followed by examining engineering controls, administrative controls, and personal protective equipment. Finally, the review concluded with a brief discussion of the developed ergonomic standard.

CHAPTER 3

Methodology

Introduction

The purpose of this study was to identify and assess the magnitude of losses due to work-related MSD's at Edward Kraemer & Sons, Inc. (EKS) and the exposures that contribute. Following assessment, controls including prevention and reduction can be targeted and implemented, thus producing large impacts on productivity, morale, and ultimately the bottom line. The exposures were identified through job hazard analysis (JHA) and the analysis of EKS workers' compensation records for the years 1997 through 2000 served as the prevalence indicator.

EKS primarily constructs bridges, dams, retaining walls, and other civil structures and currently has offices located in Wisconsin, Minnesota, Colorado, Arizona, Missouri, and Utah. EKS typically employs 500-750 workers of varying age and experience that mainly consist of laborers, carpenters, concrete finishers, mechanics, welders, and heavy equipment operators.

According to Nick Vranak, Loss Prevention and Control Manager at EKS, it was perceived that work related MSD's account for over 60% of workers' compensation costs at EKS on average. The year 2000 was perceived to be above average at about 75%.

This chapter describes the means by which pertinent data was collected and organized in order to conduct this study.

Job Hazard Analysis (JHA)

Job hazard analyses (JHA's) were conducted for the major activities that EKS performs in their normal operations. The process involved first; determining the job(s) to be analyzed, second; breaking the job down into a sequence of steps, third; identifying the hazards associated with each step, and fourth; recommending safeguards to minimize or eliminate the hazards. Assistance on the determination of job steps, recognition of hazards, and formulation of safe work procedures came from the EKS Loss Prevention and Control Manager and various EKS Project Managers/Engineers. The resulting safe work procedures were exemplified in a process called T.H.I.N.K. T.H.I.N.K is a process that has proved to be beneficial for both the planning and communication of jobsite hazards common to EKS. The majority of the program can be found in Appendix A – T.H.I.N.K. description and T.H.I.N.K. sheets. The acronym stands for:

Task identification.
Having the necessary tools, equipment, and PPE to perform the job safely.
Itemizing the steps, hazards, and safe work procedures to be followed to complete the task safely.
Notifying others to enhance safety and awareness during the task.
Knowing the detailed safe work procedures and OSHA standards that pertain to the task found in the EKS Safety Shorts.

Loss Analysis (W.C. Records)

In order to identify and assess losses, workers' compensation records from 1997-2000 were obtained from EKS Risk Manager, Sharon Schlieckau. The data was presented in an Excel spreadsheet and included the following information:

- Employee classification number
- Claim number
- Date of birth
- Date of hire
- Affected body part
- Cause of claim (i.e. sprain/strain)
- Project number

- State employed
- Trade
- Total incurred costs including paid compensation and medical and reserves in compensation and medical.
- Job supervisor

Once obtained, specific data was queried by various pull-down menus in the spreadsheet in order to categorize losses as follows:

- Total injury prevalence per year pertaining to all body parts
- Total injury prevalence per year pertaining to all MSD affected body parts
- Prevalence of MSD's (e.g. sprains and strains) per year per body part
- Percentage of MSD's as compared to total injuries
- Prevalence of MSD's per trade per body part (e.g. back, shoulder, wrist, knee, elbow, arm, leg, finger/thumb, hernia/groin/ab, torso, foot, neck, hand) with age and experience categories

Age and experience categories are as follows:

Age Categories:	Experience Categories:
A = 20-33	A = 0-5
B = 34-42	B = 6-11
C = 43-48	C = 12-17
D = 49-56	D = 18-23
E = 57-70	E = 24-29

- EKS ages compared to prevalence of MSD's per year
- EKS experience compared to prevalence of MSD's per year
- Total incurred costs per year per MSD affected body part
- Total MSD costs per year per body part
- Percentage of MSD only costs as compared to total injury costs

Once the data was categorized, tables were constructed for each of the areas. Prevalence along with total incurred costs were then broken down further to determine the highest areas of loss for each category and percentages to gain a perspective of the amount of loss compared to the whole picture. Some tables were then formulated to help indicate trends and relationships in the data.

CHAPTER 4

The Study

Introduction

Companies tend to downgrade the significance of worker's compensation costs compared to compliance-based activities. A loss run analysis of worker's compensation data can provide a map of where losses occur and insight to causality. The realization that worker's compensation losses are a direct drain on the profits of the company is crucial. This study was conducted to determine the various contributing risk factors in relation to MSD's along with the largest areas of monetary loss and prevalence at Edward Kraemer & Sons, Inc.

Study Objectives

1. Determine factors that contribute to EKS's exposure to work-related MSD's.
2. Determine the prevalence of MSD's at EKS with an emphasis on the impact of age and experience.
3. Analyze the total losses incurred as a result of MSD's at EKS.

The Study

The study was initiated by conducting job hazard analyses (JHA's) on the various activities that EKS performs in their normal operations. Once the JHA's were established, a closer look was taken to determine those hazards that affect the workers from an ergonomic standpoint (see Appendix A). Next, EKS worker's compensation loss records for years 1997 through 2000 were obtained and then sorted into the following tables with emphasis on injury prevalence and monetary impacts. Specific body parts are categorized along with trades, age, and experience broken down by year with totals and percentages to aid in the determination of severity.

Objective 1

The first objective of this study was to determine the activities that EKS performs during normal operations that may contribute to MSD's. Employee job descriptions for EKS Carpenters, Laborers, Concrete Finishers, and Operators can be found in Appendix A. The job descriptions give an account of essential employee duties and responsibilities, frequent and occasional requirements, physical demands, environment/health exposures, and commonly used tools. MSD hazards that were found to be present following job hazard analysis included material handling activities, work in awkward positions, and vibration exposure. Repetitive motions are also common, but vary depending on such factors as the size of job, schedule, and size of the workforce. The T.H.I.N.K. sheets found in Appendix B describe the result of job hazard analyses and the exposures associated with common EKS tasks.

Material handling activities are present in almost every task involved with typical EKS operations, but with varying sizes of materials, tools, and equipment. These activities present hazards of overexertion and bending/twisting injuries. Material handling is common while unloading trailers during the mobilization stage, placing filter fabric and rip-rap, lifting and positioning piling, placing falsework, decking materials, and rebar, forming and stripping abutment, wall, or parapet concrete forms and planking, and placing concrete.

Working in awkward positions is also common on EKS jobsites. Awkward positions are common while performing any of the material handling activities especially if the material/tool/equipment is in a position that requires reaching or bending over. Awkward positions are common during demolition activities, placing falsework, decking, formwork, rebar, concrete, and piling.

Finally, vibration exposure is common at EKS because of the various tools commonly used. Jackhammers, chipping hammers, impact wrenches, rivet busters, and concrete vibrators are common during demolition activities, steel dismantling and erection, and concrete placement.

Objective 2

Objective number two was aimed at determining the prevalence of MSD's at EKS as well as the results of age and experience with regard to prevalence. All of the body parts listed in the worker's compensation records included backs, shoulders, wrists, knees, ankles, elbows, arms, legs, fingers/thumbs, hernia/groin/ab, torso, feet, neck, hands, body, face, eyes,

ears, skin, hips, respiratory, head, mouth and teeth, and toes. The total number of injuries that occurred in the four-year analysis is shown in Table 4-1. As seen in the table, the three most prevalent body areas for injury are backs, knees, and fingers/thumbs.

Table 4-1 Total Number of Injuries Per Year for All Body Parts

Body Part	1997	1998	1999	2000	Total
Backs	15	17	20	14	66
Shoulders	6	6	7	1	20
Wrists	4	1	6	1	12
Knees	5	11	17	6	39
Ankles	6	1	3	1	11
Elbows	5	4	5	3	17
Arms	1	8	3	1	13
Legs	3	7	5	3	18
Fingers/Thumbs	12	12	15	6	45
Hernia/Groin/Ab	5	1	4	2	12
Torso	3	4	4	2	13
Feet	4	6	7	4	21
Neck	0	1	3	1	5
Hands	7	8	3	4	22
*Body	0	6	3	2	11
*Face	0	3	5	2	10
*Eyes	8	4	14	5	31
*Ear	1	2	2	0	5
*Skin	4	3	10	0	17
*Hips	2	0	0	0	2
*Respiratory	1	1	5	0	7
*Head	2	3	4	1	10
*Mouth & Teeth	2	1	2	3	8
*Toes	1	0	1	1	3
Totals	97	110	148	63	418

*No reported relationship with MSD problems

Table 4-2 shows similar information although it includes only those areas of the body where MSD's were reported. Nearly all of the reported MSD's were classified as "sprains and strains," while a couple were listed as "occupational." Backs, knees, and fingers/thumbs remained the most prevalent body areas while dealing with the MSD only category.

Table 4-2 Total Number of Injuries Per Year Per MSD Affected Body Part

Body Part	1997	1998	1999	2000	Total
Backs	15	17	20	14	66
Shoulders	6	6	7	1	20
Wrists	4	1	6	1	13

Knees	5	11	17	6	39
Ankles	6	1	3	1	11
Elbows	5	4	5	3	17
Arms	1	8	3	1	13
Legs	3	7	5	3	18
Fingers/Thumbs	12	12	15	6	45
Hernia/Groin/Ab	5	1	4	2	12
Torso	3	4	4	2	13
Feet	4	6	7	4	21
Neck	0	1	3	1	5
Hands	7	8	3	4	22
Totals	76	87	102	49	314

Table 4-3 below is a breakdown showing the total number of MSD injuries each year per body part. The difference between Table 4-3 and Table 4-2 is the fact that the injuries counted in Table 4-3 are strictly MSD injuries (sprains and strains). Table 4-2 includes all of the MSD affected body parts, but also includes falls or struck by injuries for example. The three most prevalent MSD injuries occurred in the backs, shoulders, and knees. Backs contribute to the total number of MDS's by 46%. Of the total affected MSD body parts, 47% of the injuries resulted in MSD's.

Table 4-3 Total Number of MSD's (Strains & Sprains) Per Year Per Body Part

Body Part	1997	1998	1999	2000	Total
Backs	14	16	17	16	63
Shoulders	6	4	5	2	17
Wrists	5	1	5	2	13
Knees	4	1	7	3	15
Ankles	3	1	1	1	6
Elbows	1	1	0	0	2
Arms	0	1	1	0	2
Legs	0	1	0	1	2
Fingers/Thumb	1	2	0	0	3
Hernia/Groin/Ab	5	1	4	2	11
Torso	0	3	1	0	5
Feet	1	0	1	0	3
Neck	0	0	3	1	4
Hands	1	1	1	0	3
Totals	38	32	46	22	149

In order to give another view of the prevalence of MSD injuries in comparison to the injuries that were recorded in MSD affected body parts Table 4-4 was formulated. The results of the table show that 95% of the injuries to the back were MSD injuries, while 100%

occurred in the wrists. 92% of the hernia/groin/ab injuries were also MSD injuries resulting from strains or sprains. The neck and shoulders followed as the next prevalent areas.

Table 4-4 Percent MSD's vs. Total Injuries					
Body Part	**1997**	**1998**	**1999**	**2000**	**Total**
Backs	93%	88%	85%	86%	95%
Shoulders	83	67	71	100	85%
Wrists	100	100	83	100	100%
Knees	80	9	41	50	38%
Ankles	50	100	33	100	55%
Elbows	20	25	0	0	12%
Arms	0	13	33	0	15%
Legs	0	14	0	33	11%
Fingers/Thumbs	8	17	0	0	7%
Hernia/Groin/Ab	100	100	100	100	92%
Torso	0	75	25	0	38%
Feet	25	0	14	0	13%
Neck	0	0	100	100	80%
Hands	14	13	33	0	14%
Totals	50%	37%	45%	45%	47%

Tables 4-5a through 4-5n depict information with regard to employee ages and experience in relation to their respective trades. The various trades listed in the worker's compensation records include carpenters, laborers/flaggers, operators, cement finishers, welders, mechanics, ironworkers, engineers/project managers, yard supervisor, foreman, traffic control supervisor, and pile driver. In order to simplify age and experience, categories were determined based on the given range and similar studies conducted. The letters A through E were used to indicate the age or experience category the employee fell into. The categories are as follows:

Age Categories:
A = 20-33
B = 34-42
C = 43-48
D = 49-56
E = 57-70

Experience Categories:
A = 0-5
B = 6-11
C = 12-17
D = 18-23
E = 24-29

Table 4-5a Prevalence of Back MSD's (strains & sprains) Per Trade With Age & Experience Categories					
Trade	**1997 (Age/Experience)**	**1998 (Age/Experience)**	**1999 (Age/Experience)**	**2000 (Age/Experience)**	**Tot**
Carpenter	E/C	C/E	D/A	C/D	
	C/E	C/A	A/A	D/D	

	A/A	D/C	A/A	D/E	
	B/A	E/B	C/B	D/A	
	C/B	C/E	D/A	B/B	
		D/A		B/A	
		B/A		B/D	
Totals	5	7	5	7	**24**
%					**38%**
Laborer	D/A	A/A	C/A	E/B	
	B/A	A/A	A/A	A/A	
	B/B	D/A	A/A	C/C	
	D/A	A/A	A/A	B/A	
	B/A		B/B	D/A	
	E/C		B/A	C/A	
	D/B		A/A	D/A	
Totals	7	4	7	7	**25**
%					**40%**
Operator	C/A		B/A	D/A	
			B/A		
Totals	1		2	1	**4**
%					**6%**
Cement Finisher		A/A	D/E		
		C/A	B/A		
Totals		2	2		**4**
%					**6%**
Welder	C/E	C/E			
Totals	1	1			**2**
%					**3%**
Mechanic			D/D		
Totals			1		**1**
					2%
Ironworker			C/A		
Totals			1		**1**
%					**2%**
Yard Supervisor		D/C			
Totals		1			**1**
%					**2%**
Project Manager		C/A			
Totals		1			**1**

%					2%
				Grand Total	63

Table 4-5b Prevalence of Shoulder MSD's Per Trade With Age & Experience Categories

Trade	1997 (Age/Experience)	1998 (Age/Experience)	1999 (Age/Experience)	2000 (Age/Experience)	Total
Carpenter	E/B	C/B	C/A		
	A/C	B/A			
	B/B				
Totals	3	2	1		**6**
%					**35%**
Laborer	A/B	C/A			
Totals	1	1			**2**
%					**12%**
Operator			D/B	D/B	
				D/E	
Totals			1	2	**3**
%					**18%**
Cement Finisher	C/B		E/A		
			A/A		
Totals	1		2		**3**
%					**18%**
Mechanic					
	D/D				
Totals	1				**1**
%					**6%**
Ironworker			D/A		
Totals			1		**1**
%					**6%**
Engineer/ Project Manager		A/A			
Totals		1			**1**
%					**6%**
				Grand Total	**17**

Table 4-5c Prevalence of Wrist MSD's Per Trade With Age & Experience Categories

Trade	1997 (Age/Experience)	1998 (Age/Experience)	1999 (Age/Experience)	2000 (Age/Experience)	Tot
Carpenter	A/A		C/A		
	C/C		A/A		
	D/B		B/A		
Totals	3		3		**6**

%					**46%**
Laborer/ Flagger	E/B	C/A		A/A	
	E/B				
Totals	2	1		1	**4**
%					**31%**
Operator			B/A		
Totals			1		**1**
%					**8%**
Mechanic				C/A	
Totals				1	**1**
%					**8%**
Ironworker			D/A		
Totals			1		**1**
%					**8%**
				Grand Total	**13**

Table 4-5d Prevalence of Knee MSD's Per Trade With Age & Experience Categories

Trade	1997 (Age/Experience)	1998 (Age/Experience)	1999 (Age/Experience)	2000 (Age/Experience)	Tot
Carpenter	E/E		B/B	B/C	
	B/A		B/A	E/A	
Totals	2		2	2	**6**
%					**40%**
Laborer/ Flagger	C/E		A/C		
	B/A		C/A		

			B/A		
			E/C		
Totals	2		4		**6**
%					**40%**
Operator			C/B		
Totals			1		**1**
%					**1%**
Cement Finisher		B/A			
Totals		1			**1**
%					**1%**
Foreman				C/A	
Totals				**1**	**1**
%					**1%**
				Grand Total	**15**

Table 4-5e Prevalence of Ankle MSD's Per Trade With Age & Experience Categories

Trade	1997 (Age/Experience)	1998 (Age/Experience)	1999 (Age/Experience)	2000 (Age/Experience)	Tot
Carpenter			C/D	C/B	
Totals			1	1	**2**
%					**33%**
Laborer	C/A	A/A			
	B/A				
Totals	2	1			**3**
%					**50%**
Operator	A/A				
Totals	1				**1**
%					**17%**
				Grand Total	**6**

Table 4-5f Prevalence of Elbow MSD's Per Trade With Age & Experience Categories

Trade	1997 (Age/Experience)	1998 (Age/Experience)	1999 (Age/Experience)	2000 (Age/Experience)	Tot
Carpenter		C/A			
Totals		1			**1**
%					**50%**
Laborer	C/A				
Totals	1				**1**
%					**50%**

Table 4-5g Prevalence of Arm MSD's Per Trade With Age & Experience Categories					
Trade	**1997 (Age/Experience)**	**1998 (Age/Experience)**	**1999 (Age/Experience)**	**2000 (Age/Experience)**	**Total**
Laborer			A/A	E/C	
Totals			1	1	**2**
%					**100%**

Table 4-5h Prevalence of Leg MSD's Per Trade With Age & Experience Categories					
Trade	**1997 (Age/Experience)**	**1998 (Age/Experience)**	**1999 (Age/Experience)**	**2000 (Age/Experience)**	**Total**
Laborer/ Flagger		A/C		B/A	
Totals		1		1	**2**
					100%

Table 4-5i Prevalence of Finger/Thumb MSD's Per Trade With Age & Experience Categories					
Trade	**1997 (Age/Experience)**	**1998 (Age/Experience)**	**1999 (Age/Experience)**	**2000 (Age/Experience)**	**Total**
Laborer		C/C			
		B/A			
Totals		2			**2**
%					**67%**
Operator	E/D				
Totals	1				**1**
%					**33%**

Table 4-5j Prevalence of Hernia/Groin/Ab MSD's Per Trade With Age & Experience Categories					
Trade	**1997 (Age/Experience)**	**1998 (Age/Experience)**	**1999 (Age/Experience)**	**2000 (Age/Experience)**	**Tot**
Carpenter	B/A				
	B/A				
	B/D				
Totals	3				**3**
%					**27%**
Laborer/ Flagger		C/B	A/A	A/A	
			D/A		
Totals		1	2	2	**5**
%					**45%**
Cement Finisher	C/A				
Totals	1				**1**
%					**9%**

Mechanic			B/A		
Totals			1		**1**
%					**9%**
Traffic Control Supervisor			A/A		
Totals			1		**1**
%					**9%**
				Grand Total	**11**

Table 4-5k Prevalence of Torso MSD's Per Trade With Age & Experience Categories

Trade	1997 (Age/Experience)	1998 (Age/Experience)	1999 (Age/Experience)	2000 (Age/Experience)	Tot
Carpenter		C/A			
		B/B			
Totals		2			**2**
%					**40%**
Laborer		A/A	C/A		
Totals		1	1		**2**
%					**40%**
Operator		B/C			
Totals		1			**1**
%					**20%**
				Grand Total	**5**

Table 4-5l Prevalence of Foot MSD's Per Trade With Age & Experience Categories

Trade	1997 (Age/Experience)	1998 (Age/Experience)	1999 (Age/Experience)	2000 (Age/Experience)	Tot
Carpenter	C/C				
	C/C				
Totals	2				**2**
%					**67%**
Laborer			E/C		
Totals			1		**1**
%					**33%**
				Grand Total	**3**

Table 4-5m Prevalence of Neck MSD's Per Trade With Age & Experience Categories

Trade	1997 (Age/Experience)	1998 (Age/Experience)	1999 (Age/Experience)	2000 (Age/Experience)	Total
Welder				C/E	
Total				1	**1**
%					**25%**

Traffic Control Supervisor			B/A		
Totals			1		**1**
%					**25%**
Project Manager			C/B		
Totals			1		**1**
%					**25%**
Pile Driver			A/A		
Totals			1		**1**
%					**25%**
				Grand Total	**4**

Table 4-5n Prevalence of Hand MSD's Per Trade With Age & Experience Categories

Trade	1997 (Age/Experience)	1998 (Age/Experience)	1999 (Age/Experience)	2000 (Age/Experience)	Tot
Carpenter	A/C	A/B			
Totals	1	1			**2**
%					**67%**
Operator			E/A		
Totals			1		**1**
%					**33%**
				Grand Total	**3**

In order to paint a better picture of the impact of age and experience on the prevalence of work related MSD's, Tables 4-6 and 4-7 were constructed based on the information presented in Tables 4-5a through 4-5n. As shown in Table 4-6 and the graph that follows, the majority of MSD injuries take place with younger workers. The highest prevalence of MSD's was reported in age group C, which consists of those employees 43 to 48 years of age. Age groups A through C, which includes ages 20 to 48 makes up 73% of the reported MSD's.

Table 4-6 EKS Ages vs. Prevalence of MSD's Per Year

Age Range	1997	1998	1999	2000	Total	%
20-33 (A)	6	9	13	4	32	22%
34-42 (B)	11	6	12	5	34	23%
43-48 (C)	12	13	9	7	41	28%
49-56 (D)	7	4	8	8	27	18%
57-70 (E)	5	1	4	3	13	9%
Total					147	

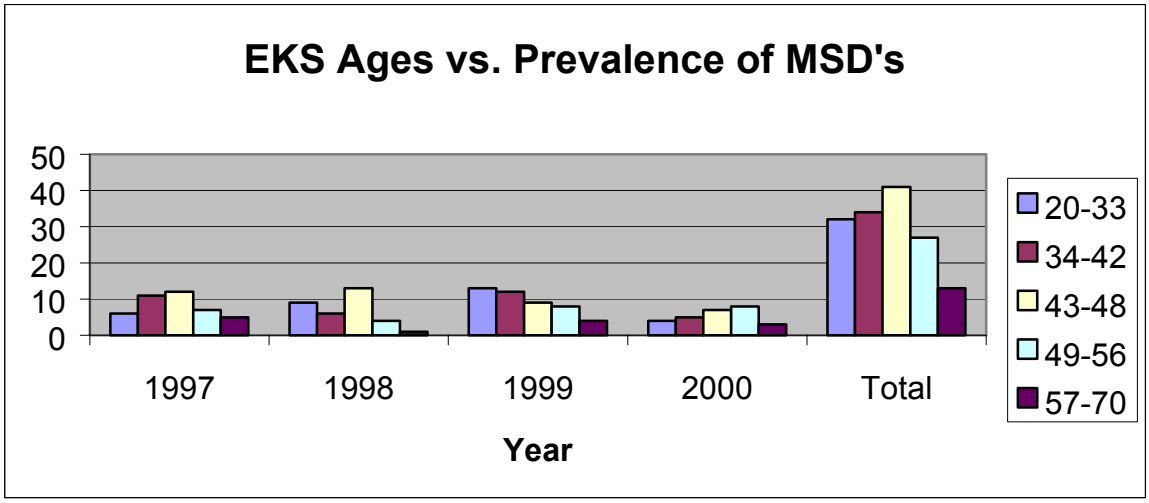
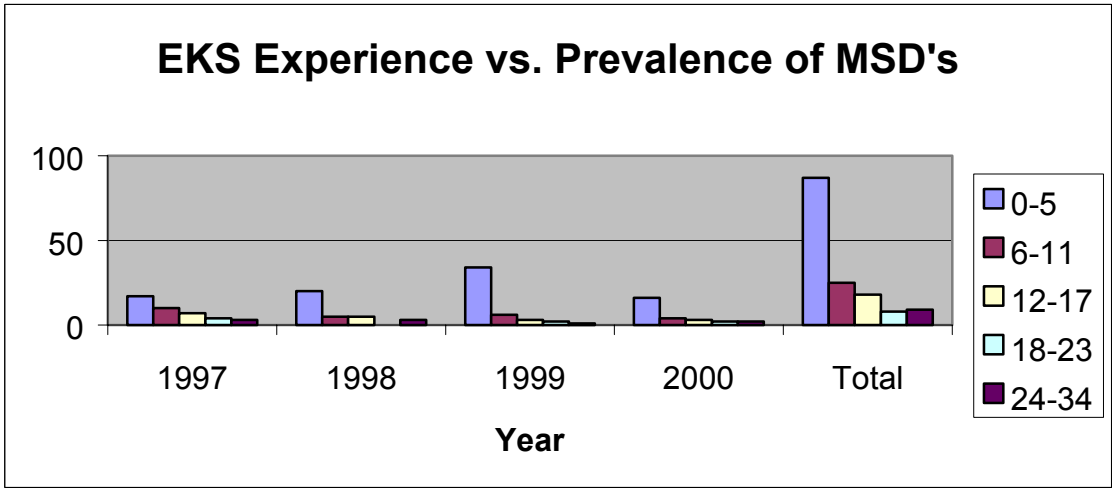


Table 4-7 shows a clear picture that the highest contributor (59%) to MSD's at EKS are workers with zero to five years experience. It is important to note that the experience data pertains to EKS experience only. The first two categories A and B consist of experience ranging from 0-11 years and makes up 76% of the reported work related MSD's.

Table 4-7	EKS Experience vs. Prevalence of MSD's Per Year					
Range	**1997**	**1998**	**1999**	**2000**	**Total**	**%**
0-5 (A)	17	20	34	16	87	59.2%
6-11 (B)	10	5	6	4	25	17.0%
12-17 (C)	7	5	3	3	18	12.2%
18-23 (D)	4	0	2	2	8	5.4%
24-34 (E)	3	3	1	2	9	6.1%
Total					147	



Objective 3

The final objective of this study was to determine the costs associated with MSD's at EKS. The costs of injuries are important because they show the severity of loss. Table 4-8 shows the costs associated with all of the MSD affected body parts. In a matter of four years, over two million dollars was spent on injuries where MSD's were reported. The top three areas of monetary loss were (1) backs, (2) shoulders, and (3) knees. At over $841,000, backs contributed over 41% to the total costs.

Table 4-8 Total Injury Costs Per Year Per MSD Affected Body Part

Body Part	1997	1998	1999	2000	Total
Backs	$56,526.00	$201,923.51	$358,964.95	$224,034.35	$841,448.81
Shoulders	73,792.85	26,339.00	232,003.64	18,064.00	350,199.49
Wrists	1,078.02	351.00	4,186.49	1,139.94	6,755.45
Knees	2,280.01	54,014.11	74,899.15	32,699.00	163,892.27
Ankles	99,478.57	337.82	11,134.02	198.00	111,148.41
Elbows	813.17	1,340.28	1,700.61	2,897.41	6,751.47
Arms	9,736.37	121,663.48	516.00	206.00	132,121.85
Legs	10,648.28	4,171.85	2,061.57	1610.73	18,492.43
Fingers/Thumbs	5,783.71	12,997.55	9,154.57	3,402.78	31,338.61
Hernia/Groin/Ab	54,493.32	22.28	4,161.48	1,000.00	59,677.08
Torso	14,071.00	1,090.80	1,849.41	1,389.27	18,401.31
Feet	88,276.56	52,820.26	11,746.68	3,593.61	156,437.11
Neck	0	65,973.50	1,601.00	897.00	68,471.50
Hands	40,966.51	13,778.91	810.77	1,983.85	57,540.04
Totals	$457,944.37	$556,824.35	$714,790.34	$303,115.94	$2,032,675.00

Table 4-9 is similar to Table 4-2 in that it shows the difference between the actual MSD injuries reported compared to all the injuries reported in the MSD affected body part. Table 4-9 indicates that backs, shoulders, and feet are the highest loss producers based solely on reported MSD injuries. Once again, as reflected by the total losses, backs are major problem at about 55% of the total cost of MSD injuries.

Table 4-9 Total MSD Costs Per Year Per Body Part

Body Part	1997	1998	1999	2000	Total
Backs	$54,753.05	$57,687.23	$305,188.50	$213,040.35	$631,168.13
Shoulders	66,438.31	24,809.35	166,817.41	18,064.00	276,129.07
Wrists	1078.02	351.00	2,945.96	1,139.94	5,514.92
Knees	2,150.74	21,371.00	4,963.32	32,699.00	61,184.06
Ankles	16,469.22	337.82	529.00	198.00	17,534.04
Elbows	240.22	514.61	-	-	754.83
Arms	-	3,189.24	202.00	-	3,391.24
Legs	-	239.00	-	978.23	1,217.23
Fingers/Thumbs	117.00	1,153.50	-	-	1,270.50
Hernia/Groin/Ab	54,493.32	22.28	4,161.48	1,000.00	59,677.08
Torso	-	615.23	669.18	-	1,284.41
Feet	80,395.89	-	170.71	-	80,566.60

Neck	-	-	1,601.00	897.00	2,498
Hands	7,034.49	105.88	198.99	-	7,339.36
Totals	283,170.26	110,396.14	487,447.55	268,016.52	$1,149,529.47

As a reflection MSD costs to total injury costs, Table 4-10 provides a comparison by percentages. Shoulders, wrists, and hernia/groin/ab have the three highest percentages. For example, 82% of the wrist injury costs are attributed to MSD's.

Table 4-10	**Percent MSD Only vs. Total Injury Costs**				
Body Part	**1997**	**1998**	**1999**	**2000**	**Total**
Backs	97%	29%	85%	95%	75%
Shoulders	90	94	72	100	79%
Wrists	100	100	70	100	82%
Knees	94	40	7	100	37%
Ankles	17	100	5	100	16%
Elbows	30	38	-	-	11%
Arms	-	3	39	-	3%
Legs	-	6	-	61	7%
Fingers/Thumbs	2	9	-	-	4%
Hernia/Groin/Ab	100	100	100	100	100%
Torso	-	56	36	-	7%
Feet	91	-	1	-	52%
Neck	-	-	100	100	4%
Hands	17	1	25	-	13%
Totals					57%

Summary

This chapter reviews the results of a loss analysis for the years 1997 through 2000 at Edward Kraemer & Sons, Inc. Employee job descriptions (found in Appendix A) describe the normal duties and activities that could contribute to the onset of MSD's. The results of the job hazard analysis (found in Appendix B) further explained the hazards associated with the various tasks EKS performs. The prevalence and resulting monetary loss as determined from the loss analysis are depicted through various tables and graphs. The data includes information on specific trades or crafts as well as age and experience. The resulting information helps to point out the major areas of loss. Chapter five will reiterate some of the conclusions gained from this chapter and seek to make recommendations based on the study as well as the literature review.

CHAPTER 5

Summary, Conclusions, and Recommendations

Summary

Restatement of the Problem

The purpose of this study was to better define the problem of MSD's at Edward Kraemer & Sons, Inc. in order to determine controls. This was done by first examining risk factors, followed by the determination of the prevalence and monetary impacts as well as the impacts of trades, age, and experience.

The goals of this study were to:

1.) Determine the various activities that may be contributing to Edward Kraemer & Sons, Inc. exposure to work-related MSD's.

2.) Determine the prevalence of MSD's at EKS with an emphasis on the impact of age and experience in the respective trades of those affected.

3.) Analyze the total losses incurred as a result of MSD's at EKS.

Methods and Procedures

The study began with an analysis of EKS operations through a process called job hazard analysis (JHA). With the assistance of various EKS personnel, specific hazards along with coinciding safe work procedures were determined that pertain to each step in the process. The information was then used to formulate the EKS T.H.I.N.K. Sheets, which explain the safe work procedures while referencing further information found in EKS Safety Shorts (safety letters). Workers' compensation records for the years 1997 through 2000 were also obtained and analyzed to determine MSD prevalence. Prevalence was then broken down further to examine trades, ages, and experience levels. The study was concluded with the analysis of the costs incurred as a result of MSD's as they relate to EKS's total loss picture.

Major Findings

1. The highest number of claims with regards to EKS's total loss picture was associated with backs, knees, and fingers/thumbs from 1997 through 2000 as shown in Table 5-1.

Table 5-1 Total Number of Injuries Per Year for All Body Parts					
Body Part	**1997**	**1998**	**1999**	**2000**	**Total**
Backs	15	17	20	14	66
Knees	5	11	17	6	39
Fingers/Thumbs	12	12	15	6	45

2. Backs, shoulders, and knees had the largest contribution to MSD only claims in the four-year time period. Backs top the list at 63 in Table 5-3.

Table 5-3 Total Number of MSD's (Strains & Sprains) Per Year Per Body Part					
Body Part	**1997**	**1998**	**1999**	**2000**	**Total**
Backs	14	16	17	16	63
Shoulders	6	4	5	2	17
Knees	4	1	7	3	15

3. As shown in Table 5-4, nearly half (47%) of the reported injuries at EKS were MSD claims for the time period. 100% of the wrist claims and 95% of the back claims were MSD's. Hernia/groin/ab (92%), shoulders (85%), and neck (80%) were close behind.

Table 5-4 Percent of MSD's (Strains & Sprains) vs. Total Injuries					
Body Part	**1997**	**1998**	**1999**	**2000**	**Total**
Backs	93%	88%	85%	86%	95%
Shoulders	83	67	71	100	85%
Wrists	100	100	83	100	100%
Hernia/Groin/Ab	100	100	100	100	92%
Neck	0	0	100	100	80%
Totals	50%	37%	45%	45%	47%

4. The most prevalent and costly body part was the back. Table 5-5a indicates that most MSD claims pertaining to the back are by laborers (40%) followed by carpenters (38%).

Table 5-5a Prevalence of Back MSD's (strains & sprains) Per Trade With Age & Experience Categories					
Trade	**1997 (Age/Experience)**	**1998 (Age/Experience)**	**1999 (Age/Experience)**	**2000 (Age/Experience)**	**Tot**
Carpenter	E/C	C/E	D/A	C/D	
	C/E	C/A	A/A	D/D	
	A/A	D/C	A/A	D/E	
	B/A	E/B	C/B	D/A	

	C/B	C/E	D/A	B/B	
		D/A		B/A	
		B/A		B/D	
Totals	5	7	5	7	**24**
%					**38%**
Laborer	D/A	A/A	C/A	E/B	
	B/A	A/A	A/A	A/A	
	B/B	D/A	A/A	C/C	
	D/A	A/A	A/A	B/A	
	B/A		B/B	D/A	
	E/C		B/A	C/A	
	D/B		A/A	D/A	
Totals	7	4	7	7	**25**
%					**40%**
Operator	C/A		B/A	D/A	
			B/A		
Totals	1		2	1	**4**
%					**6%**
Cement Finisher		A/A	D/E		
		C/A	B/A		
Totals		2	2		**4**
%					**6%**
Welder	C/E	C/E			
Totals	1	1			**2**
%					**3%**
Mechanic			D/D		
Totals			1		**1**
					2%
Ironworker			C/A		
Totals			1		**1**
%					**2%**
Yard Supervisor		D/C			
Totals		1			**1**
%					**2%**
Project Manager		C/A			
Totals		1			**1**
%					**2%**
				Grand Total	**63**

5. The impact of age and experience is shown in Tables 5-6 and 5-7. The most prevalent age group to make a MSD claim was the 43 to 48 year old age group (28%) followed by the 34-42 year old group (23%) and the 20-33 year old group (22%). Data pertaining to experience is much more definitive. Clearly, the 0-5 year experience range has the highest prevalence of MSD's.

Table 5-6 EKS Ages vs. Prevalence of MSD's Per Year						
Age Range	**1997**	**1998**	**1999**	**2000**	**Total**	**%**
20-33 (A)	6	9	13	4	32	22%
34-42 (B)	11	6	12	5	34	23%
43-48 (C)	12	13	9	7	41	28%
49-56 (D)	7	4	8	8	27	18%
57-70 (E)	5	1	4	3	13	9%
Total					147	

Table 5-7 EKS Experience vs. Prevalence of MSD's Per Year						
Range	**1997**	**1998**	**1999**	**2000**	**Total**	**%**
0-5 (A)	17	20	34	16	87	59.2%
6-11 (B)	10	5	6	4	25	17.0%
12-17 (C)	7	5	3	3	18	12.2%
18-23 (D)	4	0	2	2	8	5.4%
24-34 (E)	3	3	1	2	9	6.1%
Total					147	

6. Table 5-8 shows a clear picture of the highest three claims for MSD affected body parts. The total cost associated with MSD affected body parts was over two million dollars for the four year time period. Backs made up the majority of the costs at over 841,000 dollars.

Table 5-8 Total Injury Costs Per Year Per MSD Affected Body Part					
Body Part	**1997**	**1998**	**1999**	**2000**	**Total**
Backs	$56,526.00	$201,923.51	$358,964.95	$224,034.35	$841,448.81
Shoulders	73,792.85	26,339.00	232,003.64	18,064.00	350,199.49
Knees	2,280.01	54,014.11	74,899.15	32,699.00	163,892.27
Totals	$457,944.37	$556,824.35	$714,790.34	$303,115.94	$2,032,675.00

7. As shown by Table 5-9 and 5-10, over half (57%)of the total costs that were related to MSD affected body parts were MSD claims. Backs remain as the highest cost at over 631,000 dollars. 100% of the hernia/groin/ab, 82% of the wrists, and 79% of the shoulders were MSD claims.

Table 5-9	Total MSD Costs Per Year Per Body Part				
Body Part	**1997**	**1998**	**1999**	**2000**	**Total**
Backs	$54,753.05	$57,687.23	$305,188.50	$213,040.35	$631,168.13
Shoulders	66,438.31	24,809.35	166,817.41	18,064.00	276,129.07
Feet	80,395.89	-	170.71	-	80,566.60
Totals	283,170.26	110,396.14	487,447.55	268,016.52	$1,149,529.47

Table 5-10	Percent MSD Only vs. Total Injury Costs				
Body Part	**1997**	**1998**	**1999**	**2000**	**Total**
Backs	97%	29%	85%	95%	75%
Shoulders	90	94	72	100	79%
Wrists	100	100	70	100	82%
Hernia/Groin/Ab	100	100	100	100	100%
Totals					57%

Conclusions

The study verified the assumption that MSD hazards are common to many of the activities EKS performs on a daily basis. Following a review of the JHA's/EKS T.H.I.N.K. program, it was found that the following activities pose the largest risk from and ergonomic standpoint:

Mobilization: Unloading material from trucks and other positioning can cause overexertion or awkward positions

Demolition: Vibration exposure or back strain from jackhammers, chipping hammers, impact wrenches, rivet busters, etc.

Rip-Rap: Back strain from chinking heavy rip-rap or lifting filter fabric rolls, sprained ankles, knees, and wrists from walking on rip-rap

Piling: Overexertion injuries from jockeying piles

Decking: Lifting, bending, and twisting is common while carrying and installing falsework, adjustable joists, plywood, rebar, etc.

Rebar mats: Continually bent over tying bars as well as the potential for sprained ankles, knees, and wrists from walking on rebar

Concrete Forming: Awkward positions can be common while positioning and fastening forms for abutments, piers, etc.

Concrete Finishing: The finishing machine (Bid-well) causes bent over position for finishers, vibrating machine causes fatigue. Raking, wheeling, shoveling, or handling pump hose can present employees with overexertion, repetitive motions, and awkward positions.

Placing Parapet: Parapet forms can be very heavy and awkward without the assistance of a crane

Stripping forms: The potential for back injuries and shoulder strains exitst during stripping while trying to release seized up formwork; shoulder strains from continually working overhead.

The study also reinforced the fact that the prevalence of MSD's at EKS varies depending on age, experience, and trade. MSD's are most prevalent among carpenters and laborers with 0-5 years experience. The ages of 20 to 48 showed the most prevalence with the 43 to 48 year old age group being slightly higher than the previous two age groups. 57% of all injuries experienced at EKS from 1997-2000 were considered MSD's.

The final objective of the study pinpointed the major contributions to loss at Edward Kraemer & Sons, Inc. Over a four-year time period the total cost associated with MSD affected body parts totaled over two million dollars. The costs of MSD's at EKS are a burden with backs being the number one loss area at over $841,000. Losses associated with shoulders and knees were also significant totaling over $514,000.

Recommendations

Based on the results of the loss analysis performed in chapter four and the research found in chapter two, the following is recommended:

1. Discontinue the purchase of outdated and inefficient tools if there are more ergonomically correct tools available. Consider power tools and maintain existing tools to provide for maximum efficiency.
2. Make available and train employees on the use of mechanical lifting aids to prevent overexertion injuries. Equipment should be well maintained to limit vibration.
3. Whenever possible, institute processes (i.e. worker rotation) that will eliminate or limit the amount of repetitive and forceful motions, awkward and static postures, and vibration and temperature exposure.
4. Utilize employee rotation whenever possible to eliminate or limit the amount of repetitive and forceful motions, awkward and static postures, and vibration and temperature exposure, which are major risk factors that contribute to MSD's.
5. Establish and enhance thorough job descriptions and non-discriminatory screening devices for employees to aid in pre-placement based on capabilities in an attempt to match abilities with the requirements of the job.
6. Institute a stretching and strengthening program in order to prepare employees for daily tasks and maintain physical strength and agility in order to prevent unnecessary muscle pulls and strains/sprains.
7. Institute a wellness program to promote healthful habits. The following programs could enhance the program: exercise/fitness program; health appraisal program; substance abuse program; smoking cessation programs; nutrition programs; and a stress control program.
8. Utilize an early return to work policy in order to reduce the amount of paid compensation versus medical costs. Temporary alternative duty (TAD) should be utilized to promote a feeling of self-worth and appreciation for the injured employee.

The longer a worker is away from work the less likely the worker will return. Replacement of a skilled workers is expensive or, at times, difficult or impossible.

9. New-hire and per-project orientation is a critical recommendation for EKS. Based on the statement that one out of five serious injuries or deaths involve workers who have been employed on the job site from zero to thirty days (see chapter two) and data indicating that 59 percent of MSD claims involve workers employed at EKS for zero to five years (see chapter four) creates the need for adequate training from day one. There should also be a focus on training carpenters and laborers as a result of the study which indicated the two trades as the most likely to suffer from MSD's (see chapter 4).
10. Annual training should be continued in order to maintain the knowledge base and introduce any new information or changes in programs. Training should be informative, as well as effective and include relevant information on applicable standards as well as hazard recognition, incident reporting, etc. Employees should be trained to recognize the symptoms associated with MSD's and encouraged to report symptoms early. Any changes in information and/or internal standards should be incorporated into the Corporate Employee Safety and EEO Handbook. Greater emphasis (i.e. diagrams and descriptions) should be placed on proper lifting techniques throughout the handbook. Note: Information on ergonomic studies, programs, facts, and prevention can be found at www.search.cdc.gov (enter search term "lifting")
11. The process of job hazard analysis (JHA) along with the EKS T.H.I.N.K program should be utilized and continuously improved in order to contribute to efficient and effective operations. JHA and THINK serves as a consistent orientation, training, and re-training tool for new employees, transfers, and long-term employees, a performance standard that provides standard procedures, and a control measure that familiarizes both supervisors and employees to job hazards and exposures.
12. Continue to utilize daily pre-task planning (e.g. TEAM) in order to increase awareness along with safety and production (safe production) on the jobsite (see chapter four). The meeting should stress the importance of using proper tools, equipment, and personal protective equipment and should encourage employee participation in order to maximize awareness and assess worker conditions. A safe lifting program can be incorporated into the meeting in order to plan the lifts that will take place during the day. This will promote the thinking process and determine the best way to perform a lift whether it be personal, mechanical, or with a teammate. Finally, the daily pre-task planning meeting provides an opportunity for the stretching and strengthening program to take place.
13. Weekly safety letters or toolbox talks can also be incorporated into the daily pre-task (TEAM) meetings. They can make an impact by offering the opportunity to cover broad topics, introduce new safety procedures, reinforce current company practices, or discuss upcoming safety issues in depth. It is important to consider the relevance of the material being discussed as it pertains to the employees when dealing with "canned" letters. Many good examples of safety letters can be found in Appendix B. Note: Additional safety letters can be found at www.toolboxtopics.com.
14. Continue to utilize the S.T.O.P. (Safety Training Observation Program) to assess and track employee behaviors while comparing to set internal standards in order to direct

efforts for improvement. The program can provide an accurate picture of common adverse behaviors and provide insight to the root causes of incidents. A direct correlation has been found between STOP participation and safety performance at EKS. STOP has also been proven to be successful at Hensel Phelps Construction Company, a contractor who performs over a billion dollars of work per year. Marathon Ashland Petroleum, a refinery located in St. Paul Park, Minnesota, uses a similar program termed A.W.A.R.E. (All Work At Risk Eliminated). The program is new, but is showing improved results.

15. An audit should be performed based on checklists containing information to assist in assessment of the hazards associated with specific hazards prevalent during EKS operations. Appendix C contains a fairly comprehensive set of guidelines that can be used in part or in its entirety.
16. Although a last resort, personal protective equipment (PPE) has proven to be a necessity in many applications. PPE such as shoe inserts/insoles, anti-vibration or vibration attenuating gloves, shoulder pads, and tool belts with suspenders can be effective in reducing MSD hazards.

Principal Point

Despite the fact that Congress has overturned the promulgated Ergonomics standard, the data indicated in this study has proven that workers employed in the construction industry are exposing themselves to the risks of developing work-related musculoskeletal disorders (WRMSD's) or are experiencing symptoms which can ultimately lead to WRMSD's. Furthermore, these injuries, whether they are symptoms or diagnosed MSD's are resulting in lower productivity, lower worker morale, and are ultimately costing construction companies big money. Standard or no standard, a proactive company such as Edward Kraemer & Sons, Inc., who understands the value of a good employee in a period where an aging workforce and a boom in the construction industry is resulting in a shortage in skilled craftspeople, will want to retain their employees and prevent the need to pay for unnecessary compensation or medical bills, or replace a worker who was forced to retire early because of a work-related MSD.

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Position Title: **Carpenter**

EDWARD KRAEMER & SONS, INC.

General Summary

Concrete form carpenters employed by Edward Kraemer & Sons, Inc. are responsible for assembly and removal of forms used for forming concrete structures during bridge/dam construction. Such forms include footings, abutments, walls, pier stems/columns, pier caps, bridge decking and parapets.

Essential Duties and Responsibilities

- Lifting and carrying up to 75 lbs., usually with assistance from laborer.
- Lifting and carrying objects and materials of various weight, less than 50 lbs.
- Use of various saws and hammers.
- Repetitive climbing, stooping, kneeling, bending and reaching overhead.
- Balancing with large sheets of plywood.
- Repetitive use of hands and wrists with various tools, including fine motor movements and manipulations.

Frequent Requirements

- Lifting and carrying up to 75 lbs. unassisted.
- Pushing and pulling objects up to 100 lbs., which may be suspended from a crane.
- Sitting and crawling.

Occasional Requirements

- Crawling in close quarters stripping concrete forms.
- Lifting 100 lbs.

Physical Demands

Climbing, reaching, handling materials, and lifting are common requirements of a carpenter. Occasionally, carpenters work from areas that require handling from fall protection gear, which includes body harness attached to rebar assemblies.

Environment/Health Exposures: Exposure to cold/hot temperatures, respirable dust, chemical vapors, lead fumes, and falls from heights.

Tools Used: Power and hand tools.

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Position Title: **Laborer**

EDWARD KRAEMER & SONS, INC.

General Summary

Laborers have general responsibility to provide support and assistance to other skilled crafts working on the project. Laborers employed by Edward Kraemer & Sons, Inc. commonly assist carpenters forming concrete structures, hand excavation, pouring concrete and demolition of structures.

Essential Duties and Responsibilities

- Lifting and carrying up to 75 lbs.
- Repetitive climbing, stooping, kneeling, bending and reaching overhead.
- Use of hands with various tools.
- Climbing ladders 20-30 times a day.

Frequent Requirements

- Pushing and pulling objects up to 100 lbs., which may be suspended from a crane.
- Repetitive use of hands for fine motor manipulations.

Occasional Requirements

- Jack hammering with a 90 lb. hammer.
- Crawling in close quarters stripping concrete forms.
- Lifting 100 lbs.

Physical Demands

Climbing, reaching, handling materials, bending and balancing from heights are common requirements of laborer.

Environment/Health Exposures: Exposure to cold/hot temperatures, respirable dust, chemical vapors, lead fumes, and falls from heights.

Tools Used: Shovels, picks, 16 lb. hammer and 90 lb. air compressed jackhammers.

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Position Title: **Concrete Finisher**

EDWARD KRAEMER & SONS, INC.

General Summary

Concrete finishers employed by Edward Kraemer & Sons, Inc. are responsible for assisting placement of concrete and finishing final concrete surfaces which are visible after a bridge/dam is built. Concrete finishers grind concrete after curing and spray on chemical concrete sealors when necessary.

Essential Duties and Responsibilities

- Lifting and carrying up to 25 lbs.
- Repetitive climbing, stooping, kneeling, bending and reaching overhead.
- Repetitive use of hands and wrists with various tools, including fine motor movements and manipulations.

Frequent Requirements

- Lifting and carrying up to 75 lbs. unassisted.

Occasional Requirements

- Lifting 100 lbs.
- Crawling in close quarters stripping concrete forms.

Physical Demands

Climbing, reaching, handling materials and lifting are common requirements of a concrete finisher. Also, there are several jab tasks which require overhead use of power/hand tools and working at heights from an aerial lift.

Environment/Health Exposures: Exposure to cold/hot temperatures, respirable dust, chemical vapors, lead fumes, and falls from heights.

Tools Used: Concrete floats, screeds, hand tools, and power grinders.

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Position Title: **Operator**

EDWARD KRAEMER & SONS, INC.

General Summary

Operators employed by Edward Kraemer & Sons, Inc. operate mobile cranes from 225 tons to 15 tons while building bridges and dams. Also, compaction crews and aggregate crushing plans require blades, backhoes, haul-paks and end loaders to accomplish daily job tasks.

Essential Duties and Responsibilities

- Lifting and carrying up to 25 lbs.
- Repetitive use of hands and feet while operating equipment.

Frequent Requirements

- Pushing and pulling 75 lbs.
- Climbing

Occasional Requirements

- Lifting 100 lbs.
- Crawling in close quarters.

Physical Demands

Climbing, reaching, and operating foot/hand controls are common requirements of an operator. Good vision is essential, along with the fact some projects require annul operator health physical.

Environment/Health Exposures: Exposure to cold/hot temperatures, respirable dust, chemical vapors, lead fumes, and falls from heights.

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T-H-I-N-K

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Thank you for taking the initiative to **T-H-I-N-K**

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With your help we can merge the core values of Safe Production**:**

STOP **for safety excellence,**

THINK before taking action, and

Achieve production, quality, and safety as a **TEAM**

You already understand the process of **STOP** and **TEAM** – now it's time for the next level…

T Identify the **TASK.**

H **HAVE** the necessary tools, equipment, and PPE to perform the job safely.

I **ITEMIZE** the steps, hazards, and safe work procedures we will follow to complete the task safely.

N **NOTIFY** others to enhance safety and awareness during the task.

K **KNOW** the detailed safe work procedures and OSHA standards that pertain to the task found in the EKS Safety Shorts.

The **THINK** Sheet is concluded with the **Safe Lifting Plan**, which will combat our high incidence of back injuries/pain caused by heavy lifting or overexertion.

Read further to gain a better understanding of the THINK process and how it will help you contribute to the health and safety of yourself and fellow workers. Simply taking the time to **T-H-I-N-K** on a daily basis will prevent or reduce the occurrence or magnitude of loss and ultimately contribute to the success and profitability of EKS.

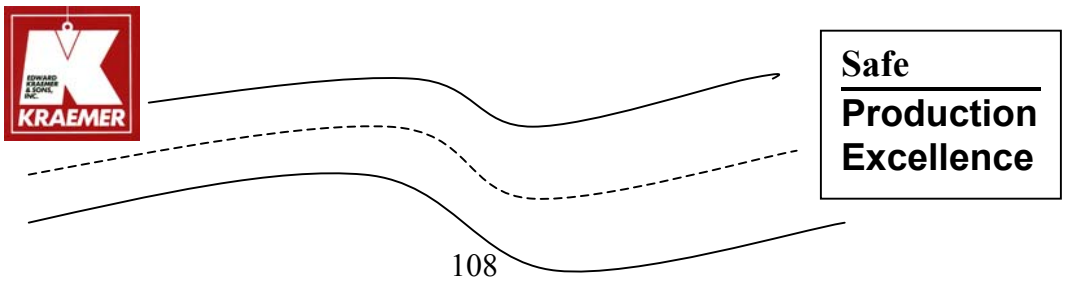
With the proper and consistent use of…

THINK, and

TEAM

STOP,

EKS is on the road to Safe Production excellence!



How do we **THINK**?

As part of the TEAM and STOP process, you are asked to take a look at your activity(ies) to be performed (TASK) for the day and look up the number on the master bridge activity list. In general:

100's apply to **Mobilization**,
200's apply to **Access and Temporary Bridges**,
300's to **Removals**,
400's to **Excavation, Rip-Rap, and Sheeting**,
500's to **Piling and Caissons**,
600's to **Concrete**,
700's to **Rebar** (typically subbed out),
800's to **Steel, Prestress, and Railing**, and
900's are tied to **Miscellaneous** activities.

TASK

Once you find the THINK sheet that corresponds to your **T**ASK for the day, find it following the introduction in this binder.

HAVE

The THINK sheet will provide you with a recipe for success. It will list the PPE you are required to **H**AVE to do the job safely, followed by the recommended tools that may be used during the operation. The numbers included in this section will key you into the safe practices that are listed in the itemize section described below.

ITEMIZE

The **I**TEMIZE section will point out the potential safety hazards associtated with the task. The potential safety hazards are the same as those that appear on the STOP card. This will help you recognize the potential hazards you typically encounter on the job, which will therefore increase the quanitity and improve the quality of STOP cards written. If you want to specialize on a few potential hazards (based on the time permitting) that you feel are important, simply pick a few (i.e. struck by, falling to below or same level, contacting sources of electricity) and you will see numbers to the left. Those numbers correspond to the best practices or things to consider in order to perform the job safely. These best practices came about through the process of Job Hazard Analysis (JHA).

The JHA process will be explained further to help you gain a better understanding of the process and to encourage continuous improvement.

NOTIFY

The **N**OTIFICATIONS section serves as an important reminder to things that may be important for consideration. Examples include:

- Calling Digger's Hotline before digging
- Filling out a Critical Lift Plan when the load exceeds 80% of the crane's rated capacity or when making a dual crane lift.

KNOW

Finally, the **K**NOW section will direct you to added resources or further clarifications. This enhances the the recipe for success. Essentially you are conducting your own safety meeting based on what you feel is important depending on the day's needs and activities. Eventually, all of the pertinent safety letters and other valuable information (continous improvement) will be standardized into Safety Shorts and are referenced throughout the THINK Sheets. Simply record what you have covered in the TEAM booklets.

Safe Lifting Plan

As mentioned earlier (and as shown on the THINK Sheet) the purpose of the safe lifting plan is to prevent back injuries or pain caused by heavy lifting or overexertion. The plan asks the question, *Does the material/object exceed 35 lb. In weight?* If the answer is NO, it is still recommended that you perform stretching before lifting the object. If the answer is YES, you are advised to complete a Safe Lift Plan (describe how you will safely perform the lift).

Example:

- Using proper lifting techniques (describe)
- Using a TEAM-mate or two (or more) (describe how many and positioning)
- Using mechanical devices (i.e. crane with slings or chains, forklift)

Remember that stretching can prevent muscle strains!

Comment Section: (How do we continuously improve or THINK-ing?)

At the bottom of the THINK Sheets you will find a comments section. This section will allow us to *continuously improve our recipes for success.* You are encouraged to make comments that you feel would enhance the effectiveness of the THINK Sheets. If there is a specific hazard (maybe you witnessed an incident or near-miss) that you feel is important, but is not included in the THINK sheets or Safety Shorts, make a recommendation. YOU are the one that does the job everyday-YOU are the expert! Furthermore, if you feel there is a whole process that deserves a Job Hazard Analysis (JHA) or a THINK sheet, you are welcome to fill out the JHA or THINK Sheet template(s) (see the attached copies). Submit your comments and you will be rewarded for your efforts. You can find personal satisfaction knowing that YOU made a positive contribution on *EKS's Road to Safe Production Excellence.*

Appendix B

Performing a Job Hazard Analysis (JHA)

A JHA is a procedure used to identify the basic steps of a job, uncover the hazards associated with these steps, and recommend safe work procedures to eliminate or control the hazards.

The primary steps in completing a JHA are:

5. Determine the jobs to be analyzed
6. Break the job down into a sequence of steps.
7. Identify the hazards associated with each step.
8. Recommend safe work procedures, controls, or safeguards to minimize or eliminate the hazards.

Once a specific job has been selected for analysis, it must be broken down into basic sequential steps. Determining job sequences is best accomplished by direct observation of the job being performed, along with employee input. Explain to the employee (the one(s) performing the task) what the JHA is and that the intent is to make the job as safe as possible. Inform them that the job is being studied, not the employee's work performance. Use the JHA template (see attached) to help you document observations and the employees comments.

The average job can be expected to fall in the range of five to eight steps. If more steps are needed to accurately describe the work, conideration should be given to split the job into segments and analyze each segement separately.

After listing all steps, look at each and identify the hazards. All actual and potential hazards should be identified whether they could result from an unsafe act or unsafe condition or both.

The next phase of the JSA is the development of recommended procedures or safeguards. Determine whether the job could be performed in another way to eliminate hazards or whether safety equipment and precautions are needed to reduce the hazards. Here you must be specific. Merely writing, use caution or be careful is not useful information. List the action in a way that will help a worker who is learning the job. After the JHA is completed, review it with the employees performing the job to make sure each step has been included in all hazards identified.

Words to consider:

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Here are some important portions of an email sent from Todd Pfeil, Vice President, HR and Risk Management, on Thursday, October 12, 2000:

> *"The key to our safety success is both planning and focusing on the behaviors that lead to accidents or incidents and then change those behaviors. This is the cornerstone of the behavior-based safety program that we adopted. "*

"...each of us have to be actively involved in looking for behaviors that create unsafe situations. We cannot rely on the safety staff to do this. Each of us needs to lead the effort to create a culture where we look at what people do and then intervene to improve upon what they do. Please take the time to focus on unsafe behaviors and then work to change those behaviors. It is more than writing a STOP card or conducting a TEAM meeting, it is taking the time to change people's behavior and properly plan. Let's not just go through the steps but actively become involved in leading the effort to continue to improve our safety culture and the good results we have seen to date."

Todd Pfeil
Vice President, HR and Risk Management
Corporate Counsel and Secretary

Behaviors

80 - 96% of all accidents are caused by unsafe behaviors, according to various data sources. So what are the behaviors that lead to accidents or incidents?

1. Taking shortcuts,
2. Being distracted,
3. Using the wrong tool, equipment, or work procedure,
4. Being in a hurry,
5. Doing a job you aren't properly trained for,
6. Overconfidence and complacency,
7. Not observing the job to identify potential hazards,
8. Failure to communicate, and
9. Not using common sense

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Taking Shortcuts

- The only reason for taking a shortcut is because completing a job quickly is a greater priority than YOUR safety.
- Completing a job quickly is NEVER a greater priority than your safety.
- Remember what your parents used to say, "haste makes waste"

Being Distracted

- Construction work demands your constant attention.
- Even a short lack of concentration can result in a serious injury.
- Focus on the task at hand.

Using the Wrong Tool, Equipment, or Work Procedure

- Don't start a job/task if you haven't been trained properly. Take the time to THINK and ask questions about the procedure before an accident happens.
- Take the time to get the correct tools and equipment.

Being in a Hurry

- When should you be in a hurry on a construction project?
- Is getting a job done quickly ever more important than your safety?

Doing a Job You Aren't Properly Trained for

- The most dangerous worker is the person who doesn't know, or refuses to admit when they don't know.
- If you aren't trained to do the job, let your supervisors know

Overconfidence and Complacency

- Statements heard just before a worker is injured:
  "I've done this for 10 years and have never been hurt"
  "It's not going to happen to me"
- No matter how many times you've done a job, plan it as if you're doing it for the first time.
- Always look at your job and ask, "What could go wrong here, and how could I do this job more safely?" – THINK.
- Know your limitations.

Not Observing the Job to Identify Potential Hazards

- Don't "plunge right into" a job.
- Observe the job.
- Look for potential hazards. Ask yourself:
  What could go wrong with this job that could lead to injury?
  How can I do the job more safely?

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Failure to Communicate

- Communication is planning
- Communicate with other contractors, other crafts, and with supervisors
- Communication means discussing:
  -Hazards of the job
  -How to do the work
  -Training needed

Not Using Common Sense

- Common sense isn't "common"
- Common sense requires you to THINK the job through before you begin.
- Common sense means NOT doing something you know could be risky.
- Common sense is asking questions about the job.
- If something doesn't look right, if you THINK the job may be hazardous, if you don't know how to do a task, common sense tells you to STOP, THINK it over, and talk to your supervisor.

Why is it important to THINK?

- To stay alive.
- To avoid pain and suffering.
- Because you have loved ones who care for and depend on you.
- A serious injury can affect your ability to support yourself and your family.
- Accidents are costly to everyone.
- Accidents can result in time off from work and play.
- Accidents result in inconveniences, such as trips to the doctor, changes in schedule, etc.
- To help co-workers earn incentives.
- To gain recognition and respect from co-workers and management.
- To fulfill your responsibility to yourself and co-workers.
- To help EKS maintain a straight and speedy path on the Road to Safe Production Excellence

Remember:

ALWAYS, STOP, T-H-I-N-K, and ask yourself the following questions before completing a task:

- What is the **Task** at hand?

- Do I **Have** the necessary tools, equipment, and PPE to perform the job safely?

- What are the **Itemized** steps, hazards, and safe work procedures I will follow to complete the task safely?

- Who do I need to **Notify** to ensure that my personal safety as well as my co-workers' safety will not be affected by someone else's lack of planning or awareness?

- Do I **Know** the detailed EKS safe work procedures and relevant standards/guidelines that pertain to the task I'm performing (which can be found in the EKS Safety Shorts section)?

In order to reach the next level of safety performance and keep us on the Road to *Safe Production Excellence*, we must:

Concentrate on eliminating unsafe acts by enhancing the safety behaviors of ALL employees, and

Emphasize more craft level involvement in S.T.O.P, T.E.A.M, and T-H-I-N-K. Time and again, STOP and TEAM performance has resulted in lower OSHA incident and total incident frequency (TIF) rates.

EKS T-H-I-N-K Sheet

T A S K

The TASK we will be doing is:

Activity Number(s):		**Description:**	

H A V E

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE		**Hard Hat**		**Eyes & Face**		Hearing Protection		**Arms & Hands**
		Chest & Body		**Legs & Feet**		Respiratory Protection		**Other**

Tools and Equipment

•	•	•	•

I T E M I Z E

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

	Striking Against Objects		**Contacting Sources of Electricity**
	Struck By Objects		**Inhaling/Absorbing/Swallowing Haz. Substances**
	Caught In, On, or Between Objects		**Overexertion-Lifting and Twisting**
	Falling to Below or Same Level		**Repetitive Motions/Vibrations**
	Contacting Temp Extremes		**Awkward Positions/Static Postures**
	Exposure to Temp Extremes		**Confined Space**
	Tool & Equipment Considerations		**Housekeeping/Mtl. Storage Considerations**

BEST PRACTICES – Things To Consider

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	1. 2. 3. 4. 5. 6. 7. 8. 9. 10.
	11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23.

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N	**NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:**	
O T I F Y	❑ **Digger's Hotline – call before you dig** ❑ **Critical Lift Plan** ❑ **Manbasket/Personnel Suspended/Stripping Platforms** ❑ **Confined Space Permit**	❑ **Railroad Flagger** ❑ **Owner** ❑ **Subcontractors** ❑ **Other _____**
K	**KNOW the safe work procedures and OSHA standards that are related to your operations:**	
N O W	**Related Safety Shorts:**	
	•	• •

SAFE LIFTING PLAN

The purpose of the safe lifting plan is to prevent back injuries caused by heavy lifting or overexertion.

Does the material exceed 35 lbs. In weight? **YES NO**
If **NO,** has stretching been performed before lifting is attempted?

If **YES**, complete the lift plan below describing how to safely perform the identified task. (Be sure to address the type of required headcount and/or mechanical device to be used). **Remember that stretching can prevent muscle strains.**

EKS T-H-I-N-K Sheet

T A S K

The TASK we will be doing is:

Activity Number(s):	101	Description:	MOBILIZE - DEMOBILIZE

H A V E

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE	✓	Hard Hat	7,8	Eyes & Face		Hearing Protection	7,8	Arms & Hands
		Chest & Body		Legs & Feet		Respiratory Protection		Other

Tools and Equipment

See EKS Pre-Job Checklist

I T E M I Z E

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

7,10	Striking Against Objects	3	Contacting Sources of Electricity
7,10	Struck By Objects		Inhaling/Absorbing/Swallowing Haz. Substances
7,8	Caught In, On, or Between Objects	9	Overexertion-Lifting and Twisting
7	Falling to Below or Same Level		Repetitive Motions/Vibrations
	Contacting Temp Extremes	9	Awkward Positions/Static Postures
	Exposure to Temp Extremes		Confined Space
5-7, 10,12	Tool & Equipment Considerations	1,2,12	Housekeeping/Mtl. Storage Considerations

BEST PRACTICES – Things To Consider

1. Be sure to pre-plan/layout the work area and lay-down areas to provide for optimum efficiency. Consider material to come in and to go out and placement of truck/trailer. See Housekeeping Safety Short (Sect. C)
2. All materials stored in tiers shall be stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, or collapse. Non-compatible materials should be segregated.
3. Be aware of overhead power lines and any limitations they will pose. See Power Lines Safety Short (Sect. L) Be sure to contact Digger's hotline to locate underground utilities.
4. Make sure an adequate traffic control is in place. Consider pedestrian control plan to provide walkways and arrange for necessary flaggers, traffic lights, stop signs, etc.
5. Check tool and/or personnel trailers for proper tools and equipment, seating/break areas, postings, first-aid materials and fire protection See Fire Safety Shorts (Sect. E), emergency contact numbers, stairs and railings, and general orderliness.
6. Check equipment for defects. Consider fluid levels, back-up alarms, bent boom lacing, broken glass, bad cables, sheaves, etc. Conduct required daily, monthly, and annual inspections.
7. Use caution while unloading tools/equipment/materials to prevent being struck by moving objects, falling from trailer, or getting caught in pinch points.

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8. Be aware of pinch points while assembling equipment (i.e. crane boom) as well.
9. Use proper lifting techniques and know limitations of human (worker(s), crane (capacities), and rigging (slings, chains, loading). See Materials Handling (Sect. O) and Cranes and Rigging Safety Shorts (Sect. L)
10. Establish designated parking areas as far away as reasonably possible from moving equipment, flying debris, traffic, or other hazards.
11. Post necessary warning signs. (i.e. "EKS Keep Out Unauthorized","Danger Overhead Power lines", "No Trespassing", etc.)
12. Be aware of flood plains. Setting up in a flood plain can result in lost or damaged equipment, materials, and tools.

NOTIFY

NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:

- ❑ Digger's Hotline – call before you dig
- ❑ Critical Lift Plan
- ❑ Manbasket/Personnel Suspended/Stripping Platforms
- ❑ Confined Space Permit
- ❑ Railroad Flagger
- ❑ Owner
- ❑ Subcontractors
- ❑ Other _____

KNOW

KNOW the safe work procedures and OSHA standards that are related to your operations:

Related Safety Shorts:

• Crane Safety Basics	• Teamlift	• Safe Housekeeping
• Crane Safety	• Jacking Safety	• Rigging Safety Basics
• Safe Lifting	• Grading and Clearing Safety	• Straddle Chains
• Fire Ext -1	• Power Lines	• Propane Safety

SAFE LIFTING PLAN

The purpose of the safe lifting plan is to prevent back injuries caused by heavy lifting or overexertion.

Does the material exceed 35 lbs. In weight? **YES NO**
If **NO,** has stretching been performed before lifting is attempted?

If **YES**, complete the lift plan below describing how to safely perform the identified task. (Be sure to address the type of required headcount and/or mechanical device to be used). **Remember that stretching can prevent muscle strains.**

Comments:

Appendix B

EKS PRE-JOB CHECKLIST

PROJECT MANAGEMENT	Date Completed:	Completed By:	Comments:
Have utilities been contacted for locates?			
Are there any utilities such as gas lines, sewers, cables, and/or powerlines that should be relocated or marked to prevent damage or incident?			
Have arrangements been made for a designated employee parking area, and signs posted to define this area?			
Are the following required Risk Management Materials on site?			

❑ EKS Jobsite Specific Accident Prevention Plan ❑ EKS New Hire Packet ❑ TEAM Books ❑ STOP Cards ❑ Safety Operations Manual ❑ Jobsite Spill Contingency Plan	❑ Crisis Management Kit (yellow box) ❑ Hazard Communication Book ❑ Crane Manual ❑ Bridge Manual ❑ EKS Employee Safety & EEO Handbook ❑ Crane Mobilization Manual	❑ EKS Job Site Posting Board ❑ EKS First Report of Incident Forms ❑ EKS Medical Authorization Forms ❑ OSHA Manuals Parts 1910 & 1926

Have the emergency phone & utility numbers & map to selected medical facility been posted?			
Are appropriate first-aid materials supplied and/or replenished, including Blood Borne Pathogen Kits for employees?			
Has a determination been made whether any lead exposure will be encountered during the project? **If yes**, contact the Safety Department to coordinate Lead and Respiratory Safety Program training.			
Has a determination been made whether any operations involving confined space will be encountered during the project? **If yes**, contact the Safety Department to coordinate Confined Space Safety Program training.			
Will pile driving or sheeting operations be performed within 500' of an existing structure? **If yes**, contact Safety Department to procure seismographic monitoring equipment.			
Have EKS Safety exceptions been verbally reviewed with the onsite personnel of subcontractors and sub-tier contractors?			

JOBSITE SECURITY	Date Completed:	Completed By:	Comments:
Are all necessary EKS signs posted?			

❑ Keep out / Unauthorized Personnel	❑ No Trespassing ❑ Danger Powerlines ❑ No Smoking	❑ Traffic Control and Access Signs	❑ No Riding Bikes on Bridge

Has a Jobsite Security Plan been developed for the prevention of trespassing, theft, and vandalism?			

❑ Security Fencing ❑ Barricades	❑ Trailers ❑ Storage Boxes	❑ Lighting ❑ Signage (see below)

Appendix B

ELECTRICAL PROTECTION	Date Completed:	Completed By:	Comments:
Is there an EKS assured grounding kit on site?			
If powerlines are present, has EKS from 147 been completed and submitted to the utility owner requesting relocation, outages, and/or marking?			
Does temporary jobsite electrical meet all codes? • Circuits properly labeled, grounded, fused, and inspected • Panel boxes covered and warnings posted • No romex used for outdoor applications • temporary lighting properly supported and protected			
Electrical cords routed away from stairways, walkways, doorways, and driveways were they can be damaged and or create additional safety hazards.			

FIRE PROTECTION	Date Completed:	Completed By:	Comments:
"Danger No Smoking" signs posted wherever flammables and/or combustible liquids exist.			
Have all fire extinguisher been inspected and properly tagged for the current calendar year?			
Fire extinguishers properly located (cranes, equipment, and in work areas).			
Fire hydrant locations noted, and action taken to prevent material from being stacked within 20' of them.			
Are 'hot work' precautions taken in urban and environmentally sensitive areas?			
Flammable and Combustible liquids storage and handling containers are EKS approved and labeled?			
Flammables and combustibles stored properly in EKS flammable and combustible liquid storage cabinets (Yellow Cabinet).			
Outside storage tanks and spill prevention/ containment systems are in place for all fuels, and liquids.			
Storage of flammable and combustibles a minimum of 100' from buildings.			
Approved safety cans available for disposal of oily and greasy rags.			

CONSTRUCTION COMPOUND AREA	Date Completed:	Completed By:	Comments:
Office and job trailers equipped with stairs and handrails?			
Have temporary heat units been "Safety Checked?"			

HOUSEKEEPING	Date Completed:	Completed By:	Comments:
Has a safe place been designated for burning trash and if necessary, have proper permits been attained?			
Proper waste material containers provided in the immediate work area.			
Action taken to keep storage area free of combustibles and scrap.			
House keeping tools available to keep walking and working surfaces, stairs, etc. free of liquid spills, debris, tools, equipment, and materials.			

Adequate supply of EKS Spill Containment materials.			
Adequate snow, ice, removal equipment onsite when necessary.			
Banding materials on site to allow for the proper stacking and banding of materials.			

SANITATION	Date Completed:	Completed By:	Comments:
Adequate supply of fresh drinking water with disposable cups and waste containers provided.			
Potable and non-potable hand washing water sources labeled.			
Toilet facilities adequate for personnel (1 per 25 employees) and readily accessible.			

MATERIALS STORAGE AND HANDLING	Date Completed:	Completed By:	Comments:
Action taken to ensure that storage and lay down areas will be flat, firm, and orderly.			
Materials properly stacked and blocked, to prevent sliding, falling, rolling, or collapse.			
Barrel cages on site if necessary to move 55 gallon barrels. (do not lift barrels with cut-outs)			

COMPRESSED GAS CYLINDERS	Date Completed:	Completed By:	Comments:
Multiple compressed gas cylinder cages available for storage of oxygen and fuel gas, and are cages separated by minimum of 20'?			
Cylinders secured and upright, and action taken to ensure that only one oxygen and one fuel gas are stored in each cage being worked out of.			
Cylinders stored away from heat and electrical contact and equipped with flash back arrestors.			
Empty cylinders returned to storage area.			

EXCAVATION AND TRENCHING	Date Completed:	Completed By:	Comments:
Competent person has been trained and identified as required to inspect all trenches and excavations daily prior to employee entrance.			
Excavations in excess of 4 feet must be sloped, benched, trench boxed, or shored in accordance with EKS Safety Operations Manual. NOTE: materials and spoil piles must be 2' or more from edge of excavation.			
Employees protected by proper sloping or mechanical means from cave-ins, sliding, falling, or rolling materials/debris, hazardous atmospheres, and water accumulation.			
Proper ingress and egress provided for employees every 25' when entering trenches or excavations greater that 4' in depth.			
Excavations in excess of 20' designed by a registered engineer.			

Appendix B

SCAFFOLDING & SHORING	Date Completed:	Completed By:	Comments:
Scaffolding designed, erected, dismantled, moved, or altered under the supervision of a trained competent person.			
Footings solid, scaffold erected plumb, level and all anchorage secured.			
Are loading capacities posted			

PERSONAL PROTECTIVE EQUIPMENT	Date Completed:	Completed By:	Comments:
Required personal protective equipment immediately available at the jobsite.			

❑ Hard Hats ❑ Safety Glasses ❑ Goggles/Face Shields	❑ Work and Welding Gloves ❑ Full Body Fall Protection Harnesses ❑ Life Vests	❑ Ear Plugs ❑ Traffic Vests ❑ Dust Masks/Respirators ❑ Vibration Gloves

FALL PROTECTION	Date Completed:	Completed By:	Comments:
Fall protection plan approved by Safety Department and in-house engineer.			
Adequate supply of full body harnesses, lanyards, lifelines, retractables, etc. available for use.			
Adequate number of scaffold planking, 2 x 4's, and posts procured to completely deck working platforms.			

POWDER ACTUATED TOOLS	Date Completed:	Completed By:	Comments:
Operators trained and authorized.			
Means for storage and control of spent and unspent charges.			

CRANES	Date Completed:	Completed By:	Comments:
Are warning signs posted and legible as required			
Load capacity and hand signal charts posted			
Crane Annual Inspection completed.			
EKS Crane Log available for all cranes (EKS and rental).			
Window safety glass, free of defects and distortion.			
Properly sized and inspected fire extinguisher in cab.			
Swing radius of counterweight protection in place			
A solid level area prepared for the crane and substantial cribbing procured. (not 4 x 4's and scrap)			
Has the required safe working distance been marked on the ground from live overhead lines and warning signs installed.			
Has a critical lift plan been developed for all single crane lifts exceeding 80% of the crane rated capacity or any anticipated dual crane picks.			

Appendix B

EKS T-H-I-N-K Sheet

T A S K

The TASK we will be doing is:

Activity Number(s):	300's	Description:	REMOVALS

H A V E

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE	✓	Hard Hat	9,15,17	Eyes & Face	9,17	Hearing Protection	14,17	Arms & Hands
	7,9	Chest & Body		Legs & Feet	9,11, 15	Respiratory Protection		Other

Tools and Equipment

• Backhoe & pneumatic breaker • Concrete saw • Crane & frost ball	• Drills & Grinders • Jackhammers & hammer-chisels	• Gas-cutting torches • Shear cutters • Impact wrenches	• Rivet busters • Explosives • Clamshell

I T E M I Z E

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

18-20	Striking Against Objects	16,21	Contacting Sources of Electricity
1,4,15,16, 18-21	Struck By Objects	11,15	Inhaling/Absorbing/Swallowing Haz. Substances
1,4,21	Caught In, On, or Between Objects	14	Overexertion-Lifting and Twisting
1,4,6,7	Falling to Below or Same Level	14,17	Repetitive Motions/Vibrations
15	Contacting Temp Extremes	11	Awkward Positions/Static Postures
	Exposure to Temp Extremes		Confined Space
5,8,10-14	Tool & Equipment Considerations		Housekeeping/Mtl. Storage Considerations

BEST PRACTICES – Things To Consider

Mobilize/Set-up:

1. In order to prevent premature or unplanned bridge failure, a detailed demolition plan must be developed by a structural engineer, which outlines the sequence of removal for each support member.
2. Pre-job surveys need to be conducted to assess such things as; Proximity to adjacent buildings - Is there a need for seismographic monitoring? Proximity to the travelling public – Is there a need for overhead protection in order to protect cars, people, bikes, etc.? Are the proper traffic control devices in place? Be sure that controlled access zones are properly set up and maintained throughout the removal process as well.
3. Prior to the demolition phase, the Project Manager/Foreman should meet with all workers involved with the operation to review the method of removal and discuss and review safety related issues involved.
4. Use caution while unloading tools/equipment to prevent being struck by moving objects, falling from the trailer, or getting caught in pinch points.
5. Check tools and equipment for defects or damage before use. Perform the routine maintenance required for the specific tools and equipment.
6. The erection of proper fall protection equipment such as static lines and anchorage points must be engineered to afford workers appropriate and adequate safety measures. See EKS's Fall Protection Safety Systems - Safety Operations Manual Section 4 and/or Fall Protection Shorts (Sect. V)

7. Each worker should be equipped with a full body harness during demolition operation See Full Body Harness and Harness Care Safety Shorts (Sect. V)

8. Where feasible, use EKS stripping platforms, personnel platforms, or aerial lifts to aid in safe production during the operation. See EKS's Equipment Safety Systems – Sect. 3

Removal/Demolition:

9. When performing or while near the demolition/removal operation, be sure to wear the necessary PPE. These operations often produce excessive noise and dust and are often above or near water. Pieces of concrete and rubble can be projected into the eye or fall on the head or body. Also see the EKS Personal Protective Equipment Safety Program and Safety Shorts (Sect. B)

10. If using the **backhoe with the pneumatic breaker** (pecker), be sure the backhoe is equipped with Falling Object Protection Structures (FOPS) and maintain a flat and firm surface or pad. Make sure horn is operable. See Backhoe/Loader Safety Short (Sect. M). NOTE: An underwater attachment is to be used if the pneumatic breaker is to be used underwater. Contact Dave Kirk.

11. When using a **concrete saw**, use the correct type and size blade and that it rotates in the correct rotation. Water can be used to cut down on dust. Make sure the blade guard is properly positioned and free from defects. Bring yourself to the working elevation and/or take frequent breaks to combat awkward and static positions. Use a walk-behind saw whenever possible.

12. Establish and maintain the proper access and **crane** pad with sufficient cribbing when using the **frost ball**. Check the cable and tire for excessive wear and tear and for proper rigging. Only experienced operators should operate the crane and frost ball, the dynamic and repetitive forces create a hazard of overload and failure.

13. See the Power Tool Safety Short (Sect. H) and the EKS Power Hand Tool Safety Program for the safe use and care of **drills** and **grinders** during demolition activities.

14. When using breakers (i.e., **jackhammers, hammer-chisels**), inspect the body of the breaker and the bit for any signs of damage before each use. Use proper lifting procedures when using a large breaker. See Materials Handling Safety Shorts (Sect. O). If possible, avoid using the **breaker** in way where the bit could fall through or fall off the area being repaired. If this is not possible, hold the breaker in such a way that if it did drop through/off the concrete, you could catch it without severe and traumatic bending of the back. Wear padded gloves to combat vibration.

15. There are many hazards associated with the use of **gas-cutting torches** during removal operations. Lead overexposure or other toxic fumes, burns, particles in the eyes, falling objects, exploding tanks, and other fire hazards are examples. For more information see the EKS Lead, Respiratory, and Oxygen-Fuel Gas Cutting Safety Programs along with the Torch Cutting,(Sect. S)Gas Cylinder (Sect. R) and, Lead Safety Shorts(Sect. Q).

16. If using the **shear cutters** for steel removal, do not overload the picking capacity and try to pick at the center of gravity. Keep persons away from handled steel and be aware of overhead power lines. See Power Line Safety Short (Sect. L). Be sure that trucks to be loaded are equipped with Falling Object Protection Structures (FOPS).

17. The use of **impact wrenches** and **rivet busters** for removing bolts and rivets requires the use of necessary PPE (i.e. ear plugs, safety glasses, vibration gloves) and proper fall protection for the job. See the EKS Fall Protection Plan and Fall Protection (Sect. V) and PPE Safety Shorts (Sect. B)

18. Loading and blasting is normally done by a blaster, but a blaster may be assisted during loading by a driller, or general laborer. No one should handle **explosives**, or **blasting agents**, unless under the direct supervision of an authorized person. Blasting operations must be under the direct control of authorized persons. In many states, an authorized person must hold state certification, such as a blaster's certificate, or shot- firer's papers.

19. Because of potential danger, all **explosive materials** should be handled carefully. Never drop, or roughly handle packages containing explosives.

Appendix B

Disposal/Clean-up:

20. Stay clear of the crane swing when using the crane and clamshell to prevent being struck by the load or loose, falling material. Use proper rigging and crane safety when using slings and chains as well. See Cranes and Rigging Safety Shorts (Sect. L). Also reference the EKS Employee Safety/EEO Handbook.

21. Do not overload the picking capacity of the **shear cutters** and try to pick at the center of gravity. Keep persons away from handled steel and be aware of overhead power lines. See Power Line Safety Short (Sect. L). Be sure that trucks to be loaded are equipped with Falling Object Protection Structures (FOPS). If stacking a pile to be salvaged or loaded-out at a later time, watch for pieces of shifting or falling steel to prevent struck by and caught between hazards.

NOTIFY

NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:

- ❑ **Digger's Hotline – call before you dig**
- ❑ **Critical Lift Plan**
- ❑ **Manbasket/Personnel Suspended/Stripping Platforms**
- ❑ **Confined Space Permit**
- ❑ **Railroad Flagger**
- ❑ **Owner**
- ❑ **Subcontractors**
- ❑ **Other** _____

KNOW

KNOW the safe work procedures and OSHA standards that are related to your operations:

Related Safety Shorts:

- **Full Body Harness**
- **Harness Care**
- **PPE**
- **Backhoe/Loader**
- **Power Tool**
- **Lifting/Teamlifting**
- **Torch Cutting**
- **Gas Cylinders**
- **Power Line**
- **Crane**
- **Rigging**
- **Alloy Steel Chains**

SAFE LIFTING PLAN

The purpose of the safe lifting plan is to prevent back injuries caused by heavy lifting or overexertion.

Does the material exceed 35 lbs. In weight? **YES NO**

If **NO,** has stretching been performed before lifting is attempted?

If **YES**, complete the lift plan below describing how to safely perform the identified task. (Be sure to address the type of required headcount and/or mechanical device to be used). **Remember that stretching can prevent muscle strains.**

Comments:

Appendix B

EKS T-H-I-N-K Sheet

T — TASK

The TASK we will be doing is:

Activity Number(s):	400-411	Description:	EXCAVATION AND BACKFILL

H — HAVE

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE	✓	Hard Hat	✓	Eyes & Face	17	Hearing Protection		Arms & Hands
	5,11	Chest & Body	18	Legs & Feet	18	Respiratory Protection		Other

Tools and Equipment

• Excavation/Backfill Equipment (backhoe, crane & clamshell, loaders, etc.)	• Sheeting, Trench Boxes, or other shielding	• Shovels • Barricades • Dewatering Pumps	• Warning Vests • Ladders • Plate Tampers • Sheepsfoot Roller

I — ITEMIZE

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

2,8	Striking Against Objects	1	Contacting Sources of Electricity
2,3-8,12-15	Struck By Objects	9,10	Inhaling/Absorbing/Swallowing Haz. Substances
2,3,4,11-15	Caught In, On, or Between Objects		Overexertion-Lifting and Twisting
	Falling to Below or Same Level	18	Repetitive Motions/Vibrations
	Contacting Temp Extremes		Awkward Positions/Static Postures
	Exposure to Temp Extremes	8,9,12	Confined Space
4,7,8,13,14,17	Tool & Equipment Considerations	2	Housekeeping/Mtl. Storage Considerations

BEST PRACTICES – Things To Consider

1. Be sure all underground utilities are located and protected, or removed or temporarily relocated. Performing pot holing is good practice when unsure of locates. See also Grading and Clearing Safety Short (Sect. M)
2. Be sure all surface hazards and spoil piles are moved back the required 2' from the edge of the excavation, or that protection is being used to prevent loose rock or soil from falling or rolling into the excavation.
3. All excavations in soils other than stable rock and less than 4' in depth are maintained at a minimum of a 1 to 1 slope (45 degrees), and/or other protective means (i.e., trench box, protective shoring/sheeting) are used.
4. Always maintain a safe means of entry and exit for excavations more than 4' deep. There should be an approved access ladders or stairs within 25' of personnel.
5. Always wear EKS warning vests when your work exposes you to live vehicular traffic.
6. Prohibit anyone from standing under loads handled by lifting or digging equipment and never swing the bucket or clamshell over other workers. All workers should stay clear of the bucket swing and the cab rotation when working around backhoes, clamshells, and loaders See Cranes and Rigging (Sect. L) and Heavy Equipment Safety Shorts (Sect. M).
7. When the soil is soft, make sure that the equipment is on a solid foundation, such as mats or heavy planking, and that outriggers are fully extended before starting operations. Never operate closer than 10 from overhead power lines See Power Line Safety Short (Sect. L).
8. Have a warning system (i.e., stop logs, signal person) in place when the operator of mobile equipment does not have a clear direct view of the edge of the excavation while the equipment is being operated adjacent to or near the edge of excavations. See Heavy Equipment Safety Shorts (Sect. M)
9. Always test for hazardous atmospheres and if present, eliminate them prior to entry. Contact the EKS Safety Department if you are ever uncertain if your excavation/trench has a hazardous atmosphere. See Trenching and Excavating Safety Short (Sect. P)

10. Have rescue equipment (i.e., breathing apparatus, a safety harness and lifeline, basket stretcher) available where hazardous atmospheres or other conditions exist or could reasonably be expected to develop during work in the excavation.
11. Provide adequate protection (i.e. lift vests) before anyone works in an excavation when mass water accumulation is a hazard.
12. The designated competent person must: (1) inspect the excavation, adjacent area, and protective systems daily for evidence of situations that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, (2) inspect after every rainstorm or other occurrence that could increase the hazards, and (3) remove employees from the excavation or trench if any of these hazards exist.
13. Protect yourself from cave-ins by using adequate protective systems (including sloping and benching, sheeting, trench boxes, or shield systems). Inspect shoring and bracing for visual defects and potential failures.
14. Make sure there is no water, surface tension cracks, or other environmental conditions present that reduces the stability of the excavation. Also, minimize vibration (or provide monitoring) if heavy equipment operation, vehicular traffic, and pile driving or sheeting is taking place in the vicinity that causes vibration to the excavation while employees near.
15. Make sure that work crews in the excavation are the minimum number needed to perform the work and the work has been planned and will be carried out in a manner to minimize the time employees are in the excavation.
16. Use proper hand tool awareness during excavation, backfilling, or fill operations, See Hand Tool Safety Short (Sect. G)
17. If compaction is being performed with a sheepsfoot roller, make sure it is equipped with a backup alarm and the operator always looks in the direction of travel. Workers should wear a safety vest and if necessary, ear plugs.
18. If operating or near a walk-behind or pneumatic plate tamper (on backhoe), be sure to wear the required PPE (i.e., steel toes, metatarsal protection, dust masks, ear plugs). See PPE Safety Shorts (Sect. B) and EKS Protective Footwear Program. A walk-behind tamper (e.g., Wacker) is only to be used on level ground.

NOTIFY

NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:

- ☐ **Digger's Hotline – call before you dig**
- ☐ **Critical Lift Plan**
- ☐ **Manbasket/Personnel Suspended/Stripping Platforms**
- ☐ **Confined Space Permit**
- ☐ **Railroad Flagger**
- ☐ **Owner**
- ☐ **Subcontractors**
- ☐ **Other** _____

KNOW

KNOW the safe work procedures and OSHA standards that are related to your operations:

Related Safety Shorts:

• **Excavation Safety Basics**	• **Rigging Safety**	• **PPE**
• **Trenching and Excavating**	• **Backhoe/Loader Safety**	• **Grading and Clearing Safety**
• **Crane Safety**	• **Hand Tool Safety**	• **Power Line**

SAFE LIFTING PLAN

The purpose of the safe lifting plan is to prevent back injuries caused by heavy lifting or overexertion.

Does the material exceed 35 lbs. In weight? **YES NO**
If **NO,** has stretching been performed before lifting is attempted?

If **YES**, complete the lift plan below describing how to safely perform the identified task. (Be sure to address the type of required headcount and/or mechanical device to be used). **Remember that stretching can prevent muscle strains.**

Comments:

EKS T-H-I-N-K Sheet

T A S K

The TASK we will be doing is:

Activity Number(s):	430-442	Description:	FILTER FABRIC & RIP-RAP PLACEMENT

H A V E

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE	✓	Hard Hat		Eyes & Face		Hearing Protection	3	Arms & Hands
	2	Chest & Body		Legs & Feet		Respiratory Protection		Other

Tools and Equipment

• Crane & Clamshell Bucket	• Utility Knife	• Shovels	• Waders

I T E M I Z E

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

	Striking Against Objects		Contacting Sources of Electricity
3,5-7	Struck By Objects		Inhaling/Absorbing/Swallowing Haz. Substances
5	Caught In, On, or Between Objects	4	Overexertion-Lifting and Twisting
9	Falling to Below or Same Level		Repetitive Motions/Vibrations
	Contacting Temp Extremes	9	Awkward Positions/Static Postures
	Exposure to Temp Extremes		Confined Space
	Tool & Equipment Considerations		Housekeeping/Mtl. Storage Considerations

BEST PRACTICES – Things To Consider

1. See Excavation THINK sheet and Safety Shorts (Sect. P) for general excavation safety
2. Whenever possible, stay out of water unless necessary for placing geotextile fabric, otherwise keep sure footing using slow and deliberate movements in currents and wear a life jacket.
3. A correct and sharp utility knife will be most effective and prevent cuts and lacerations while cutting fabric.
4. Use proper lifting techniques, teamlifting, or mechanical devices to prevent overexertion while lifting fabric rolls and chinking rock. See Materials Handling Safety Shorts (Sect. O)
5. Dump truck must be equipped with backup alarm to keep nearby workers aware of operations. Stay clear of the dumping operation to prevent struck by or pinch point incidents while dumping rock and returning dump box. See Heavy Equipment Safety Shorts (Sect. M)
6. Timbers or another form of stop can be used to indicate edge of excavation to dump operator if necessary.
7. Use proper crane signals, rigging techniques, and in general, be aware of overhead loads & hazards while using clamshell bucket for placing rip-rap or filter rock. Also be aware and stay clear of the swing radius of the crane. See Cranes and Rigging Safety Shorts (Sect. L)
8. Maintain a solid, level area for the crane (if using clamshell bucket). See also Crane Safety Short (Sect. L).

9. If necessary to walk on rip-rap, use slow and deliberate steps to prevent a sprained or twisted ankles and knees.

10. If placing grouted rip-rap the same hazards apply. See also Mixing and Handling Concrete Materials Safety Short (Sect. T).

NOTIFY

NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:

❑ Digger's Hotline – call before you dig	❑ Railroad Flagger
❑ Critical Lift Plan	❑ Owner
❑ Manbasket/Personnel Suspended/Stripping Platforms	❑ Subcontractors
❑ Confined Space Permit	✓ Other DNR Notification

KNOW

KNOW the safe work procedures and OSHA standards that are related to your operations:

Related Safety Shorts:

• Excavation Safety • Crane Safety Basics	• Crane Safety	• Mixing and Handling Concrete Materials Safety

SAFE LIFTING PLAN

The purpose of the safe lifting plan is to prevent back injuries caused by heavy lifting or overexertion.

Does the material exceed 35 lbs. In weight? **YES NO**
If **NO,** has stretching been performed before lifting is attempted?

If **YES**, complete the lift plan below describing how to safely perform the identified task. (Be sure to address the type of required headcount and/or mechanical device to be used). **Remember that stretching can prevent muscle strains.**

Comments:

Appendix B

EKS T-H-I-N-K Sheet

T — TASK

The TASK we will be doing is:

Activity Number(s):	460 - 469	Description:	COFFERDAMS, SHEETING, DEWATERING, & WELL POINTS

H — HAVE

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE	✓	Hard Hat	2	Eyes & Face	2	Hearing Protection	2	Arms & Hands
	3	Chest & Body		Legs & Feet		Respiratory Protection		Other

Tools and Equipment

• Crane(s) • Vibro-Hammer • Crane Log/Manual	• Lube, Oil, & Fuel • Rigging • Torches & Welders	• Oxy & Acet Tanks • Sheet Piling • Ring Steel	• Ladders • Life Rings • Personnel Boats

I — ITEMIZE

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

7	Striking Against Objects	1	Contacting Sources of Electricity
1,3,5,6, 9-12	Struck By Objects	9	Inhaling/Absorbing/Swallowing Haz. Substances
1,3,5,6, 9-12	Caught In, On, or Between Objects	12	Overexertion-Lifting and Twisting
3	Falling to Below or Same Level		Repetitive Motions/Vibrations
2	Contacting Temp Extremes		Awkward Positions/Static Postures
	Exposure to Temp Extremes	9	Confined Space
	Tool & Equipment Considerations	1	Housekeeping/Mtl. Storage Considerations

BEST PRACTICES – Things To Consider

1. When unloading cofferdam ring steel and sheet piling, workers not involved should stay clear, use/know proper crane signals and operation, and practice proper rigging techniques See Cranes and Rigging Safety Shorts(Sect. L) and EKS Employee Handbook). Use proper dunnage and stacking techniques to prevent being caught between sheets.

2. When trimming or placing sheet piling or ring steel, be sure to wear proper PPE and handle oxygen and acetelene tanks properly See Welding (Sect. S), PPE (Sect. B), and Gas Cylinders (Sect. R) Safety Shorts for further explanation. Wear ear protection while vibro-hammer is in operation.

3. All workers that are not part of the operation should stand clear until the sheets have been interlocked and the vibro-hammer is in place. Work around water requires the use of life vests. Life rings, life boat(s), and non-skid, railed gangplanks should also be on site and accessible (if applicable). Be sure to check the layout of the cofferdam/sheeting and its agreement with plan requirements.

4. Prior to setting up the vibro-hammer, an inspection should be conducted to detect damage to the hammer, hoses, and connections to prevent malfunction or rupture.

5. When water currents are present, the bottom of the sections may require cable or bracing to maintain vertical alignment until the sheet has been driven in far enough to withstand pressure.

6. Vibration monitoring is required when sheeting operations are performed within 500' of an existing structure. Inspections of cofferdams and studies of upstream water levels and weather conditions should be conducted to prevent collapse and drowning.

7. If there is boat traffic in the vicinity of cofferdams, adequate warning lights and upstream warning signs should be provided in accordance with U.S. authorities.

8. See Cranes and Rigging (Sect. L) and Excavations & Backfilling (Sect. P) Safety Shorts/THINK Sheets for the prevention of the hazards associated with excavating and backfilling inside cofferdams or adjacent to sheeting.

9. If driving piling inside cofferdams or as part of a sheeting operation, see the Piling THINK Sheet and Piling Safety Short (Sect. W). Work inside a cofferdam (i.e., installing well points and dewatering pumps, placing templates and piling) is considered a confined space, see EKS's Confined Space Safety and Air Monitoring Safety Programs. As protection against unexpected flooding, strairways at strategic points should be provided for the evacuation of workers in a dewatered area.

10. If pouring concrete for piers, see the Concrete Forming and Placement THINK sheets, Cranes and Rigging Safety Shorts (Sect. L), and the Pump Truck Safety Short (Sect. T) (if applicable).

11. Following installation, use proper crane and rigging safety when pulling, cleaning, and loading sheets. See Cranes and Rigging Safety Shorts (Sect. L).

12. The vibro-hammer should be properly stored to prevent unnecessary wear and tear. The vibro and hoses are extremely heavy. Use the proper lifting techniques, teamlifting, or mechanical devices to prevent overexertion. See Safe Lifting and Teamlifting Safety Shorts (Sect. O). Note: the vibro should always be stored on proper dunnage and also boxed and heated during freezing temperatures.

NOTIFY

NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:

- ❑ **Digger's Hotline – call before you dig**
- ❑ **Critical Lift Plan**
- ❑ **Manbasket/Personnel Suspended/Stripping Platforms**
- ❑ **Confined Space Permit**
- ❑ **Railroad Flagger**
- ❑ **Owner**
- ❑ **Subcontractors**
- ❑ **Other** _____

KNOW

KNOW the safe work procedures and OSHA standards that are related to your operations:

Related Safety Shorts:

- **Crane Safety**
- **Rigging Safety**
- **PPE Safety**
- **Gas Cylinders Safety**
- **Excavations**
- **Piling Safety**
- **Pump Truck Safety**
- **Safe Lifing**
- **Team Lifting**

SAFE LIFTING PLAN

The purpose of the safe lifting plan is to prevent back injuries caused by heavy lifting or overexertion.

Does the material exceed 35 lbs. In weight? **YES NO**
If **NO,** has stretching been performed before lifting is attempted?

If **YES**, complete the lift plan below describing how to safely perform the identified task. (Be sure to address the type of required headcount and/or mechanical device to be used). **Remember that stretching can prevent muscle strains.**

Comments:

Appendix B

EKS T-H-I-N-K Sheet

T A S K

The TASK we will be doing is:

Activity Number(s):	500's	Description:	PILING

H A V E

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE	✓	Hard Hat	11,14 21,22	Eyes & Face	11	Hearing Protection	11,14, 17	Arms & Hands
	19, 20	Chest & Body	14	Legs & Feet	21,22	Respiratory Protection		Other

Tools and Equipment:

• Crane & Pile Hammer • Crane Log/Manual • Lube, Oil, & Fuel	• Rigging • Oxy & Acet Tanks • Torches & Welders	• Piling (timber, pipe, H, pre-cast) • Cables/Wire Rope • Tag Line	• Pile Points, End Plates, & Backing Rings

I T E M I Z -

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

	Striking Against Objects	1	Contacting Sources of Electricity
1,2,8,10 18,21	Struck By Objects	15	Inhaling/Absorbing/Swallowing Haz. Substances
1,4,5,10 12,18	Caught In, On, or Between Objects	12	Overexertion-Lifting and Twisting
	Falling to Below or Same Level		Repetitive Motions/Vibrations
21,22	Contacting Temp Extremes		Awkward Positions/Static Postures
	Exposure to Temp Extremes		Confined Space
3-8	Tool & Equipment Considerations	16	Housekeeping/Mtl. Storage Considerations

BEST PRACTICES – Things To Consider

1. When unloading piling, workers should not be allowed on top of shipment or along the unloading side after banding has been cut.
2. Piling should be stacked to prevent rolling or collapse and in an orderly manner so that it can be easily skidded to locations near the pile driver.
3. Inspection and proper assembly will reduce the likelihood of an incident occurring such as a mechanical failure leading to personal injury. Also see Pile Driving Safety Shorts (Sect. W)
4. Be sure leads are provided with an adequate ladder,sections are bolted together correctly, and that a steel cable rope grab system is installed and functional.
5. Hoisting drums and brakes should be kept in good operating condition. Also inspect all sheaves, cable, machinery, slings, and other parts of pile drivers.
6. Mats and cribbing should be used for support in cut, fill, or other unstable soil areas. Use extreme caution close to an excavation. Shoring should be used to retain sidewalls. See Excavation Safety Short (Sect. P)
7. If using rubber-tired crane, fully extend outriggers to provide maximum stability and lifting capacity.
8. Pile-driving equipment movement should always be watched closely due to its excessive weight.
9. Use proper rigging techniques. See Rigging Safety Shorts (Sect. L)
10. When piles are being lifted into position, workers not engaged in the operation should be kept at a safe distance. Use caution when moving piling from stacks to avoid collapse and possible injury.
11. All workers handling piles should wear heavy gloves, steel-toed boots, hard hats, safety glasses, and ear protection when driving piles to prevent injury. See PPE Safety Shorts (Sect. B)

Appendix B

12. When a worker is guiding a pile into position, the worker should be cautioned against putting arms or hands between the pile, inside the guide, or on top of the pile. Try using a 2x4 and limit overexertion and twisting.
13. Before lifting wood piles into position, place an iron ring or pile cap over driving end to prevent brooming.
14. Proper personal protective equipment should be worn for trimming or pointing wood piles with chainsaws. Workers should be far enough apart to avoid injury from swinging saw or flying chips. Use proper chainsaw safety. See Power Tool Safety Short (Sect. H)
15. Wear gloves and long sleeves to prevent exposure to creosote when handling wood piles or treated timbers.
16. All areas around pile drivers should be kept clear of materials and equipment not being used, and all workers not actually engaged in operations should be kept at a safe distance
17. Vibration monitoring is required when pile driving or sheeting operations are performed within 500' feet of an existing structure.
18. The pile driver operator should receive signals from a designated signalperson.
19. Proper fall pro (i.e. harness, cable grab) if must climb. See Fall Protection Safety Shorts (Sect. V)
20. Use appropriate protection when driving pile on or around water (i.e., life vests, life rings, & lifeboat.)Gangplanks should be provided, secured against slipping, non-skid, and provided with handrails for boarding floating rigs and for crossing between barges and other craft.
21. There are many hazards associated with the use of gas-cutting torches during piling operations. Toxic fumes, burns, particles in the eyes, falling objects, exploding tanks, and other fire hazards are examples. For more information see the EKS Respiratory and Oxygen-Fuel Gas Cutting Safety Programs along with the Torch Cutting (Sect. S) and Gas Cylinder (Sect. R) Safety Shorts.
22. Wear proper PPE and clothing while welding piles. Use proper setup, welding, and tear down procedures while welding. See Welding Safety Short (Sect. S) and the EKS's Welding Safety Program.

NOTIFY

NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:

- ❑ Digger's Hotline – call before you dig
- ❑ Critical Lift Plan
- ❑ Manbasket/Personnel Suspended/Stripping Platforms
- ❑ Confined Space Permit
- ❑ Railroad Flagger
- ❑ Owner
- ❑ Subcontractors
- ❑ Other _____

KNOW

KNOW the safe work procedures and OSHA standards that are related to your operations:

Related Safety Shorts:

- Pile Driving Safety Basics
- Power Tool Safety
- Torch Cutting
- Gas Cylinders
- Welding
- Full Body Harness
- Harness Care
- Crane Safety Basics
- Crane Safety
- Rigging
- Excavation Safety

SAFE LIFTING PLAN

The purpose of the safe lifting plan is to prevent back injuries caused by heavy lifting or overexertion.

Does the material exceed 35 lbs. In weight? **YES NO**

If **NO,** has stretching been performed before lifting is attempted?

If **YES**, complete the lift plan below describing how to safely perform the identified task. (Be sure to address the type of required headcount and/or mechanical device to be used). **Remember that stretching can prevent muscle strains.**

Comments:

Appendix B

EKS T-H-I-N-K Sheet

T — TASK

The TASK we will be doing is:

Activity Number(s):	601,603,605,607,609, 611, 619	Description:	CONCRETE FORMING & STRIPPING

H — HAVE

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE	✓	Hard Hat	4,13	Eyes & Face		Hearing Protection	1	Arms & Hands
	10,16	Chest & Body		Legs & Feet		Respiratory Protection		Other

Tools and Equipment

• Lumber (4x4's, 2x4's, plywood, etc.) • Fasteners (nails, screws, bolts, etc.)	• Generator & Fuel • EFCO Forms • Scaffold brackets & Planks • Pry Bars	• Caulking • Chamfer • Form Oil & Sprayer • Snap Ties • Coil Rod	• Inserts • Ladders • Fall Pro (harnesses, retractables, anchorages, etc.)

I — ITEMIZE

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

3	Striking Against Objects	4	Contacting Sources of Electricity
3,5,8,9	Struck By Objects	13	Inhaling/Absorbing/Swallowing Haz. Substances
1, 9	Caught In, On, or Between Objects	11	Overexertion-Lifting and Twisting
2,7,9,16	Falling to Below or Same Level		Repetitive Motions/Vibrations
	Contacting Temp Extremes	5	Awkward Positions/Static Postures
	Exposure to Temp Extremes	9	Confined Space
4,6, 9,15	Tool & Equipment Considerations		Housekeeping/Mtl. Storage Considerations

BEST PRACTICES – Things To Consider

1. Watch out for pinch points while unloading shop fabricated or manufactured forms from trailer.
2. Be aware of and eliminate slip, trip, and fall hazards while loading/ unloading materials.
3. Use proper crane signals, rigging techniques, and in general, be aware of overhead loads and hazards. See Cranes and Rigging Safety Shorts (Sect. L)
4. When building forms on site practice circle saw safety to prevent cuts, contact with electrical, and debris flying into eyes. See Circle Saw Safety Short (Sect. H)
5. Position forms in best possible manner to prevent awkward positions and struck by accidents while fastening.
6. Be aware of struck by and pinch point hazards while positioning forms for assembly/placement. Don't get caught between other forms, equipment or machinery and live loads.
7. Be sure proper rebar protection is in place to prevent cuts or impalement from slips, trips, or falls. See Rebar Caps Safety Short (Sect. T)
8. While placing forms, use caution to prevent forms, brackets, walers, etc. from falling.

Appendix B

9. Whenever possible, install thru tubes prior to setting rebar cages for abutments, piers, and columns to prevent the need to climb into formwork, thus eliminating confined space hazards and the likelihood of being cut by rebar or tie wire, or possibly dropping/damage of tools and equipment.

10. Use proper fall protection techniques (i.e. harness & lanyard, retractables, positioning hooks, guardrail systems) to prevent falling from forms (above land or water)or planking/guardrail systems. See EKS Fall Protection Plan and Full Body Harness Safety Short (Sect. V)

11. Use proper lifting techniques, teamlifting, or mechanical devices to prevent overexertion. See Materials Handling Shorts (Sect. O)

12. Use proper ladder safety (i.e. 3 point contact rule, tie-off, proper angle, 3' extension above landing, base, etc) – See Ladder Safety Short. Use EKS approved ladders, ramps, or stairs shall be used to access all excavations, cofferdams, bridge decks, and other elevated heights. (Note that handrails need to be included). See Handrails (Sect. V) and Ladder (Sect. H) Safety Shorts

13. Note wind conditions and fire hazards while spraying form oil to prevent getting oil on skin, in eyes, or to prevent accidental combustion and damage to vehicles and equipment.

14. Be sue all hand electric power tools are assured ground checked and tagged before use and whenever possible plug into a GFCI protected circuit. See Ground (Sect. F) and Power Tools (Sect. H) Safety Shorts

15. Note that picking/rigging while stripping forms becomes more critical because of pressures caused by stuck or wedged forms. Be sure to use a snap tie clamp and cable for gang forms.

16. Pre-planning becomes critical while stripping because the absence of rebar or formwork may limit proper tie-off and anchorage. It is important to install fall protection anchorages prior to placing concrete.

NOTIFY

NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:

- ❑ **Digger's Hotline – call before you dig**
- ❑ **Critical Lift Plan**
- ❑ **Manbasket/Personnel Suspended/Stripping Platforms**
- ❑ **Confined Space Permit**
- ❑ **Railroad Flagger**
- ❑ **Owner**
- ❑ **Subcontractors**
- ❑ **Other** _____

KNOW

KNOW the safe work procedures and OSHA standards that are related to your operations:

Related Safety Shorts:

- **Crane Safety**
- **Circle Saw Safety**
- **Rigging Safety**
- **Rebar Caps**
- **Ladder Safety**
- **Straddle Chains**
- **Ground**
- **Power Tool Safety**
- **Lifting**
- **Teamlifting**
- **Full Body Harness**
- **Handrails**

SAFE LIFTING PLAN

The purpose of the safe lifting plan is to prevent back injuries caused by heavy lifting or overexertion.

Does the material exceed 35 lbs. In weight? **YES NO**

If **NO,** has stretching been performed before lifting is attempted?

If **YES**, complete the lift plan below describing how to safely perform the identified task. (Be sure to address the type of required headcount and/or mechanical device to be used). **Remember that stretching can prevent muscle strains.**

Comments:

Appendix B

EKS T-H-I-N-K Sheet

T — TASK

The TASK we will be doing is:

Activity Number(s):	602, 604, 606, 608	Description:	CONCRETE PLACEMENT

H — HAVE

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE	✓	Hard Hat	1	Eyes & Face		Hearing Protection	2	Arms & Hands
		Chest & Body	2	Legs & Feet		Respiratory Protection		Other

Tools and Equipment

• Screed • Bull Float • Trowels/Mags	• Rubber Boots • Rakes • Broom	• Shovels • Backup Generator • Vibrator	• Concrete Bucket • Wheelbarrow • Tremie

I — ITEMIZE

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

6	Striking Against Objects	14,15	Contacting Sources of Electricity
1-10	Struck By Objects	1-5	Inhaling/Absorbing/Swallowing Haz. Substances
7,13	Caught In, On, or Between Objects	18,20	Overexertion-Lifting and Twisting
11-13	Falling to Below or Same Level		Repetitive Motions/Vibrations
	Contacting Temp Extremes	16	Awkward Positions/Static Postures
18	Exposure to Temp Extremes	17	Confined Space
19-21	Tool & Equipment Considerations	19	Housekeeping/Mtl. Storage Considerations

BEST PRACTICES – Things To Consider

1. Wear safety glasses to prevent getting fresh concrete in your eyes from splashing.
2. Wear rubber boots to prevent damage to your leather boots, rubber gloves, and long sleeve shirts to protect to skin from concrete burns
3. Immediately wash off any concrete that comes in contact with the skin with fresh water.
4. Inform your supervisor at the first sign receiving a concrete burn on your skin. Concrete burns are serious and need to be treated immediately.
5. Should fresh concrete splash into the eyes, flush with fresh water immediately and if need be seek immediate professional medical attention.
6. Only one person who is familiar with standard crane hand signals will signal the operation of a crane or pump truck. See Crane and Rigging Safety Shorts (Sect. L)
7. Be aware of swing radius of concrete chute, pinch points and handling of chute, and NEVER WORK UNDERNEATH A CHUTE AT ANY TIME! Chutes can and do collapse!
8. Be sure that all pump concrete lines are secured and pinned at all joints. See Pump Truck Safety Short(Sect. T)
9. Prohibit others from working under concrete buckets while being elevated or lowered into position.
10. All equipment shall be equipped with back-up alarms or shall be escorted into position by a ground guide wearing an orange vest.
11. Required fall protection shall be used when exposed to a fall of 6 feet or more. See EKS Safety Operations Manual Section-4 Fall Protection for examples.
12. EKS approved ladders, ramps, or stairs shall be used to access all excavations, cofferdams, bridge decks, and other elevated heights. (Note that handrails shall be included). See Handrails (Sect. V) and Ladders (Sect. J) Safety Shorts

13. All personnel shall be cautioned concerning the wet and slippery conditions around concrete pours. Additionally personnel should be cautioned concerning the dangers of slips, trips, and falls while working around forms and reinforcing steel. Be sure to cap protruding rebar. See Rebar Caps Safety Short (Sect. T)
14. All hand electric power tools shall be assured ground checked and tagged before use when possible plugged into a GFCI protected circuit. See Assured Grounding Safety Short (Sect. F)
15. Check for overhead power lines. Avoid contact with float handles, pump booms and other tools and equipment. Working with bull floats within 20 feet of live electrical circuits, power lines, or in area where the handle can cause damage that may result in a live circuit, the float handle shall be made of a non-conductive material. Always stay a minimum of 10' away from power lines. See Power Line Safety Short (Sect. L)
16. Excessive reaching while trowelling or floating and continuous bending over while working under Bidwell can cause fatigue or back pain.
17. Prior to workers entering excavations, cofferdams, or other similar spaces, the confined space requirements shall be determined, and if permits needed they shall be issued. See EKS Safety Operations Manual Section-1 and Excavation Safety Shorts (Sect. P)
18. Adequate drinking water and breaks shall be provided to guard against heat exhaustion. See Heatstroke Safety Short (Sect. D)
19. Concrete work is usually fast paced work. Be aware of equipment, fellow workers and vehicles nearby if things need to be moved or rearranged then do your best to make it happen.
20. Material handling requires proper lifting procedures, it always a good idea to review them and stretch out before you start working. See Lifting and Teamlifting Safety Shorts (Sect. O)
21. Double check to be sure that concrete forms have been designed, fabricated, erected, supported, braced, and maintained so that they are capable of supporting all loads that may be anticipated.
22. Secure area keeping curious members of the public, especially children, away from work area.

Adequate manpower, training, planning, coordination, and time are the most important controls of accidents in concrete construction.

NOTIFY

NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:

- ❑ Digger's Hotline – call before you dig
- ❑ Critical Lift Plan
- ❑ Manbasket/Personnel Suspended/Stripping Platforms
- ❑ Confined Space Permit
- ❑ Railroad Flagger
- ❑ Owner
- ❑ Subcontractors
- ❑ Other _____

KNOW

KNOW the safe work procedures and OSHA standards that are related to your operations:

Related Safety Shorts:

• Crane Safety	• Rebar Caps	• Heatstroke
• Pump Truck Safety	• Handrails	• Ladder Safety
• Power Line Safety	• Excavation Safety	• Lifting & Teamlifting

SAFE LIFTING PLAN

The purpose of the safe lifting plan is to prevent back injuries caused by heavy lifting or overexertion.

Does the material exceed 35 lbs. In weight? **YES NO**

If **NO**, has stretching been performed before lifting is attempted?

If **YES**, complete the lift plan below describing how to safely perform the identified task. (Be sure to address the type of required headcount and/or mechanical device to be used). **Remember that stretching can prevent muscle strains.**

Comments:

Appendix B

EKS T-H-I-N-K Sheet

T A S K

The TASK we will be doing is:

Activity Number(s):	800's	Description:	STEEL, PRESTRESS, & RAILING

H A V E

We HAVE the necessary tools, equipment, and PPE to perform the job safely:

Required PPE	✓	Hard Hat	15	Eyes & Face	15	Hearing Protection	15	Arms & Hands
	14	Chest & Body		Legs & Feet		Respiratory Protection		Other

Tools and Equipment

• Crane • Crane Log/Manual	• Rigging • Tag Lines	• Fasteners • Spud wrenches	• Fall Protection (harnesses, retractables, etc.)

I T E M I Z E

We have ITEMIZED the steps, hazards, and safe work procedures we will follow to complete the job safely:

Potential Safety Hazards:

4-6, 11,12, 16	Striking Against Objects	4	Contacting Sources of Electricity
3-9, 12,15,16	Struck By Objects	15	Inhaling/Absorbing/Swallowing Haz. Substances
	Caught In, On, or Between Objects		Overexertion-Lifting and Twisting
13,14,16,17	Falling to Below or Same Level	15	Repetitive Motions/Vibrations
15	Contacting Temp Extremes	14	Awkward Positions/Static Postures
	Exposure to Temp Extremes		Confined Space
10-12	Tool & Equipment Considerations	3	Housekeeping/Mtl. Storage Considerations

BEST PRACTICES – Things To Consider

1. Erecting steel is one of the most hazardous activities in the construction industry. Safe steel erection doesn't just happen – it requires quality engineering, proper equipment, a safe erection sequence, and a skilled erection gang and crane operator.

2. Safe structural steel erection must begin IN DESIGN. Improperly sized members, unsuitable or dangerous connections, structural steel instability, or an improper erection sequence should be called to your supervisor's attention.

3. The sheer WEIGHT of steel demands caution during unloading, storage, handling, and erection.
   - Loads often shift during shipment, so use extreme caution when releasing chains, binders, or banding.
   - Structural steel lay down areas should start from a firm, level ground with materials stored on sufficient blocking.
   - As steel arrives, unload them in a clean, flat area on blocking that is sufficient to keep the steel clean and to prevent roll over.
   - If in doubt on the weight of beams, contact the supplier to obtain exact weights – play it safe.

4. The crane is the workhorse of the structural steel crew. Care should be taken to inspect it every day to ensure safe operation and minimize down time.
   - Before attempting to use any crane check its load chart to confirm that it's capable of handling the load at the desired distance. Size the erection crane to the MOST DIFFICULT LIFT.
   - Perform a critical lift plan for all single crane lifts exceeding 80% of the crane's capacity or any anticipated dual crane picks.

- Always check the lifting area for overhead electrical wires. See Power Line Safety Short (Sect. L)
- Whenever possible, make a test lift to verify that all calculations are correct.
- Always use proper rigging techniques. See Rigging Safety Short (Sect. L)

5. Before making any lifts perform the daily crane inspection to insure that no defects exist in the boom, cables, and accessories, including chokers and hooks. Make sure that mechanical functions are operational.

6. Due to potential injuries from swinging or falling objects, whenever possible, the erection area should be "off limits" to all employees who are not part of the operation. Swing radius protection should be in place for workers in the immediate area.

7. NEVER ride on a suspended load, hook, or headache ball in order to prevent falls and injuries.
8. ALWAYS stay alert to avoid being struck, pinned, or smashed by a suspended load.
9. NEVER work underneath people working who may drop objects such as nuts, bolts, tools, cords, etc.
10. NEVER drag cables over obstacles.
11. ALWAYS use tag lines to control suspended loads.
12. NEVER release hoist lines until all connections are properly secured to the structure.

13. Before going up on iron, make sure that your shoes are clean of grease, oil, mud, snow, ice, etc.

14. Be sure to wear a properly fitting fall protection harness and lanyard. Be sure there are adequate anchorage points (i.e., beam straps, retractable). See Full Body Harness and Harness Care Safety Shorts (Sect. V)

15. When making connections, watch for pinch points. If welding, practice safe and proper welding techniques. See Welding Safety Short (Sect. S) If using an impact wrench, use vibration gloves.

16. Be alert – unexpected wind gusts can throw you off balance and cause suspended loads to swing.

16. Take precautions to avoid tripping on tools, air hoses, extension cords, etc.

Remember – confusion causes accidents – only one person at a time should signal the crane operator. Be sure to always leave enough room for the unexpected.

NOTIFY

NOTIFICATIONS, Plans, and Permits that will give others an awareness of our operations:

❑ **Digger's Hotline – call before you dig**	❑ **Railroad Flagger**
❑ **Critical Lift Plan**	❑ **Owner**
❑ **Manbasket/Personnel Suspended/Stripping Platforms**	❑ **Subcontractors**
❑ **Confined Space Permit**	❑ **Other** _____

KNOW

KNOW the safe work procedures and OSHA standards that are related to your operations:

Related Safety Shorts:

• **Power Line Safety**	• **Full Body Harness**	• **Welding**
• **Rigging**	• **Harness Care**	

Appendix C

Charles N. Jeffress
BEACON Biodynamics and
Ergonomics Symposium
University of Connecticut
Farmington, Conn.
October 27, 2000

- Why is OSHA pushing so hard to complete its ergonomics standard this year? I want you to know that I've answered that question dozens of times since last November.
- Of course, all of us gathered here today know the answer. Work-related musculoskeletal disorders or MSDs are a serious, pervasive problem throughout American workplaces.
- Every year 1.8 million U.S. workers experience work-related MSDs-back injuries, carpal tunnel syndrome, or tendinitis, for example. This includes nearly 600,000 injuries serious enough to cause workers to miss work-a full third of the most serious on-the-job injuries.
- Here's another way to look at these numbers. Today, this day, more than 1,500 working Americans will suffer painful injuries related to overexertion or repetitive motion. These injuries are potentially disabling and can require long recovery periods. For example, workers need an average of 28 days to recuperate from carpal tunnel syndrome-more time than necessary for amputations or fractures.
- MSDs are also very costly injuries. Direct costs of MSDs total $15 to $20 billion per year. Indirect costs increase that total to $45 to $54 billion. That's an average of $135 million per day.
- But real solutions exist that can spare workers pain and pare expenses for their employers. It's time we began putting those solutions to work for everyone's benefit. No worker should take a job to earn a living only to return home disabled. And no employer should have to bear the expense associated with injuries that can be prevented.
- OSHA has found substantial evidence that ergonomics programs can cut workers' compensation costs, increase productivity and decrease employee turnover. In fact, as you know, ergonomics began as an effort to streamline work processes and improve efficiency to save money.
- In short, good ergonomics is good economics. It's about working smarter and safer. That's good business.
- We know better than to push equipment beyond its rated capacity. That's a surefire recipe for malfunction or breakdown. So why would we want to push our people beyond their physical capacity? Obviously, we don't.
- OSHA has spent 10 years studying ergonomics, and the record includes more than 14,000 studies. During this rulemaking, we have received more than 8,000 public comments and heard from more than 700 witnesses during our nine-week hearing.

- The evidence is more than sufficient. It is overwhelming. Musculoskeletal disorders are related to work, and reducing repetition, excessive force, awkward postures and heavy lifting can reduce the risk of injury. The time to act is now.
- In 1995, OSHA developed a draft ergonomics rule that it circulated for feedback. That draft would have required employers to examine all jobs against a set of risk factors. High-risk jobs would then need to be fixed.
- The business community reacted swiftly and strongly. Business opposition led Congress to pass appropriations riders for fiscal years 1995, 96 and 98, prohibiting OSHA from even publishing an ergonomics proposal.
- Business was up in arms at the prospect of having to examine every job in every workplace to determine if doing that job might result in an MSD. Trade associations and other business leaders wanted OSHA to find a better way to focus the standard, to zero in on high-risk jobs.
- So we developed a new proposal in 1999 to address this concern. It asks employers with high-risk jobs-about 25 percent of general industry employers-to provide information to workers and set up an injury reporting system. Employers would only need to take action to analyze jobs when someone actually suffers an MSD.
- Of course, using an injury trigger is not the most preventive approach. But it zeroes in very effectively on jobs and activities where real problems clearly exist.
- OSHA's proposal also recognizes that no ergonomics program will prevent every MSD, and that different people may be affected by different risk levels. But the injury trigger flags jobs that need correction to prevent future problems. Witnesses in our hearings also pointed to the need to identify specific physical risks that led to the injury and that must be reduced to avoid additional injuries. We were encouraged to set thresholds for these risks would make it clearer to employers when a job needs fixing and when they had done enough.
- The state of Washington has used a risk factor approach in its new ergonomics standard to help employers quickly determine which jobs require further analysis and possible action. Under WISHA's standard, employers would need to examine jobs that involve specific awkward postures, repetitive lifting of various weights or engaging in other high risk activities for specified periods of time. The Washington state standard requires worker education and reduction of physical risks in individual jobs to reduce injuries.
- WISHA expects a 40-percent reduction in work-related MSDs through its new standard. This is based on research indicating that the lower the intensity, duration and frequency of exposure to physical risk factors at work, the lower the risk a worker will develop an MSD. Therefore, reducing the weight of objects workers must lift, limiting the time workers must work in awkward postures or cutting the number of repetitive motions workers must perform should reduce injuries. Evidence presented in comments to us and at the OSHA hearing indicated this is a promising approach.
- One of OSHA's commitments in its 1999 proposal was to provide flexibility for employers in determining how to solve problems. One size does not fit all. We know it's critical in the final standard to maintain flexibility and continue a performance-oriented approach.

- At the same time, our proposal was criticized for being vague about when an employer was in compliance. Employers want to know when they've done enough. They want to be sure that their response is sufficient to protect their employees. They want to be certain that their ergonomics program will meet the approval of an OSHA inspector.
- Finding the balance between performance and specification is very tough to do. If we're not specific enough, we're not providing the guidance that some employers, particularly small businesses, may need. If we're too specific, our requirements won't give employers the flexibility they need to resolve the unique problems they face. It's damned if you do, and damned if you don't. But if we must tilt one way or the other, I think it's most important to maintain flexibility. And no doubt I'll hear more on this subject from speakers who follow me.
- Now I want to address Work Restriction Protection. This has proven to be one of the more controversial provisions in OSHA's proposed ergonomics standard. It has generated a significant amount of public comment and crossfire during the hearing-even though earlier OSHA standards have required similar medical removal protection. And in the case of high blood lead levels, workers may be removed from jobs involving lead exposure for up to 18 months. We proposed a six-month limit for WRP.
- Under WRP, employees would receive full pay and benefits for light duty work and 90 percent of net pay and benefits if they have to miss work. And WRP payments are offset by any workers' compensation that injured workers receive.
- The key to preventing serious disability as a result of MSDs lies in early reporting. And more than any other OSHA standard, the ergonomics proposal depends upon individual workers coming forward promptly to report their injuries.
- OSHA's experience has shown that workers may be reluctant to report problems early if doing so will cause them to miss work and lose pay. We must find a way to reassure employees that they won't be penalized for reporting injuries. This is particularly a problem for workers at smaller businesses, which often do not provide sick time. Currently, if their employer directs them to take a few days off to recover from tendinitis, workers who do so know their next paycheck will be short. So, a worker may decide instead to put up with the pain in hopes that it will just go away.
- In our final standard, we need to include some strategy that encourages early reporting to reduce both the incidence and severity of MSDs. When we depend so heavily on workers to report problems, we must find a way to encourage them to do it sooner rather than later, before irreversible damage occurs.
- And we are close to a final standard. I expect that our final standard will be published by the end of the year. After that, our challenge will be to provide employers with the assistance they need to implement programs that fit their workplaces.
- What we must remember is that real solutions are available to fix problem jobs. And when we identify them, both employers and employees will benefit.
- While ergonomics relies on a scientific approach to fit the job to the worker, it isn't necessarily exact. Sometimes it requires experimentation. But every safety

and health professional can identify solutions that eliminate musculoskeletal disorders that result from a mismatch between the job and the worker.

- Solutions can be simple, obvious and inexpensive. Things like adding a platform to reduce reach, padding hand tools and work surfaces, substituting a more effective tool or reducing the size of items workers must lift. These are sensible approaches that reduce risk without reinventing the factory. Often they are suggested and developed by the workers in the jobs that need to be fixed.
- While we have sound science linking work and MSDs, there is clearly room for more research. The research work that panelists here are doing is important. You've focused on an issue that is in the forefront of safety and health. And your research has the potential to significantly improve lives.
- How can we design the work environment and the work flow to minimize physical stress? How can we re-design common jobs that have already resulted in injury? How can we address ergonomics in other industries like construction? What solutions are in use in Europe or Japan?
- Are there more objective measures of MSDs that we could rely on? What strategies prove most effective in treating various MSDs? What new interventions might be successful?
- We need your contributions, and we welcome them. We want to send every worker home whole and healthy every day. Your work will guide employers and employees in finding practical solutions to common problems to prevent injuries. We appreciate your partnership in creating safer workplaces, and we look forward to working together in the future.

Appendix D – Sample Safety Letters

The following safety letters have been taken from the online sources of Eagle Insurance Companies found at **http://www.eig.com/smodex.htm** and WorkSafe Online found at **http://worksafebc.com/pubs/brochures**

BACK CARE

Sample #1

SAVE YOUR BACK WHEN WORKING IN AWKWARD POSITIONS

by Charlie Kittleson

We have all been told to avoid back injury by bending our knees when we lift, keeping the load close and avoiding twisting motions. These safety rules may be appropriate for simple, direct lifting of materials, but what about back care when you are working in awkward positions? Work tasks that require you to reach or stretch away from your body while handling materials can also put excessive strain on the vertebral discs and soft tissues in the back. An awkward position is a work posture that distorts the spine from its natural curves, puts unbalanced pressure on the discs, and can strain arm, leg or back tissues if held for any length of time.

What are some work situations that may put you in "awkward" positions?

1. Jobs that require you to bend and reach into bins or containers to retrieve or place material.
2. Overhead work, installing or servicing equipment, pulling wire, cleaning ceilings, etc.
3. Floor or ground level jobs such as installing or servicing equipment, cleaning, etc.
4. Work tasks in confined or small spaces where there is limited range of motion such as boilers, hatches, pipes, tanks, vaults, crawl spaces, etc.
5. Jobs on ladders, work platforms or scaffolding where you may over-reach to adjust, clean, install or service.
6. Pulling loads, instead of pushing them, when removing equipment or other materials.
7. Repetitive tasks that require twisting of the back such as loading or handling material 90^{o} to 180^{o} from the starting point

How can you avoid injury when working in awkward positions?

- Raise bins and containers off the floor and/or tilt them to reduce bending and over-reaching.
- When working overhead, stand on a steady and adjustable platform. Keep your back posture in its natural curve to avoid uneven spinal loading.
- If working on the floor, avoid bending over to work. Squat down using your leg muscles and wear cushioned knee pads if you have to kneel at work.

- In confined spaces, plan your work, and reduce clutter in the area which confines you further and increases the need to twist or overreach. Also arrange for adequate illumination.
- Don't hold an awkward position for too long. Pause often to stretch and straighten out.
- When leaning forward to work, support the weight of your upper body on your free hand and arm, whenever possible. This greatly relieves pressure on your lower back.
- Position yourself as close as possible to the job, avoid overreaching and/or use tools with longer handles when working on ladders or scaffolding.
- Never lift heavy loads that are far from your body's center of gravity. Get help in such cases.
- Position your work below the shoulder and above the knees to minimize over-reaching.
- Push, rather than pull, loads to help maintain the spine's natural curve.
- Remember that a back support belt may remind you to lift correctly, but it will not protect your spine if you overreach or twist with a load.

What specific awkward positions do <u>you</u> face in your work?
How can you "work smarter instead of harder" to prevent injuries?

<u>Sample #2</u>

Give Your Back a Break

by Dean Estabilio

Almost everyone will suffer some type of back pain in his or her life. It is estimated that approximately 80% of all Americans will seek medical care for these pains. To prevent yourself from becoming a part of that statistic you must think carefully about how you use your back.

When it comes to preventing back injuries, apply the axiom "work smarter and not harder." A quick analysis of what must be done to accomplish the task at hand can go a long way towards reducing your chances of injury. The following simple questions will help you accomplish your task without injury:

- Can mechanical assistance be used to lift, carry, move or handle heavy or awkward items? Mechanical assistance should also be used to minimize repetitive movements or motions such as are found in production areas.

- Can the workflow process be improved to limit the amount of physical labor involved? Changing the pattern or process in which work flows may also improve productivity.

- Is the workstation or work area designed for the specific task or job? The table or desk height may need to be changed or chairs may need adjustment. Lighting and room temperature must also be considered.

If after asking yourself these questions, you still find that you cannot use mechanical assistance, seek help from a co-worker. You may not be able to totally change the workflow process, but any increase in comfort and safety will be an improvement. Workstations or work areas can be improved with simple furniture adjustments or by using inexpensive devices to improve body posture and positioning. Other back-saving advice, such as using proper body mechanics and staying in good physical shape, still applies.

It is your responsibility to take control of your body by carefully looking at and thinking about how you do your work. We would all like to "work smarter and not harder"; the first step is THINKING before you move.

Sample #3

BACK INJURY PREVENTION TIPS

By Mark Stice

Most of you have probably heard that in order to lift safely, you must lift properly. You're told to "bend your knees not your back," and "don't twist as you lift." This is good advice but sometimes seems to go against human nature. Yet, there *are* actions you can take to help you lift properly.

1. Get as close to the load as possible. The further the load is from the center line of your body, the greater the strain imposed on your back. If need be, squat down to lift the load and pull it between your legs. This gets it closer to the center of your body and helps prevent the need to bend at the waist. However, since your leg muscles are the largest muscles in your body, they are the biggest energy consumers. Repeated squatting can be very fatiguing, and reduces a person's ability to lift in this manner for any length of time. In addition to lifting the load, you are also hoisting the majority of your body weight. For *repeated* lifting, other strategies must be used.

2. Avoid picking up heavy objects placed below your knees. Try to see that heavy objects are placed and stored above knee level and below shoulder level. If you suspect the load is too heavy to be lifted comfortably, do not chance it. Use a mechanical aid, break the load down into its component parts, or get help. The most common cause of back injury is overloading.

3. Keep your back straight. This means don't bend at the waist when reaching to lift an object. Keep the natural arch in your lower back, which distributes the load evenly over the surface of spinal disks, and is less stressful than if the disk is pinched between vertebras. Bending principally from the hips is acceptable if you maintain the arch in your back, rather than bending at the waist.

4. Glue your hand to your thigh. If you carry a load in one hand, such as when carrying a tool box, place your free hand on the outside of your thigh and mentally "glue" it into position. This will help you maintain correct back alignment rather than lifting and tilting

to one side. When carrying a heavy load, side bending can be just as stressful to the spine as bending forward.

5. Tighten your stomach muscles. This technique helps prevent your spine from twisting. If you lift a load and need to place it off to one side, turn by moving your feet. After repeated lifts you might find yourself getting a bit sloppy and forgetting to move your feet. You can overcome this tendency if the place you set the load down is at least one step away from where it is lifted. If you wear a back support belt, wear it low on your trunk and loosen it when you are not lifting.

6. Stay in good physical condition. A protruding stomach is an extra load carried away from the center line of the body, and prevents you from keeping a lifted object close-the number one rule for back care. When you bend at the waist to lift, due to the leverage principal, the load is up to 10 times heavier than its actual weight. A "pot belly" puts extra, stressful weight on the spine.

7. Stretch and loosen up before work. Research has shown that trunk flexibility and mobility is significantly lower in the morning than later in the day, increasing the number and severity of back strains at this time. A few minutes of stretching can warm up cold stiff muscles and tendons and help you avoid an injury. All professional athletes know this-"industrial athletes" should too!

Sample #4

BACK CARE: YOU CAN MAKE A DIFFERENCE!

By: Bobby Adams

"**OUCH!** Why did I try to lift that much weight on my own?" Did you ever ponder those words after you hoisted something heavy, or lifted from an awkward position? These incidents are well known causes of back strain, but you might not have considered other "underlying" factors that lead to back injury. Several conditions influence your "back health."

The cause of most back problems is poor posture, loss of flexibility, stressful living/working habits and above all, a general decline in physical fitness. Surprised? You shouldn't be. When you "let yourself go," (and most of us do with age) the *first* thing to *go* can be back strength. Along with correct lifting techniques, we should also work on our overall physical condition.

Nutrition--is an important key to staying physically fit! As we grow older, our metabolism slows down. To counteract this natural event, we have to eat the right types of food-and not too much of it-or the pounds come on quickly! Now, what does nutrition have to do with a healthy back? For one thing, a healthy back is correctly balanced on your spine. With a "sway" back, that balance is lost-and those darned potbellies cause sway backs. Carrying around excess weight puts tremendous strain on back tissues, so lifting even a small extra load may cause an injury.

Exercise--plays an important role as well. A form of exercise as simple as walking 30 minutes a day can raise your heart rate and burn enough calories to help keep you lean. Flexibility is another condition that changes as we grow older, if we don't work to retain it. It's true, as they say-"Use it or Lose it!" Without flexibility, we lose our body's full range of motion. Then, when a sudden, physical demand takes a muscle

or joint further than it's used to, the risk of injury is high. You can do stretching exercises every morning to keep yourself flexible and ready for the physical demands of work. After all, don't athletes warm up before a game to prevent injury?

Fixed positions--not moving *enough*--can also cause back problems. Staying in a fixed position for too long can lead to muscle spasms. We feel it as stiffness, but by the time discomfort from "static" muscle contractions is experienced, low level tissue damage has begun. Take stretch breaks between long standing or sitting periods to improve circulation and prevent back strain.

Poor body mechanics and bad lifting habits usually "trigger" a back injury-and are more likely to do so if overall physical condition is poor. Remember these techniques to help escape injury:

- **Avoid using fast, jerking motions when lifting.**
- **Avoid bending and twisting at the same time.**
- **Avoid handling a load too far away! Keep the load close to your body.**
- **Teamwork! If the load is too heavy, two persons should carry the load.**

Emotional Stress leads to mental distraction, so that things other than proper body mechanics are on your mind. Stress and back pain seem to go together. Low back pain has been called "a tension headache that slipped." Solving our personal problems isn't always easy to do, but it often takes away back pain and helps prevent repeated injuries.

In Conclusion: Improper lifting isn't the *only* thing that causes back injuries. People who do not also stay in good physical and mental condition are at high risk for back problems.

It's Up To You--Take Good Care Of Your Body and Save Your Back!

Sample #5

WHAT IS YOUR BACK IQ?

by Jeannette Jacobson

Back injuries are a painful, sometimes debilitating, problem in many industries. Back strains can often be avoided by reducing the size or weight of materials handled by employees, by using mechanical aids such as hoists, conveyers or hydraulic lifts, and by making certain that employees are well trained in lifting techniques. But the key to back care lies with the individual worker. Everyone should be a back care "expert"and be able to answer the following questions:

Q: What's the most important lifting rule to remember?

A: Keep The Load Close! There are many other lifting rules, like "bend your knees and lift with

your legs," but you can't do this in every situation. Research has also shown that leg muscles

become fatigued when *frequent* lifts are required, so other techniques must be used as well.

Q: If you don't hold a load close to your body, how much heavier is the "experienced"

weight than the actual weight?

A: Ten times as heavy! The back operates as a simple lever, with the fulcrum in the lower back.

Back muscles serve as the *power arm*; the load being lifted is the *weight arm,* and a 10-1 lever

ratio exists in the lower back. The further away you hold the load, the "heavier" it is.

Q: Why never twist with a load?

A: Lumbar (lower back) vertebrae, disks and joints are under the most vertical *pressure* when

lifting a load. Twisting with a load creates a "shearing" effect on these tissues. The more

"mileage" you have on your back, the less forgiving it will be under this pressure.

Q: Which muscles are most important for keeping the spine in its strong S-shaped curve?

A: Abdominal muscles, which work in cooperation with back muscles to support your spine. The

trouble is, abdominals tend to weaken over time. It helps to tighten them during a heavy lift,

but more importantly, keep them in good shape.

Q: How can stress in your life effect back pain?

A: Whether you're aware of it or not, emotional stress can tighten muscles. Often, fatigued back

muscles are the most effected and the first to feel it. It's been said that back ache is just a

tension headache that "slipped."

Q: What time of the day are back strains most likely to happen?

A: In the morning, or at the beginning of a work shift, when muscles aren't "warmed up." Trends

also show an increase following the lunch hour, perhaps because blood circulation is in the

stomach, instead of the large muscles, and because people may be sleepy and inattentive then.

Q: How does keeping flexible help prevent back and muscle strains?

A: Muscles tend to *shorten* when not used to their full capacity. Flexible muscles are less likely

to be strained and injured than "tight" muscles, when sudden or heavy power is required. Pre-

work stretching programs have been very successful in preventing back and muscle strains.

Take a tip from professional athletes--they warm up before a game! Even five minutes helps!

Sample #6

BENDING, TWISTING, REACHING

by Jeannette Jacobson

Injuries from manual material handling, especially strains and sprains of the back, arms and shoulders, are the most frequent cause of industrial insurance claims. Overall, material handling accounts for one-third of all workplace accidents. In many types of operations this is the source of more than 75% of injuries. The major cause of these injuries is unnecessary or excessive body motions while bending, twisting and reaching. In many cases, these strains and sprains can be easily prevented. The following are a few techniques for you to consider.

Bending:

Many work tasks in industry involve unnecessary bending, which results from the improper design of the work station, a poor job layout, or inadequate or unavailable material handling equipment. The work station or area should be designed so the work is performed in the mid-range of the body, i.e., from waist to shoulder height within a 16" semicircle in front of the body.

Often this can be accomplished simply by placing a table under the material being worked on, raising the work level so it can be performed in an upright position. Stacking pallets beneath materials can also raise the work level to the mid-range. The use of a load leveling devices such as a lift table, work dispenser or other similar mechanical aid will also accomplish this goal. If the work level cannot be changed, sometimes lowering the worker, such as in the grease pit of a garage, will accomplish the goal of bringing the task into the mid-range of the body.

Twisting and Reaching:

Elimination of unnecessary twisting or reaching can also be accomplished by finding ways to keep the work or materials in the mid-range. For example, while changing a light bulb or working above floor level, place the ladder so that the task will be performed in *front* of the body instead of twisting to the side. This demonstrates how easy it can be to minimize or eliminate many twisting or reaching tasks.

Providing adequate work space so the *whole body* can turn, instead of just the upper torso, is another good technique. For example, if a pallet of material must be placed behind the worker, provide enough room so that the worker must take one or two steps when moving material. When the pallet of material is placed close to and directly behind the work station, the tendency is to twist around to pick up the material. Turning the whole body is safest for the back.

Problem Solve For Creative Solutions:

Make a list of tasks you or co-workers perform outside of the mid-range of the body and then list simple solutions that will eliminate the unnecessary bending and reaching. The most creative and practical ideas will probably come from the employees who handle the materials-so everyone should get involved with identifying both the problems and the solutions.

LIFTING TECHNIQUES

Sample #7

LIFT IT TWICE

by Dean Estabilio

Most of you have heard the general rules of safe lifting. Remember to "Get a firm grip on the load, keep it close, bend at the knees, use your legs to lift the load, and keep your spine in the natural position (with an arch in your lower back)." These principles always apply and should be incorporated into every lift--if possible! Given the enormous number of "risky" lifting situations that you are faced with at your place of work, you may not be able to apply these principles every time. This is why you must always remember to ***LIFT IT TWICE!*** **What?!**

The act of lifting is the same as any other movement that you can learn to do better with practice. As you know, the more you practice a skill the better you become at doing it. But preparing to master a skill normally involves mental as well as physical training. Consider bowling, golf, skiing or sharpshooting. You think carefully about the movements you're going to make before you do them. This is the only way to get them right--at least until they become second nature.

Most of you know the proper way to physically lift an item, but how many of you are aware that you need to lift the item ***TWICE.***

1. Your first lift is a mental lift. Think about the lift prior to actually doing it:

- How am I going to lift the item? Can I do it myself or should I get some help?
- How heavy is the item? Do I need to use mechanical assistance?
- Where am I taking the item being lifted? Is it a difficult path or a distance to go?
- What hazards may hamper the lift or obstruct the travel path?
- Eliminate those hazards before you lift the item.
- **2. The second lift is the actual physical lift. Here is where you carry out your plan.**
- Use proper body mechanics and techniques while going through the motions.
- Most important: keep the load as close to your body as possible.

Next time someone tells you to lift *twice* remember: Two lifts means less risk of a back strain.

MATERIAL HANDLING

<u>Sample #8</u>

MATERIAL HANDLING

by John Lyle

Material handling accounts for about one quarter of all occupational injuries; the most common injuries being strains, sprains and contusions. The principal causes of the injuries are the mishaps resulting from improper lifting, failing to use available equipment and unsafe work practices.

Some pointers for the prevention of injuries during manual material handling are:

1. Inspect the load to be lifted for jagged or sharp edges. Use gloves when necessary.
2. Size up the load. Is it manageable, or will this task take two?
3. Inspect the route where the load will be carried. Especially look for tripping hazards and adequate room to maneuver safely.
4. Clean off greasy, wet or dirty items before lifting. Keep your hands free of anything that will prevent a firm grasp such as oil, grease or ragged gloves.
5. Bend with your knees keeping your back straight. Get a firm grasp on the load, and make sure to have a solid footing before beginning. Once you lift the load, keep it close to your body.
6. Keep fingers away from edges where pinches may occur. This is especially important when carrying through doors or when setting a load down.
7. When handling unwieldy loads such as pipe and lumber, keep hands and fingers back from the ends. Crushing injuries, even amputations can result without these good manual material handling techniques.
8. High level stacking should always be on pallets. Riding the tines of a forklift is inviting a fall and serious injury. Never work off a pallet to retrieve stock from high shelving, or to empty trash into a dumpster. Only an approved cage with railings should be used for this purpose.

Think ahead. Every lift should be planned before it is made. Good planning is the best method of preventing material handling injuries. Proper lifting uses your leg muscles more than your back. So get a good footing - falling while carrying a load or under a load can compound any injury that occurs.

Material handling is made more difficult, when water, snow, mud or grease is permitted to accumulate. Keep work areas and floors clean, dry and free of debris.

Make Every Lift , Safe and Well Planned

Sample #9

DRUM HANDLING

By Marit Kassion

Improper handling of drums and barrels can result in severe injuries. These include painful back sprains, smashed toes and fingers, or exposure to hazardous chemicals if the contents are leaking. Proper work practices can minimize your risk of injury, so consider the following tips.

- Prior to handling the drum, read the label on the drum and look for symbols, words or other marks which indicate if its contents are hazardous, corrosive, toxic or flammable. If the drum isn't labeled, consider the contents hazardous until they are positively identified.

- Look around the drum to see if it is leaking. Before cleaning up any spill, make sure the substance has been identified. Make sure that you've been trained in the hazards of the chemical, and have the correct materials for cleaning it up. Find and review the appropriate MSDS.

- Before moving the drum or barrel, replace missing bungs and/or lids and secure as necessary.

- Depending upon the contents of the drum, estimate its weight. Determine whether you can move it yourself or if you need assistance. *A 55-gallon drum can weigh 400-800 pounds*.

- If you decide to move it yourself, use a forklift if one is available, a hand truck or a drum cart that is designed specifically for drum handling.

- If the drum can be rolled, stand in front of it and place both hands on the far side of the chime. Pull the drum forward until it balances on the bottom chime. You can now roll the drum on its chime, being careful to keep your hands from crossing over one another. You can also lower the drum to the ground for rolling by shifting your hands to the bottom side of the chime (not where they will be crushed). Then slowly lower the drum to the floor. Keep your back straight and bend at your knees. Then roll the drum with both hands. Don't use your feet or grasp the ends.

- To upend a barrel or drum, a drum lifter bar is preferable. If one is not available, crouch in front of the drum, knees apart and firmly grasp the chime on each side. Keep your back straight and use your leg muscles to lift. Balance the drum on the lower chime, shift your hands to the far edge, and ease the drum into the upended position.

- Protect your hands, feet, back and face during this work. Safety shoes should be required when moving heavy drums. Gloves, eye protection, aprons, and other personal protective equipment may be needed, depending upon the contents of the drum.

- Most importantly, use material handling equipment whenever possible, and get help when you need it!

Sample #10

SAFE USE OF HAND TRUCKS

By Kathy Kauahi

What's the best way to move something? Ask someone else to do it for you! What's the next best way? Be sure you know the proper way to move materials yourself.

If you could transfer the risk of handling heavy, large and awkward items and not get hurt, wouldn't you do it? However, for many people who must move heavy items on a regular basis at work or at home, this is not a reality. One of the best ways to avoid suffering a muscle strain or sprain is to use a hand truck. The use of this tool also increases productivity and lessens the chance of dropping and damaging merchandise.

Although hand trucks appear to be fairly simple devices, users must remember a few basic safety procedures:

- Use a hand truck that is appropriate for the job and the load to be carried.
- When stacking items on the truck, keep the heaviest load on the bottom to lower the center of gravity.
- Balance the load forward on the axle of the hand truck, so the weight will not be carried by the handle.
- Never stack items so high that you can't see where you're going.
- When carrying multiple boxes side by side, attempt to stagger them to "lock in" the boxes.
- Be sure the items to be transported on the hand truck are sturdy enough to be moved in this manner. Secure any bulky, awkward or delicate objects to the truck.
- Plan your route. Be aware of potential hazards to be encountered during the path of travel.
- As a rule, avoid walking backwards with a hand truck. Remember the back care rule: It is safer to *push* than to pull.
- Hand truck injuries typically occur by getting your hand pinched between the handles and a nearby stationary object, so take care when working your way through tight spaces. The use of gloves can provide extra protection.
- Always maintain a safe speed and keep the hand truck under control.
- Always park the trucks in a designated area, never in aisles or other places where they may cause a trip hazard or traffic obstruction. Two wheeled trucks should be stored on the chisel with handles leaning against a wall.

- When you use a hand truck properly, it does the job and reduces the chance you'll strain a muscle or be injured. Let the truck do the work for you!

Sample #11

PREVENTING STRAINS & SPRAINS

by Jeannette Jacobson

This Safety Meeting Outline is structured to help you apply general material handling rules to specific activities in which your employees are involved. You can choose work activities which apply to these principles and structure your safety meeting presentation to address them.

1. **Identify a task** involving material handling (lifting, pushing, carrying, setting down, etc.).
2. **Break the task down** into its most basic steps. What does the worker do? (Example: lift a case of material from a truck bed, turn and carry it to a location in the building where it is set on the ground).
3. **Apply the lifting principles shown below**, as applicable:

PRE-LIFT TIPS	LIFTING FROM GROUND LEVEL	LIFTING FROM OVERHEAD	LIFTING FROM A SHELF, DESK, ETC.	SETTING LOADS DOWN	TIPS WHEN CARRYING	MOVING CARTS, HANGING LOADS
Determine the weight of the load to be lifted or carried. Are you able to do it alone? Is help or mechanical assistance needed? Does the size/shape of the load present any problem? Will you have to turn/change direction while carrying the load? Is the route you will take clear of obstructions, slip, trip, or fall hazards? Do you have a back support belt, and are you wearing it properly?	Get as close as possible to the load. Bend your knees, not your back. Get a good grip on the object and test its weight. Keep the load close to your body and lift using your legs. Be aware of your balance and what part of your body is doing the work. It should be your legs.	Make certain you are standing on a stable surface before you attempt the lift. Test the load to be sure you can lift it safely. Bring the object off the shelf or support carefully, maintaining your balance. While maintaining control of the load, bring it down to waist level. Whatever the task, GET HELP for heavy loads!	Pull the load close to your body and test it for weight. Shift the weight of the load to your legs by keeping it close. Avoid reaching and lifting at the same time.	Bend your knees, not your waist. Set down the corner or edge of the object closest to you first - keeping your fingers out from under the load	Look ahead to make certain the way is clear. Set the load down if it becomes too heavy or unstable. Avoid stairs when ever possible. If unavoidable, use the banister or wall or to help you maintain balance. Have someone open doors, gates, etc. for you. Change direction by moving your feet not your hips. Keep shoulders, hips and feet pointing the same direction. Never twist at the waist while carrying a load.	Remember to *push*, not pull whenever possible. Position the load so that your legs supply the force. Use hands and arms for control and direction of the load. Keep hands & fingers inside the load whenever possible. Watch for pinch or shear points on carts, dollies or hoists.

1. **Demonstrate the proper way** to perform a variety of lifting tasks.
2. **Ask employees to demonstrate** proper procedures, after you've reviewed the lifting principles.

ERGONOMICS/STRAIN

Sample #12

PERSONAL ERGONOMICS

By Donald E. Richard

What is Ergonomics? Ergonomics is the science of matching tools and tasks to the work environment. In other words, ergonomics tries to make your job fit *you*, rather than making *you* fit your *job*. The purpose of ergonomics is to reduce or eliminate injuries and illnesses that can result from stress on muscles, nerves, and joints. These types of injuries have been common to workplaces for a long time, but safety standards concerning them are new. If OSHA finds that poor ergonomics is a threat to employee well being, it can cite a company for violating its duty to provide a safe and healthy workplace.

A variety of ergonomically-related injuries take place and a variety of terms exist to describe them. The most common terms used are musculoskeletal disorders or cumulative trauma disorders (CTDs). They are also know as repetitive motion or stress disorders. Whatever they're called, they account for approximately one-half of all reported workplace illnesses each year. These are technically called "illnesses" because the problems generally build up over time, rather than being the result of a single event, as in the case of an accident.

Physical problems from cumulative trauma: These usually involve pain and damage to muscles, tendons, and nerves in the back, neck, shoulders, wrists, hands, and elbows. Discomfort can be mild and periodic, or long lasting. Typical ailments include: Tendonitis, "Tennis Elbow," Trigger Finger, lower back pain, Carpal Tunnel Syndrome which causes hands and wrists to tingle or become numb, and Reynauds Syndrome which causes fingers to become white.

Disorders can be caused by making the same motion over and over, staying in one position too long, or working in awkward positions. They also result from working with tools that don't fit the body, using a great deal of physical force, and exposure to long periods of heavy vibration.

How To Avoid Discomfort: Ergonomically related disorders occur to all types of workers, from laborers to office personnel. You can often help yourself by learning and practicing basic ergonomic principals. There are many ways to reduce or eliminate the disorder; here are a few:

- Use two hands instead of one for a task --to reduce excess demand on a single muscle group.
- Use tools that are right for the job and proportioned for your body.
- Use power tools instead of manual tools when possible.
- Take frequent breaks from repetitive motion tasks.
- Avoid repeating awkward movements or holding yourself in awkward positions.

- Wear protective gloves that reduce pressure or tool vibration on your fingers.
- For computer use--keep the screen 12 to 18 inches from your face and just below eye level.
- Position the keyboard so that your wrists are straight and your elbows are close to your body.
- Change positions, stretch often to improve blood circulation, and take breaks regularly.

Report Early Symptoms: Repetitive motion injuries are a growing concern in the workplace. Anyone who experiences numbness, tingling or pain in their hands, arms or neck should seek the advice of a supervisor. Changes in work stations and equipment can often alleviate these problems before they become chronic, and medical attention should be sought if the problem persists. Following this simple advice can help eliminate physical stress and keep employees feeling good all day.

Sample #13

ERGONOMICS - THE TERM "*ERGONOMICS*"

by Mike Gunter

Ergonomics is an important term that is currently receiving a great deal of attention from safety professionals. Federal OSHA is in the process of developing standards that would require every company to have an ergonomics program. OSHA has set 1996 as the target date to have the regulations in place. What is ergonomics and how could it affect you?

Ergonomics is the scientific study of human work. It considers the physical and mental capabilities and limits of people as they interact with tools, equipment, work methods, tasks, and the environment. The primary goal of an ergonomics program is to reduce work-related injuries and illnesses by adapting the work to fit the person, instead of forcing the person to adapt to the work. The idea of ergonomics is to evaluate and control work conditions known to cause injuries and illnesses because of the excessive demands placed on people. In other words, "Let's find ways to work smarter rather than harder!"

It appears that the biggest challenge will be choosing the best ergonomic strategy to use for each particular situation. There are endless possibilities. A careful analysis of the situation should help in choosing the most effective strategy. As an example, let's look at just a few possible strategies to use in situations that currently involve manual carrying activity:

1) Eliminate the need to carry. This may not be feasible, but it should be the first strategy to consider.

2) Rearrange the layout of the task to eliminate unnecessary carrying. This could involve relocation of receiving, storage, production, or shipping areas.

3) Reduce the weight of the object being carried or increase the weight of the object so it is too heavy and has to be handled by mechanical devices.

4) Use mechanical handling aids such as fork lifts, hand trucks, cranes, and four wheel dollies.

5) Assign the task of carrying bulky or awkwardly shaped objects to two or more people.

6) Eliminate tripping hazards with good housekeeping practices.

You are encouraged to **get involved** and make suggestions to help in preventing injuries and illnesses by improving "ergonomic" safety. You can play a critical role in providing input for the decision making process because of your familiarity with equipment, tools, and current work methods. An ergonomics program will only be successful if everyone works together as a team to come up with solutions. OSHA believes a large part of the initial ergonomics program at most companies will involve searching for ways to correct problems that have already caused injuries and illnesses. OSHA hopes the program will eventually focus on finding pro-active solutions to situations that could lead to injury if ergonomic issues are not addressed ahead of time.

Sample #14

CTD's -- HOW CAN YOU PREVENT THEM?

by Jennifer C. Thompson

Cumulative Trauma Disorders (CTD's) are strains that may result from long-term repetitive motion or from continually working in an awkward position. Strains commonly occur in the wrists, arms, shoulders or back, affecting the body's joints and surrounding muscles and tendons.

CTD's are said to be today's fastest growing occupational problem, affecting all types of employees, from computer operators to construction workers. Modern equipment, tools and machinery have increased production capabilities in many ways. But in some cases, they have also increased the potential for strain injuries in people. These disorders not only cause great discomfort, they can also affect a person's employability and personal lifestyle choices.

SUGGESTIONS FOR REDUCING YOUR EXPOSURE TO CTD's:

- Do warm-up exercises before beginning physically demanding tasks (take a tip from athletes).
- Plan ahead, if you will be doing a job that is awkward--think of ways to make it easier.
- Rotate your work position, to change how muscles are used during your work shift.
- Use the proper tool for the job to avoid awkward movements and the need for overexertion.
- Take a rest break when fatigue sets in. Just a few minutes can make a difference.

- Carefully stretch tired or overworked muscles to improve circulation and relieve tension.
- When appropriate, use anti-shock or anti-vibration gloves, back supports, wrist supports, or other personal protective equipment that helps prevent cumulative trauma.
- Always use proper lifting techniques. Back strain is one of the most common CTD's.
- When using hand tools keep your wrists in a "neutral" position, as opposed to repeatedly bending them up, down or sideways during work tasks.
- Just because a co-worker is not affected by a physically demanding task, don't ignore messages your body sends you. Although humans share many physical characteristics, people are often different in terms of their physical strengths and weaknesses.

All muscle discomfort and fatigue is not a cumulative trauma disorder. Everyone experiences occasional aches and pains from both work and play-especially when you are not used to the activity. Nevertheless, *awkward*, *repetitive* work positions can result in long-term physical problems, so it's up to you to avoid these in whatever ways you can. If the ache doesn't go away within a day or two, follow the above suggestions.

If you have early symptoms of chronic discomfort, report it immediately to your supervisor. The *sooner* a better tool or work position can be incorporated into your work activities, the sooner those symptoms can be controlled.

Listen to what your body tells you and learn how to avoid CTD's!

Sample #15

GENERAL SAFETY- MOTION INJURIES

by Katrin Cohen

Taking the time to think about everyday tasks and their affects on our bodies is a good way to prevent injuries. The following scenarios will demonstrate how inadequate planning leads to pain and disability, affecting on- and off-the-job activities.

At the breakfast table you rush to clean everything up before going to work. You stretch awkwardly across the table to lift your infant baby out of the highchair. Half standing, you start to lift your baby, but then stop, reacting to a sharp pain in your back. Instead of using your leg muscles to lift, you used your back muscles and are consequently suffering back pain.

In the warehouse, you notice some boxes on the floor. These boxes are in the way of pedestrian traffic and so you proceed to move them. You know that the boxes could be heavy but you do not want to bother anyone to help you. You bend over at the waist to lift one box but have to stop because the load is too heavy and you feel a sudden pain in your back. As a result, you strain your back muscle -- an injury that may keep you off the job for several days.

In this next scenario, you are a production-line worker who packs boxes as they pass by on a conveyor. Throughout the day, you perform the same set of lifting and twisting motions with your arms. You begin to

experience pain in your forearms and sometimes it aches so much that you can't sleep. The repetitive nature of your work has stressed your arm tendons, muscles and nerves.

What could have been done to avoid the motion injuries mentioned above? You could have thought about the task at hand and applied the Take Two principle (Talk, Actions, Knowledge, Equipment) checklist: **Talk** to your supervisor about how to perform the job safely. Think about how your **actions** will affect safety. **Know** the right rules and procedures for the job. Use the proper **equipment** and keep it in good condition.

Keeping the above scenarios in mind, ask yourselves and your co-workers these questions:

1) Do we always think carefully about posture and proper techniques when lifting?

2) Why do we sometimes ignore our body and safety?

- Busy work schedule

- Think that "it won't happen to me."

- Lack of knowledge

- Under stress

3) What is the procedure for lifting safely?

- Make sure you are close to the object and are not bending over to lift

- Keep back straight and use leg muscles to lift

- Don't twist or stretch excessively.

4) How can we help prevent repetitive motion injuries?

- Take breaks to stretch and relax

- Rotate work stations; change positions

Living in a stressful society where time is money and deadlines are of the utmost importance, it is easy to get so caught up in what you are doing that you forget about taking care of your body. But think about the consequences of having an injury where you can't work, play, or spend any time with your family and friends. Think of how badly an injury makes you feel (physically and emotionally) and all the extra work and lost wages you have to make up for when you come back to work. Isn't your body worth an extra few minutes to do the tasks correctly and safely?

Sample #16

ERGONOMICS AND TOOL USE

by Jeannette Jacobson

Have you ever suffered pain or extreme fatigue in your hand, wrist or arm after using a hand or power tool for a prolonged length of time? If so, this is a signal to look at the "ergonomics" of how you work. Simply speaking, ergonomics involves selecting the right equipment for both the task and the specific worker. It also means you must *hold* and *use* your tools in the best possible way.

Many of today's tools are designed to reduce fatigue to the worker. Some even come in different sizes and shapes for a better "fit" between your hand and the device. The purpose of ergonomically designed tools is to minimize physical stress to the fingers, hands, wrists, arms and shoulders, which can lead to injury or chronic pain. The following actions are among those that may cause problems:

1. Strong and continued gripping, also called *static loading*
2. *Repetitive motion*, on a long term basis
3. Working with the fingers, hand or wrist held in *awkward positions*
4. *Vibrating* tools or equipment

Ergonomic Tips:

- A gloved hand tends to grip objects more tightly. Prevent static loading by avoiding gloves that are too large and require an even stronger grip in order to use the tool. If you wear gloves, be sure they fit correctly and have a non-slip palm. Consider fingerless gloves too.
- Select a tool with textured, non-slip handles, since a smooth handle can require you to grip and hold more tightly. Be sure handles are the right size for your hands as well.
- A tool such as a hammer should have a diameter of at least 1½ inches. The handle should be long enough so that it doesn't apply pressure to the base of your palm or thumb when it is used.
- Avoid a tool that is activated by a single trigger finger if you must use it for long periods. Tools that are activated by a "power grip" of several fingers or the entire palm will cause less strain.
- Whenever possible, use "ergonomically" designed hand tools, which keep the wrist in the "neutral" position (i.e., unbent in any one direction). Examples are pliers and hammers with "bent" handles or knives and powered screwdrivers with pistol-grip handles. Ergonomic tools also help prevent unnecessary twisting of your wrist, arm, elbow and shoulder while you work.
- Repeated vibration over long periods of time damages blood vessels and interferes with blood flow to the fingers. This deprives skin and muscles of oxygen which can cause permanent tissue damage and pain. Smoking and cold temperatures also contribute to this problem, since they cause blood vessels to constrict, which further impairs blood flow. Early symptoms, such as numbness or tingling in the fingers, are warnings. Vibrating tools should have handles that are designed to "dampen" the vibration. Many types of vibration-dampening gloves are available if the tools you use are not equipped with this feature.

Take care of your body--you're going to need it!

CONSTRUCTIVE IDEAS

Sample #17

Shovel design can help to reduce forces on the lower back and hands

Shovelling is hard work. It requires a lot of bending, twisting, and lifting. Your back and hands get tired and that fatigue could result in injury. Shovelling in awkward spaces or poor weather conditions, which is often the case, can further increase the risk of injury.

One shovel does not fit all jobs or all people:

- The handle might be too short or too long -- a shorter handle gives greater stability but means more stooping. A longer handle requires less stooping but makes the shovel less efficient. There is a trade-off between your posture and load stability.
- The blade might be the wrong shape for the material being shovelled -- a shovel used for moving concrete should be different from a shovel used for digging soil. Using the wrong shovel can put extra stress on your hands and arms.

A shovel designed in Australia, and available here, has features that have been shown to reduce effort by as

Tips for shovelling safely

Use good body mechanics when shovelling:

- Keep your legs apart for stability.
- Bend your knees.
- Turn your body as a unit; don't twist.
- Push rather than lift the shovelled load.
- Take breaks to stretch.
- Let machines do the heavy work.

Choose the right shovel for the job:

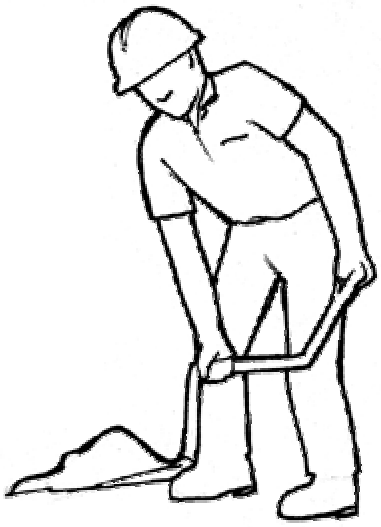
- Select the longest handle possible to reduce stooping.
- Choose the lightest shovel possible.
- Consider a "D" handle.
- Consider an angled shaft.
- Select the blade that will provide load stability.
- Select a blade with a slippery surface, as long as it is consistent with the contents of the load.

Shovel safely. Reduce the risks

much as 30 percent. The shovel is:

- Made from strong, light-weight steel
- Angled through the shaft to reduce the bending required
- Equipped with a D-shaped handle to improve gripping and stability

associated with back injuries.



For more information, contact the WCB Prevention Division at 1 888 621-7233 or 604 276-3100.

Sample #18

Suspending tools prevent back, arm, and shoulder fatigue

When you're drilling sideways into a wall or above your head, while holding a heavy tool like a 20 kg (50 lb.) drill, your arms, shoulders, and back get very tired. The weight

Benefits of hanging your tools

- If the drill bit binds, the safety sling helps to reduce

of the tool can increase the risk of injury. Here are some other factors that can also increase risk of injury:

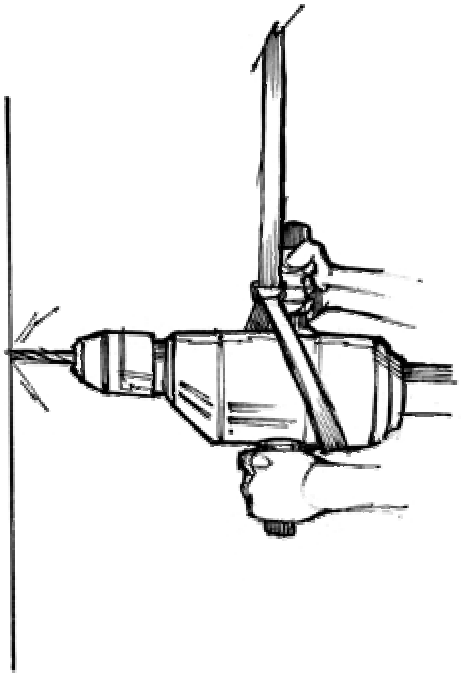
- Excessive effort needed to support the tool in one place -- the muscles have to work hard to hold the same position
- Awkward positions -- getting the tool into the proper drilling angle may require working with your arms and hands at or above shoulder level
- Vibration -- muscles have to work harder when gripping tools that vibrate

One solution to reducing your risk of injury is to suspend the tool. Some major construction firms use nylon-reinforced safety slings suspended from an I-beam or rebar to carry the weight of the air tools. The workers can easily manoeuvre the drill or jackhammer without having to bear the weight.

Tips for suspending tools

- Keep the rope or strap short enough so it doesn't create a tripping hazard.
- If the height of the tool needs to be changed, use the rope or strap as a friction pulley to adjust the position up, down, or sideways.

A safety sling is not appropriate for all drilling or chipping jobs. While it works well for suspending heavy air tools, a safety sling is difficult to use effect of the kickback
- Efforts can be used to drill or chip, rather than carry the weight of the tool.
- The stress on the shoulders and back, caused by supporting the equipment, is reduced when using the safety sling.



in a cramped space.

Sample #19

Balanced tool belts can start your back off in the right position

An unbalanced tool belt is a pain in the back

Good standing posture means keeping your body in a straight line from the top of your head through the centre of your body to the bottom of your feet. A tool belt can alter that alignment and cause back pain.

For convenience, you might place tools on one side of your tool belt for easy access by your dominant hand. As a result, your tool belt becomes significantly heavier on one side compared to the other. This can pull your back out of alignment.

Tool belt tips for reducing the risk of back pain

- Balance your tool belt -- if your tools are heavier on one side, fill the other side with materials, such as nails, bolts, or other tools, that will balance the load.
- Use broad-strapped suspenders that allow the muscles in your upper back and shoulders to bear some of the tool belt load.
- Minimize what you carry in your tool belt -- evaluate

Continual use of an unbalanced tool belt can cause the muscles on one side of your back to work harder. This is a common cause of back pain.

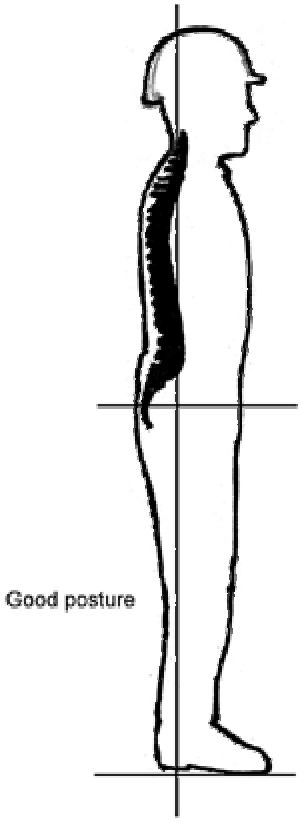
The average tool belt weighs 5 to 8 kg (15 to 20 lb.). If the weight of your tools is unbalanced on your tool belt, your spine is loaded in an awkward manner even before you start to bend, reach, or lift.

Your back takes enough stress on the construction site. Why add to that stress when you strap on your tool belt at the beginning of the day?

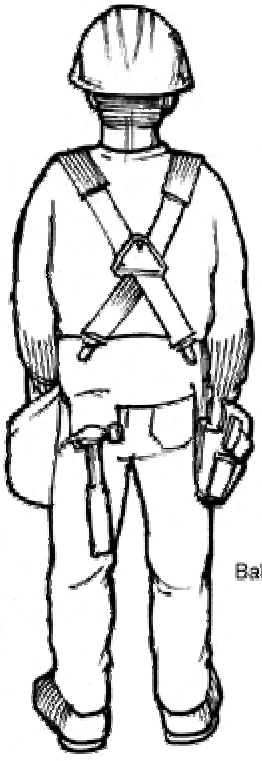
what you carry. Store infrequently used items elsewhere, or use them to balance your tool belt.

- During breaks, remove your tool belt to relieve your back of the load.

Following these tips allows your spine to maintain good posture while supporting your tools.



Good posture



Balanced tool belt

Sample #20

Job rotation gives the body a break

Doing the same task continuously throughout the work day can tire muscles, which can lead to injuries such as tendonitis, bursitis, or back strain. Working continuously in awkward positions, such as low-level or overhead positions, can cause the muscles to work even harder. Job rotation may be a solution, for it not only reduces muscle fatigue and discomfort but also provides relief from monotonous tasks.

Tips for rotating jobs

- Determine from the workers involved the most demanding tasks of the job.
- Develop a rotation cycle that schedules a lighter task following a demanding task to give muscles recovery time.
- The length of time each task is performed before rotating should be based on the most demanding task. For heavy, demanding tasks shorter work rotations are desirable.
- Alternate low-level crouching and stooping tasks with ones that require standing or reaching overhead.
- Co-ordinate workers so that the timing and sequence make sense and the job is done efficiently.

Example: Drywalling

Task rotation helps to give muscles recovery time. One drywalling team decided to approach their work in a different manner and was able to maintain efficiency. Instead of completing all of the low-level work before moving on to the overhead work, the pair alternated between the two levels as they progressed through the job.

They would stoop and crouch for a while, performing the low-level tasks. They would then give their legs and backs relief from the awkward position by working at higher levels for a period of time.

Example: Stripping forms

Stripping concrete slab beams all day can be very demanding, especially when the same actions are repeated throughout the day. Similarly, if it were your job to prepare the forms for reuse, your muscles would complete the same actions all day. Doing the same task throughout the workday without a change is hard work for the muscles.

One contractor successfully rotates workers every two hours, through each of the following distinct tasks:

- Stripping slab beams
- Scraping concrete and pulling nails so the boards can be reused

In drywalling, the work is completed in stages. Cutting and installing boards, taping, and mudding are followed by sanding. On a large job, a worker could be doing one task, such as cutting and installing boards, taping and mudding, or sanding, for the entire shift. The task is even more demanding if all the lower level installation is done at one time, followed by the overhead installation. The worker can spend long periods of time stooping and crouching, and can then switch to spending long periods of time with arms overhead and neck bent back.

- Disposing of the waste
- Delivering materials to the next work level for new form construction

In both of these examples, co-ordination was needed between workers. There will always be a transition period when adopting a new approach to work. Work rotation is one approach that provides your body with the recovery time it needs.

Think about your work activities. Rotation might be a solution to reduce muscle fatigue and discomfort.

Appendix E – ACCSH Checklist

The following checklist is a draft that was developed by the Advisory Committee on Construction Safety and Health (ACCSH).

Draft :Worksite Evaluation Checklist

Why should I fill out the checklist?

This checklist is intended to help develop an "eye" for musculoskeletal problems and to prevent injuries.

Who fills out the checklist?

Jointly updated by contractors and workers or their representatives

How often do I update the checklist?

Periodically or as the site changes. Changes may include but are not limited to weather conditions, introduction of new workers on the site, new materials, change in operations, new phase of the project, etc.

Do I need to fill out the entire checklist?

Each time the checklist is updated fill out the **Job Site Information Section**. Some parts of the checklist may not apply to your kind of work. Fill out what applies to your job or site activities.

Job Site Information

Date: _____ Site: _____

General Contractor: _____

Subcontractor: _____

Worker/Representative: _____

Name / Signature: _____

(Person filling out this form)

Materials Handling & Lifting

List those tools and materials weighing over 20 lbs that are lifted by hand. These might include bricks or blocks, drywall, plywood, rebar, structural iron, roofing materials, forms, jack hammers, tampers, saws, pneumatic wrenches or anything over 20 lbs. Fill out the box

Tools/Materials over	Jobs where lifting	Job titles	Possible solutions to

List the materials and tools weighing over 50 lbs that workers lift without assistance; how often do they perform these lifts each day. Fill in the box below.

Job title	Item being lifted over 50 lbs	# times/day	Possible Solution

Are there handles for materials that must be carried? Yes____ No____

If there are no handles, why?

How can handles be easily installed?

If there are handles, are the handles easy to use and comfortable? Yes____ No____

Are workers encouraged to get someone's help to lift heavy materials?

Yes____

No ____ Why not?

_____

Are dollies, hand-trucks, wheelbarrows or other assists available for moving materials?

Yes____

No ____ Why not?

_____

If dollies, hand-trucks, wheelbarrows or other assists are available, are they being used?

Yes____

No ____ Why not?

_____

Are materials delivered as close as possible to where they will be used?

Yes____

No ____ How can the delivery schedule be changed?

What jobs cause workers to lift overhead? Fill in the box.

Job title	Item being lifted	# times/day	Possible Solutions to reduce lift

Are materials stored on walking or working surfaces?

Yes____

No ____

Do workers have to bend down to pick up or lift materials?

Yes____

No ____

Could the materials be stored at waist height?

Yes____

No ____ Why not?_____

Which tasks do workers have to reach far to pick up or lift materials? Fill in the box.

Job title	Item being lifted	# times/day	Possible Solutions to reduce reach

Tools

Are tools kept sharp and in good condition?

Yes____

No ____ Why not? _____

What can be done to improve tool maintenance? _____

What tools weigh more than 20 lbs? Fill in the box.

List tools more than 20 lbs	Who uses them	Alternative tools

What hand tools used on site vibrate? Fill in the box.

List hand tools that vibrate	Who uses them	Ways to reduce vibration

What hand tools have to be used in awkward postures or in difficult positions? Fill in the box.

List hand tools	Who uses them	Ways to reduce awkward

List the hand tools that have poor handle designs, grips that are too big or small, blow cold air on the workers' hands or have chilled handles. Fill in the table.

List hand tools	Who uses them	Check the problems the tool has				Possible solutions
		bad	grip	cold	chilled	

Repetitive Work

List the jobs that require motions be repeated many times for 1 hour or are repeated throughout the workday? Can the repetitions be reduced by job rotation or rest breaks? Fill in the box.

Job	Job title of	Describe	Repeated	Repeated	Rest breaks	Job rotation

Awkward Postures

List the jobs that require work at shoulder height more than 1 hour per day; jobs that require overhead work more than 1 hour per day? Can scaffolds, platforms or other equipment reduce work above shoulder height?

Job	Job title of	Work at	Overhead	Scaffolds,	Other

Kneeling

List the jobs that require or kneeling for more than 1 hour a day? Are kneepads or cushions available? Are the pads or cushions being used? Fill in the box.

Job	Job title of	Kneepads or	Kneepads or	Equipment	Other

Working in one posture or position for a long period

List the jobs that require workers to stay in one position for a long time. Fill in the box.

Job description	Job title of workers	Possible solutions

Twisting, Turning, Bending

List the jobs that require a lot of twisting, turning or bending. Are there ways of reducing twisting, turning or bending? Fill in the box

Job description	Job title of	Check the motion the job requires				Possible solutions
		Twist	Turn	Bend	Combination	

Surfaces for Walking and Working

List the jobs where the working and walking surfaces are not clean and dry; obstructed; uneven or not level. How can the surfaces be improved? Fill in the box.

Location of	Condition of Work Surface					Ways to
	Wet/	Obstructed	Uneven	Steep	Other	

Worksite Lighting Conditions

List the work areas that are lit with artificial lighting. Is there enough light to do the work? To see materials being moved? Are walking surfaces adequately illuminated? Do shadows restrict visibility? Does glare restricts visibility? Fill in the box.

Work Sites	Work	Enough	Walking	Shadows	Glare	Possible

Standing

List the jobs that require workers to stand all day. Which jobs require standing on concrete or steel? Fill in the box.

Jobs	Jobs	Use anti-	Use job	Use	Other solutions?

Sitting

List the jobs that require sitting for more than one continuous hour. Are workers sitting in the cold to do the job? Sitting on building materials to do the job? Fill in the box.

Job	Job title of	Sitting in cold	Sitting on	Possible solutions?

Heavy Equipment Operators

List the types of heavy equipment operating on the site. On which machines do operators need to lean forward to see or do their work? Do they have to stretch or use awkward postures to reach the equipment controls? Are the seats comfortable for the operators? Does the seating in any of the equipment vibrate a lot? Are the mirrors in the right spots for good visibility? Fill in the box.

Equipment	Number	Need to	Stretch	Mirrors in	Good	Seats	Solutions to

Training

List the training courses that supervisors had on preventing musculoskeletal disorders? What courses do they need to take? Fill in the box. If no courses were taken, write NONE on the first line.

Name of	Name of courses taken & year	Name of

Supervisors		courses needed

List the training courses that workers had on preventing musculoskeletal disorders? What courses do they need to take? If no courses were taken, write NONE on the first line. Fill in the box.

Workers	Name of courses taken	Name of courses needed

Recording Signs and Symptoms of Musculoskeletal Disorders

List the jobs and job titles of workers that have reported muscle pain, joint and back or neck pain in the last 2 weeks. What is the possible cause of the symptom, for example, lifting, awkward postures, working in one position for long periods, repetitive work, something else? You might also want to look at OSHA 200 logs, first aid logs or any other sources of information that is available on your site. Fill in the box.

Symptom	Jobs	Job Title	Possible cause
Muscle pain			
Joint Pain			
Wrist or hand pain			
Elbow or shoulder pain			
Knee pain			
Ankle or hip pain			
Back Pain			
Neck Pain			

Reporting

	Yes	No
Do workers feel free to report symptoms of musculoskeletal disorders		
Do workers feel free to report hazards associated with		
Does the company have an incentive program that discourages		
Are hazards quickly remedied when reported?		
Do workers feel free to report suggested solutions?		
Do workers feel free to report injuries?		
Do supervisors have the same freedom to report information about		

Solutions

Now that you have reviewed all of the jobs for hazards and risk factors related to musculoskeletal disorders, this is the time to consider solutions that best fit your worksite and budget, but which fix the problems.

Based on your review, list the jobs on site that are the most hazardous for musculoskeletal injuries?

1.
2.
3.
4.
5.

Work with the supervisors and workers to analyze the hazards you have noted as well as, risk factor information to select appropriate solutions. The analysis may be as simple as providing anti-fatigue mats for workers who stand on concrete all day, or as complex as developing a rotation schedule for workers who must work in cramped spaces all day.

List the suggested solutions according to the ease of getting done, the expense, and the potential to eliminate the identified risk factor or hazard (effectiveness)?

Proposed solutions

Most effective - - - - - - - - - - - - - Easiest to get done- - - - - - - - - - - - - Least expensive

1.
2.
3.
4.
5.

Least effective - - - - - - - - - - - - - Hardest to implement - - - - - - - - - - - - Most expensive

You also might want to develop a schedule that allows you to check back periodically to see if the solution actually worked.

Program Evaluation Checklist

Every health and safety program should have one part of its activities dedicated to the elimination of work-related musculoskeletal disorders, The most effective programs are evaluated on a regular schedule, especially as worksites change. This checklist provides a cursory evaluation of the main elements of your program to reduce musculoskeletal disorders. Fill this out to see where your program is working and where it might need improvement. If you answer "No" to any question, jot down why this activity does not occur in your organization.

Management Leadership and Employee Participation

	Yes	No	Reason for No	Possible solutions
Is there program				
Is there program				
Are workers/				
Can participation be				

Hazard Awareness and Identification

	Yes	No	Reason for No	Possible solutions
Does the program ensure that				
Does the program ensure				

Job Hazard Analysis and Hazard Control

	Yes	No	Reason for No	Possible solutions

Does the program ensure that MSD				
Does the program identify controls				
Once identified, are the controls put				

Training

	Yes	No	Why not?	Who is not	Suggestions
Are workers and supervisors					
Has the training resulted in					
Give examples of improvements					

Program Evaluation

	Yes	No	Why not?	Possible solutions
Does the program include a				
Does this evaluation drive				
Is this evaluation share				

Medical Management and Alternate Duty

	yes	**no**	**why not**	**Possible Solutions**
Does the program				
Does the program				
Does the program				
Does the program				
Does the program				

CIANBRO THE CONSTRUCTORS

DEDICATED TO AN INJURY-FREE WORKPLACE SINCE 1949

SAFETY BULLETIN

OUCH!! MY BACK

Eighty Percent of the population experiences back pain with adverse effects not only to business, but for the individuals and their families. In addition to missed work, back injuries can mean a lifetime of pain, limiting recreational, social and job activities.

The good news is that back injuries and illnesses can be prevented. Cianbro has information and training available for our employees, which can help accomplish that end result. In order to benefit, employees must make a commitment to protect their backs from injury. Here are some basic guidelines to follow:

1. Never twist at the waist. Pivot from your feet.

2. Warm up before you lift – it's an athletic task! Bend or stretch gently to get ready. Use proper lifting techniques, as illustrated on attached sheets.

3. Push, rather than pull. It's much easier on your back. Brace your hands on the object, set your back in an extended position, then do all the pushing and moving with your legs.

4. If you're lifting or working overhead, use a low step stool to get closer to the object, or the work you're doing.

5. Get help. If you must lift something that feels heavy or awkward to you, ask someone to help, or get equipment to help. Use dollies, carts or machinery at all times.

6. Take your time. Hurrying causes your muscles to act inappropriately, increasing the chance of injury.

7. STRETCH. Maintaining any position too long can be harmful. If you're sitting, kneeling or bent over for any length of time, stop frequently, stand and stretch your back, placing your hands just above your waist, against your back. If you're working in a standing position, or with arms overhead, stop frequently and squat.

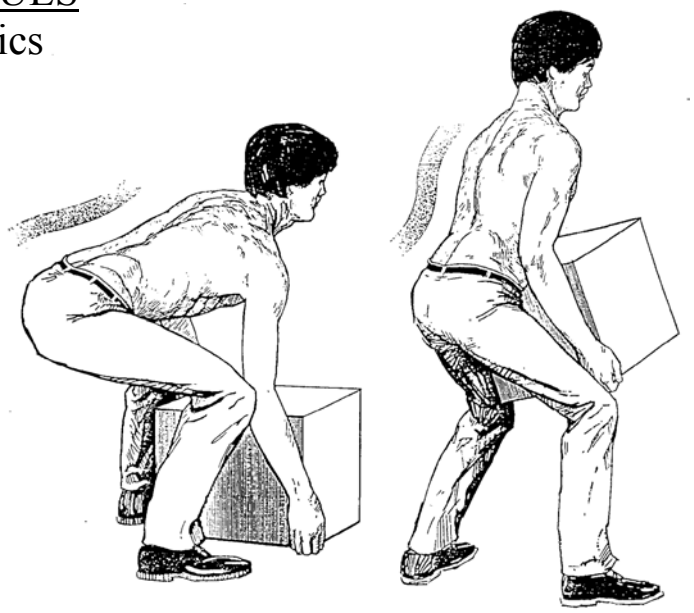
8. If you have a back problem, whether job-related or not, inform your supervisor so you will get the proper attention.

9. Use a back support cushion for long drives, high impact boot inserts for working on hard or uneven surfaces and a lumbar support belt it you do a lot of heavy lifting.

10. Exercise daily. Keep the muscles that surround your spine strong and flexible. Some simple exercises are attached.

Understand your back and take proper care of it. It's the only one you'll ever have! The following lifting techniques and exercises can help you keep your back healthy and prevent injury.

LIFTING TECHNIQUES
Proper Body Mechanics



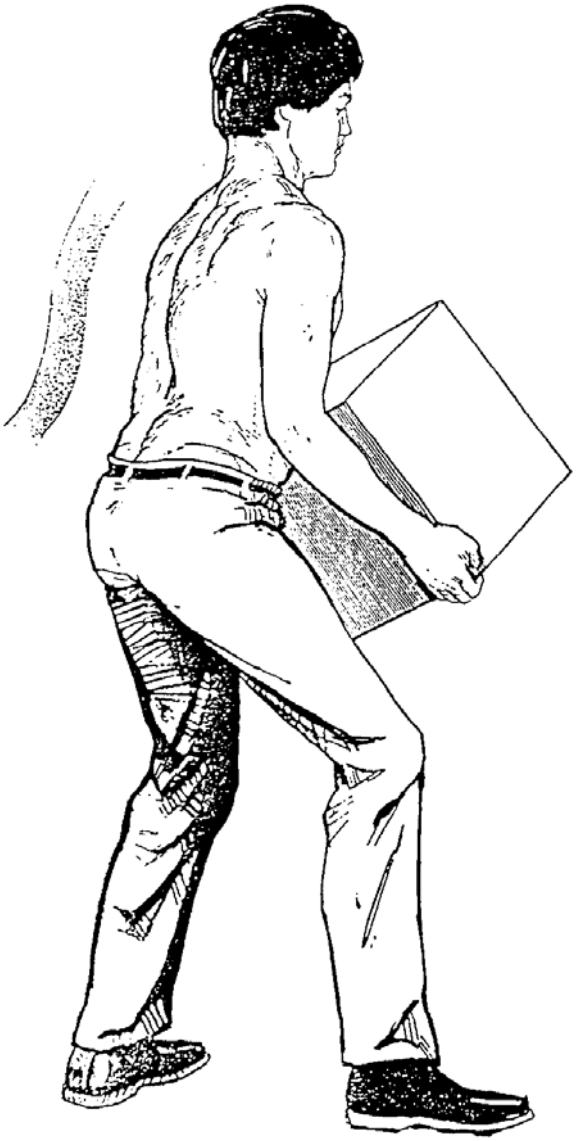
The techniques for proper lifting have been changed. Many safety films and brochures teach the old "pelvic tilt" method of lifting with a flat back. This is now considered to be wrong!

Back injuries can be avoided if your back is maintained in good normal alignment and if you abide by the following rules:

1. **Keep a wide base of support.**
Spread your feet apart to make yourself more stable. One foot may be placed ahead of the other.

2. **Keep the object close to you.**
The farther the object is from you, the more pressure you will have on your low back. A forty pound box held two feet in front of you could increase your low back pressure by as much as 400 pounds.

3. **Bend your knees and hips.**
If your arms are not a proper length for picking it up or setting it down, you need to bend your hips and knees in order to lower yourself at the same time.



4. Maintain your lumbar curve.
This is the key. Your should extend your back slightly to allow your butt to stick out. This will keep your back muscles in a position where they can work with the most strength and maintain the normal curve in the low back to prevent disc injuries. Keep your lumber spine in its normal lordotic (inward) curve during the lift.

5. Do not twist or bend sideways.
Set your spine in normal position with your back slightly extended. Face the object you are picking up or working on. If you must turn to change your direction, pivot with your feet.

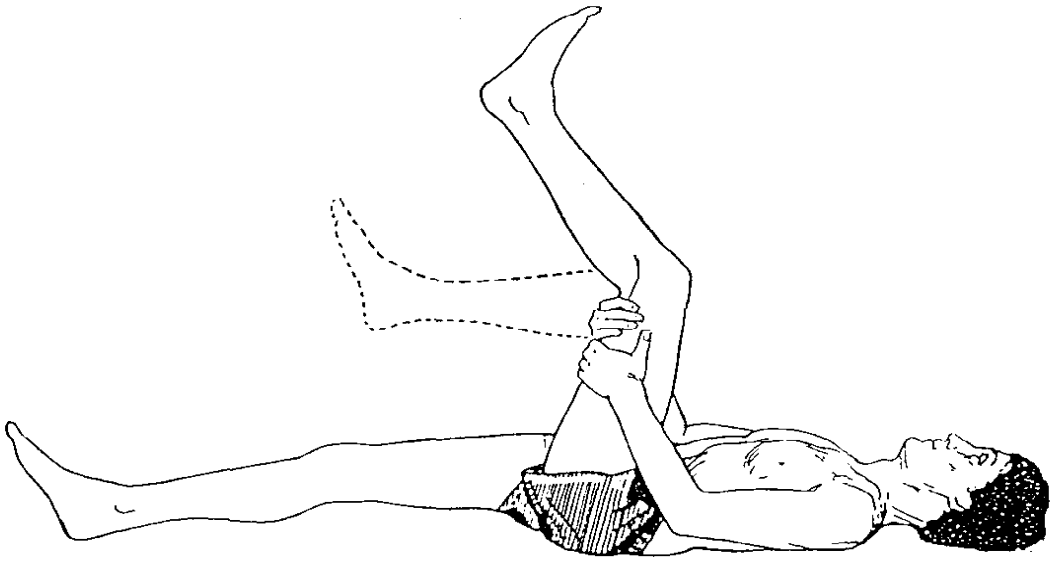
Appendix F

FLEXIBILITY AND STRENGTH

The lack of flexibility is a major risk factor in back injuries. There are many muscles in the thighs, the buttocks, the abdomen, and the back area itself that attach to the spine and the pelvis. When any of these muscles become tight and lose their flexibility (due to excessive sitting, standing, over-working, sustained positioning or pain) they produce a pulling or holding force on the spine or pelvis. This removes some of the spine's ability to move fully and safely.

Muscle stretching is very important to spine health but must be done properly. Fast, bouncing stretches will irritate the muscle fibers and can actually cause them to tighten in response. Effective and safe stretching must be done slowly and deliberately, always trying to coax the muscle into a more lengthened position. Stretching can be uncomfortable but should not result in pain that lasts after the exercise. Muscle strength is important to the prevention of injury. Muscle strength is important to the prevention of injury. Muscles need enough strength to move vertebrae while protecting the joints and ligaments. Muscles need a balance of flexibility and stability.

Physical therapists have identified some simple quick exercises that are good for your back to build flexibility and strength of muscles and provide repair and nutrition of discs and joints. Start gently and do not push yourself too much. These exercises are intended to preserve a normal back. They are often used to treat certain back pain problems. If you have back pain, or if these exercises bother your back, you may wish to consult a physical therapist for some different exercises.

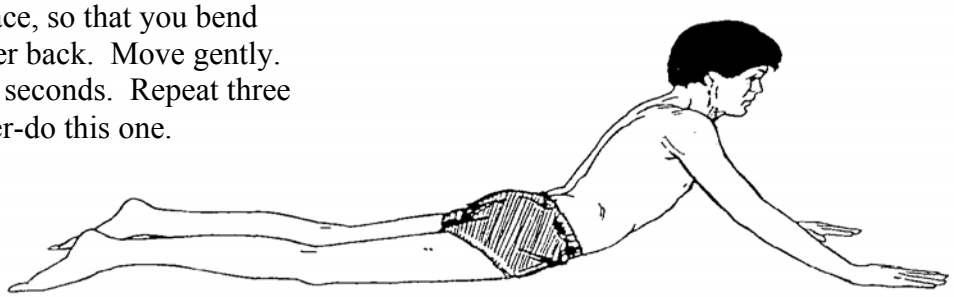


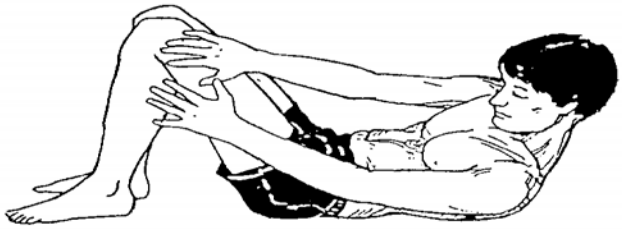
1. To stretch hamstrings.

Lie on your back with legs flat. Pull one knee toward your chest. Grasp your thigh under your knee and hold it firmly to your chest as you try to straighten your leg at your knee. Make it a slow stretch-and-relax process for about a minute to each leg.

2. Prone Press-ups.

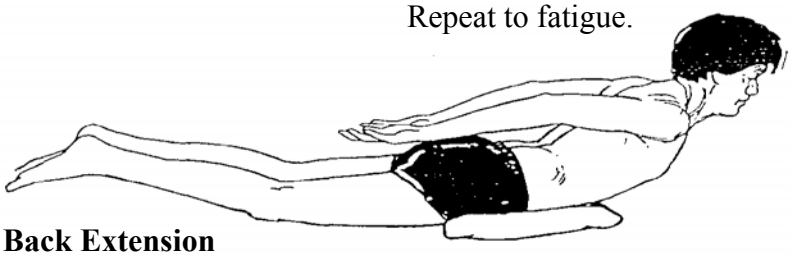
This is valuable to increase joint mobility and disc nutrition and repair. It also stretches hip flexor muscles in the groin. This exercise must be done gently. Lie flat on your belly. Place your hands on the surface, so that you bend backwards at your lower back. Move gently. Hold the position three seconds. Repeat three times only. Do not over-do this one.





3. Diagonal Half Sit-ups.

The safest and most effective sit-ups are done only part way up and on a diagonal, with knees bent. This helps low back mobility and trunk muscle stability. This exercise is done lying on your back with your legs bent. Reach your hands forward and curl up half way turning your body to one side. Hold briefly. Lie back and relax a second. Then sit up again toward the other direction. Repeat to fatigue.



4. Active Back Extension

Do this one slowly and gently. Lie flat on your belly with your arms down at your sides. Lift your head, chest, and arms up off the surface a few inches. Do not extend your head back. Hold a few seconds. Relax. Repeat to fatigue.

5. Passive flexion stretch.

Lie on your back. Pull your knees into your chest and hold them there relaxed for 30 seconds. Do a gentle standing back-bend after this.

Appendix F

STRETCHING TO REDUCE INJURY

by Mark Stice

Our industry requires a significant amount of physically demanding work. Because of this, there is a greater likelihood that you will suffer an injury than those with less physically demanding jobs.

The stresses placed on your body at work are in many ways no different than those experienced by athletes. Think of the similarities between your work and active sports. Often times both often involve sudden movements, heavy weights or loads, and awkward physical positions. Injuries occur as a result of this kind of activity, so how do skilled athletes, who perform the same activities, avoid injury and often not even miss an event or a play? It starts with flexibility stretching. This is something we in industry can learn from professional athletics.

You've seen a jogger trying to push over a tree or telephone pole, or a baseball player rocking the bat behind his shoulders. What these athletes are doing is flexibility stretching or "warming up." Cold, stiff muscles are prime targets for damage, however, when they are warmed up and stretched, muscles respond to demands without causing strains. To help prevent injuries yourself, you should warm up before work. The best warm-up is light total body stretching. Here are some examples:

1. Shoulder Shrug – Raise both shoulders as if to shrug. Slowly lift your arms above your head, then rise up onto your toes. Rotate your hands and then lower yourself down. Relax.
2. Neck Stretches – Tilt your head slowly left to right and then front to back.
3. Shoulder Stretch – Bend one arm behind your neck and shoulder. Reach up with the opposite hand and press down on your elbow. Repeat with the other arm.
4. Upper Trunk Stretch – Place your hands on your hips. Lean your body backwards and hold the position. Return to upright and relax.
5. Shoulder Rotation Stretch – Clasp your hands behind your back. Bend forward and lift hands upward. Hold this position.

Whenever doing stretching exercises, try to be as relaxed as possible. Breathe evenly and deeply. Never stretch past the point of tension, strain or pain. Hold each position for a ten count.

Pre-work stretches, such as those described are just a few that should be a part of a comprehensive stretching program designed to reduce strain and sprain type injuries. If you are concerned about your ability to perform any of the stretches, consult your physician prior to stating.

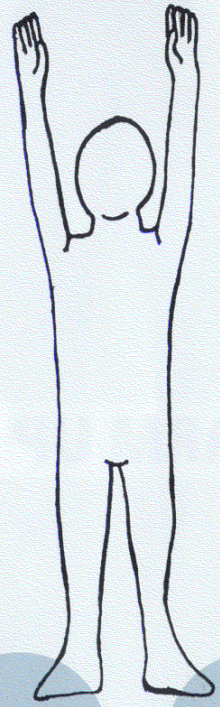
Warm Up to Safety

Work involves awkward positions, static postures, occasional high force requirements, repetitive movements, use of pneumatic tools, lifting of tools and materials, and working with various kinds of equipment. These risk factors collectively contribute to musculoskeletal injuries – the most prevalent injury type in the construction industry.

According to data released by the Bureau of Labor Statistics for the construction industry, in 1998 sprains and strains accounted for 37.5% of all injuries and illnesses involving days away from work.

The stretching exercises provided should be executed at the beginning of the workday to warm up muscles, make ligaments more flexible, and prepare the body to do work – thus reducing the risk of injury. They should also be done upon completion of the workday to assist the body in recovering from the day's activities.

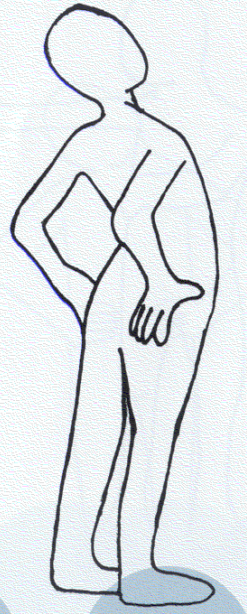
For more information visit our web site: www.stpaul.com/riskcontrol.



OVERHEAD REACH

Stand with your legs shoulder width apart. Raise both arms above your head and reach upward until you feel a comfortable stretch in your trunk. Hold for 10 seconds and repeat.

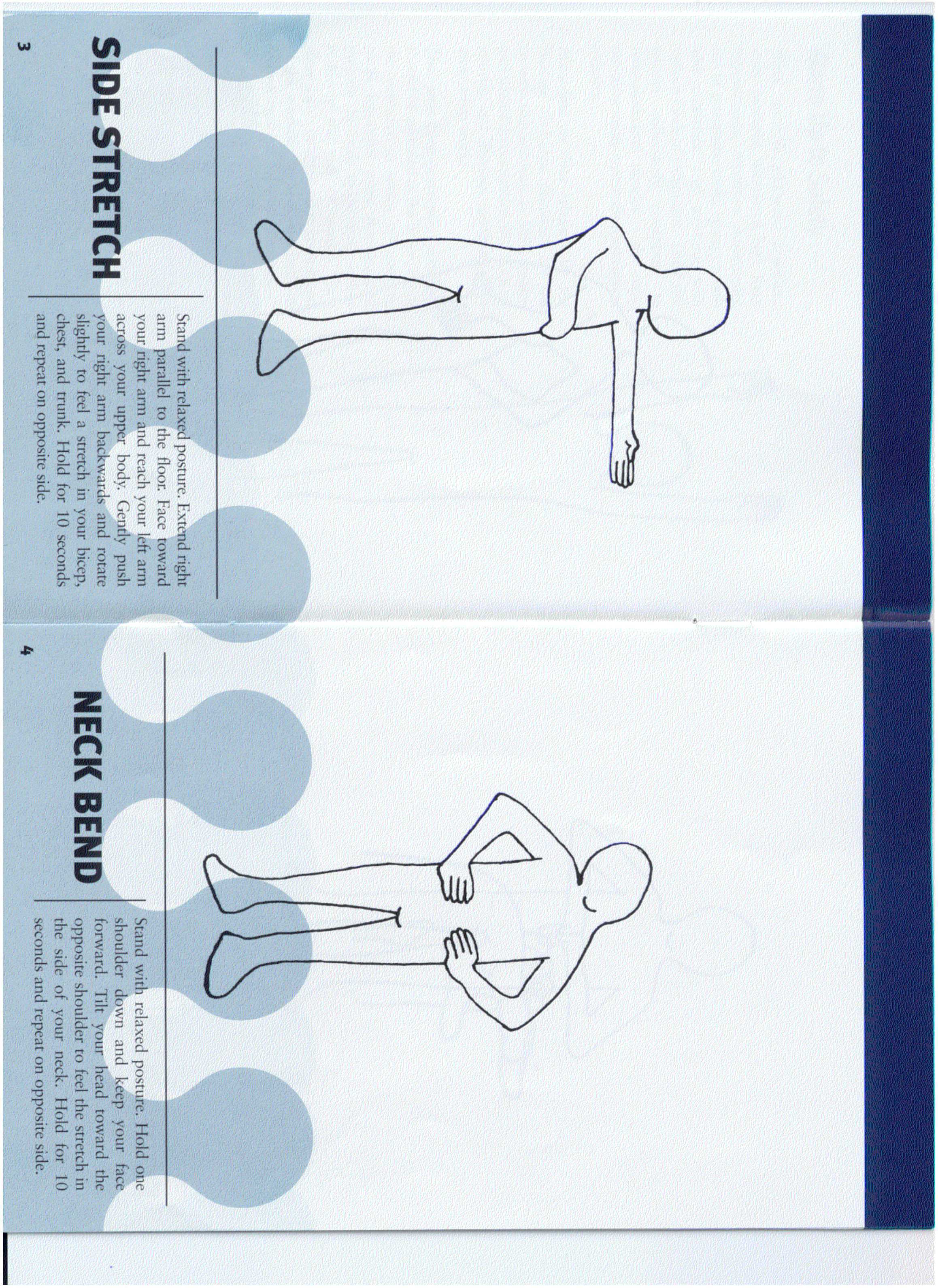
1



BACK BEND

Put your hands in the small of your back. Keep your legs straight and your eyes looking forward. Lean back until you feel a comfortable stretch. Hold for 10 seconds and repeat.

2



SIDE STRETCH

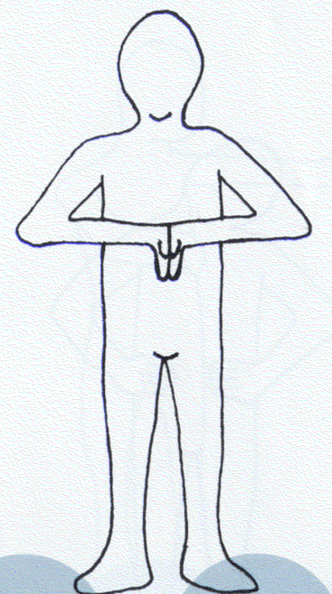
Stand with relaxed posture. Extend right arm parallel to the floor. Face toward your right arm and reach your left arm across your upper body. Gently push your right arm backwards and rotate slightly to feel a stretch in your bicep, chest, and trunk. Hold for 10 seconds and repeat on opposite side.

3

NECK BEND

Stand with relaxed posture. Hold one shoulder down and keep your face forward. Tilt your head toward the opposite shoulder to feel the stretch in the side of your neck. Hold for 10 seconds and repeat on opposite side.

4



FOREARM STRETCH

Stand with your feet shoulder width apart. Put the palms of your hands together and place them close to your body. Turn your fingers toward the floor. Slide your hands up toward your chest until you feel a comfortable stretch in your forearms. Hold for 10 seconds. Next, rotate your fingers up into a "prayer position." Slide your hands down until you feel a comfortable stretch. Hold for another 10 seconds.

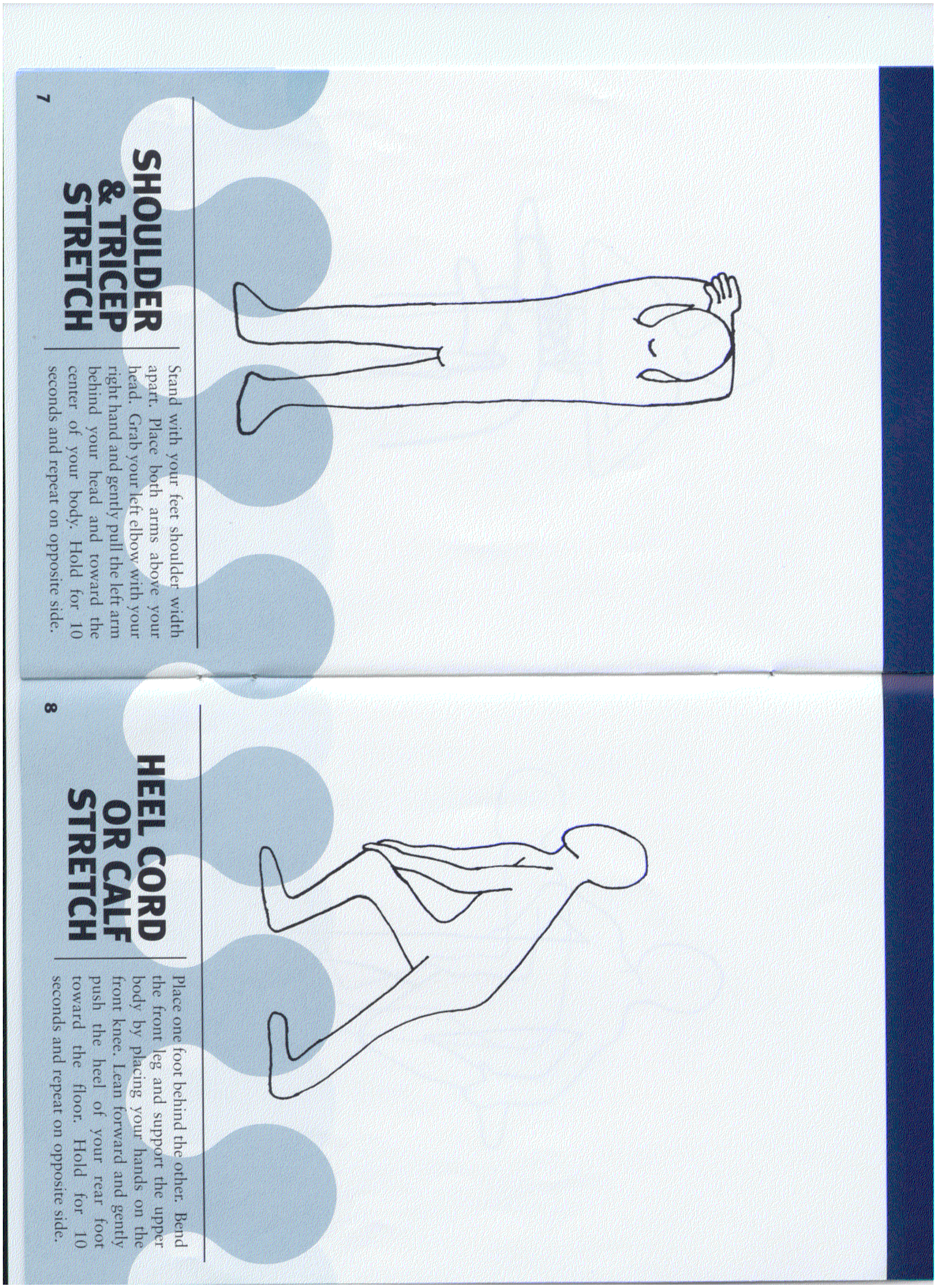
5

WRIST STRETCH

Let one hand hang in a relaxed position. Grasp this hand with your free hand by placing the fingers of your free hand across the back of your stretching hand. Use the free hand to gently push the stretching hand toward its own elbow. Hold for 10 seconds.

6

Appendix F



7

SHOULDER & TRICEP STRETCH

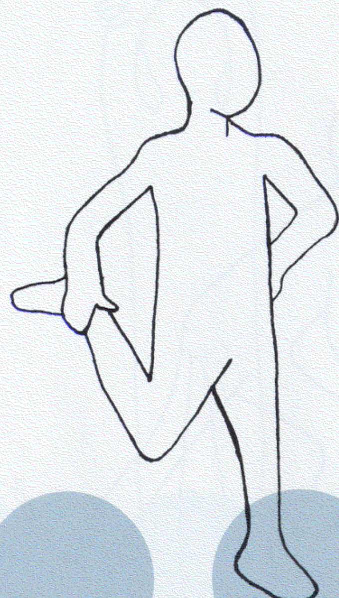
Stand with your feet shoulder width apart. Place both arms above your head. Grab your left elbow with your right hand and gently pull the left arm behind your head and toward the center of your body. Hold for 10 seconds and repeat on opposite side.

8

HEEL CORD OR CALF STRETCH

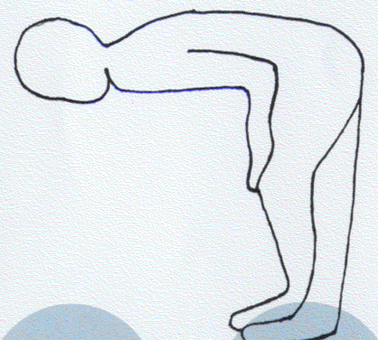
Place one foot behind the other. Bend the front leg and support the upper body by placing your hands on the front knee. Lean forward and gently push the heel of your rear foot toward the floor. Hold for 10 seconds and repeat on opposite side.

Appendix F



QUADRICEP STRETCH

Stand with relaxed posture and abdominal muscles contracted. Lift your right ankle towards your glutes and hold with your right hand. Keep your hips tilted forward and your right knee pointed toward the floor. Hold for 10 seconds and repeat on opposite side.



HAMSTRING STRETCH

Stand with relaxed posture and abdominal muscles contracted. Facing forward, cross your left foot over the right. Place your hands on the front knee to support your upper body weight. Bend forward at the hips until you feel a comfortable stretch in your right hamstring. Hold for 10 seconds and repeat on opposite side.