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A typical Tbilisi construction project. Georgia's construction sector grew 22.3% in 2005 and 26% during the first quarter of 2006.

GEORGIA'S DRAFT CONSTRUCTION CODE

Final Report

August 22, 2006

This publication was produced for review by the United States Agency for International Development. It was prepared by the USAID Business Climate Reform project managed by Chemonics International Inc. The publication was written by Short Term Construction Regulation Specialist Michael Brodsky.

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Executive Summary

GoG has developed a streamlined administrative process for construction permitting and final inspection of construction projects. The substantive functions that construction permitting should fulfill are: 1) to assure that new buildings meet basic life-safety standards, including structural integrity, fire safety, and seismic safety; and 2) to assure that construction projects respect height and bulk limits, preserve public spaces including parks, sidewalks, and streets, and enhance the quality of urban life with respect to the built environment.

Some suggestions as to steps needed to fulfill the substantive functions of number 2 above were provided in my memo of July 10, 2006, but are not addressed in further detail here.

This memo discusses considerations that should be addressed in developing legislation/regulations in the following areas related to life-safety issues: I) technical standards for building design that meet international best practices; II) workplace safety rules; III) civil liability and mandatory insurance provisions; IV) certification/licensing of architects and engineers; and V) certification of private engineering firms intended to take over safety review of building design, thus privatizing this current government function.

Attachment one is a set of timelines that treats development of legislation/regulations in areas I–V as interrelated projects to be carried out by GoG with assistance from USAID. Important details for viewing and using the timelines are discussed on page 8. Suggestions for retaining experts to assist in these projects have been included in the text of this memo and are reflected in the timelines.

Because this memo is intended to serve as an ongoing resource for carrying out projects I–V, a number of attachments and Web links are provided to catalog useful information. In order for the Web links and attachments to function properly, the viewer must have Adobe Reader version 7.0 or later, which can be downloaded free of charge at http://www.adobe.com. To open attachments in a separate window while keeping your place in this memo, click the attachments tab at left and double-click on the desired attachment in the window that opens at the bottom of the screen. A number of issues are explored in considerable detail, and throughout alternative courses of action are presented for GoG's consideration. Consequently, the reader seeking a concise overview might want to consult my memo of July 10, 2006, which is attachment two.

I
TECHNICAL STANDARDS FOR BUILDING DESIGN AND CONSTRUCTION

A. Overview.

Technical standards for building design now in force are out of date and cumbersome; for example, technical standards for seismic safety have not been updated since the early 1980s. In order to bring the Georgian construction industry up to international standards and provide for its long-term prosperity and safety, the most basic requirement is the adoption of new technical standards that will be adapted for use in Georgia, translated into Georgian, widely circulated, and consistently enforced.

A brief word on terminology may be useful here. The terms "building code" or "construction code" are generally understood in Georgia to encompass a broad range of subjects, from the regulation of construction industry professionals to zoning to civil liability for construction defects and accidents. In the U.S. and a number of other countries, "building code" refers to the technical standards for building design and construction. In Georgia, the current technical standards in force for building design and construction are referred to as "SNIPPs." The acronym and standards have been carried over from the Soviet era. This section addresses new technical standards that would replace the SNIPPs.

Technical standards in the U.S. and many other countries extend from fundamental requirements for the structural integrity and safety of buildings to detailed requirements for interior finishes, such as carpet, paint, and tile. The adaptation and adoption of each technical standard is time consuming and there are limits on how much new information the construction industry in any country can absorb in a given amount of time. I recommend that GoG first adopt a set of technical standards that are limited to the primary life-safety components of structural integrity and fire safety. This section is limited to considering structural and fire safety standards.

The steps involved in adopting technical standards are as follows: 1) select a base set of standards from which Georgian technical standards will be derived; 2) form working group subcommittees representative of the several relevant disciplines and representative of a broad range of interested parties; 3) adapt the standards so they are practical for use in Georgia and translate them; 4) seek wider comment from the Georgian construction industry; 5) finalize the standards in light of comments; 6) design a user-friendly set of volumes with attractive covers; 7) print several hundred sets of the standards; 8) publicize and distribute them throughout the construction industry; 9) allow a period of transition from the SNIPPs to the new standards; and 10) make the new standards mandatory for all projects.

B. Hiring A Short-Term Expert To Help Select A Base Set Of Standards And A Long-Term Expert To Facilitate The Adaptation Process.

There are currently two competing sets of "international" standards that are intended to serve as base standards to be adapted for use in various countries: the Eurocodes and the International Building Code ("IBC"). Each has advantages and disadvantages for use as the base code for Georgia. In addition to the Eurocodes and IBC, each of the developed countries has a set of national technical standards for its construction industry. Conceivably, Georgia could start with one of the national codes as a base rather than the Eurocodes or IBC. However, the Eurocodes and IBC are intended to be used as a base code, and one of them will probably prove more amenable to adaptation in Georgia than any of the national codes. The IBC and Eurocodes are also supported by a substantial body of educational and professional development materials. Finally, adoption of the IBC or Eurocodes will link Georgia's construction professionals to a wider international community with a common set of standards.

I discuss below several of the advantages and disadvantages of the Eurocodes as opposed to the IBC that can serve as a starting point for considering which code to choose as a base. Once the base code is selected, it will be necessary to retain a long-term expert in code development to help GoG manage the process of adapting the base code for use in Georgia.

I recommend using a different short-term expert to help in selecting the base code. The publishers of the IBC may provide referrals to experts intimately familiar with their code who can help with its adaptation if it is chosen. A number of European organizations that have been integral to the development of the Eurocodes could provide referrals to European experts intimately familiar with the Eurocodes. However, it is unlikely that either of these camps could provide an informed, unbiased opinion as to which code is best for Georgia.

Assessing and choosing a base code is also qualitatively different from adapting a code once it is chosen. The process of adapting the code involves translating page by page in conjunction with Georgian industry participants to make sure the finished code makes sense and takes account of conditions in Georgia. It is a long and tedious process that requires a lot of determination and a good deal of experience with the details of technical standards. Choosing the base code, on the other hand, requires a big-picture view and high-level skills in the latest engineering techniques. A university professor of structural engineering with ties to both Europe and America might be a good choice for the short-term assignment of assisting with the selection of the base code. A building department official experienced in administering the selected code might be a good choice for the long-term assignment of adopting the base code for use in Georgia.

It is possible that GoG/USAID may find one person who can fulfill both these roles, but more likely two individuals will be needed. I would suggest the following minimum qualifications for these experts, respectively.

Short-term expert: 1) master's degree or higher (Ph.D. preferred) in civil engineering from internationally recognized university; 2) practical experience in structural design;

3) familiarity with development of building codes; 4) experience in developing countries; 5) international affiliations; and 6) no allegiance to any of the base codes being considered.

Long-term expert: 1) BS degree or higher in civil engineering from recognized institution; 2) previous experience with the selected base code (allegiance O.K. at this stage); 3) experience with code development; and 4) history of managing complex, multi-step, long-term projects to successful completion.

C. The Eurocodes

1. Advantages and disadvantages.

a. The EU will ultimately require adoption of the Eurocodes.

The first and major advantage of the Eurocodes is political. The Eurocodes have been developed by the EU and eventually all EU member states will be required to adopt them. The Eurocodes are also intended to eliminate barriers to trade between EU members by assuring that all materials used in construction that meet the standards of the Eurocodes are accepted for use in all EU states. This political advantage is tempered by the fact that the Eurocodes are new, incomplete in some respects, and no EU member state has yet adopted them entirely to replace their national code. Consequently, there is a lack of experience with the Eurocodes in practice.

The current target date for adoption of the Eurocodes by EU states appears to be approximately 2011. I would not be surprised if this date slips by a few years. However, if Georgia seeks accession to the EU, it will eventually be required to adopt the Eurocodes. The transition from the SNIPPs to a new set of standards will be a significant undertaking. The Eurocodes are organized in a way that is fundamentally different from the IBC. A second transition from the IBC to the Eurocodes five or ten years from now would be another significant undertaking that could be avoided if the Eurocodes were adopted from the outset. The significance of this factor depends on how soon Georgia will seek accession and how soon the EU will require accession states to adopt the Eurocodes. It is recognized that how soon Georgia will seek EU accession depends on a number of factors not amenable to a firm answer at this time; however, some thought should be given to the matter in this context. As to how soon the EU will require adoption of the Eurocodes after accession, perhaps experience from Romania and Bulgaria might provide useful information.

b. The Eurocodes lack fire safety design provisions, lack workmanship provisions, and address only structural issues.

The Eurocodes do not provide standards for non-structural fire safety issues. They do provide standards related to the structural fire resistance of materials and construction. However, design issues, such as the placement of exit doors, are not considered structural and are not covered. If the Eurocodes are selected, they will have to be augmented with provisions from another source to complete basic fire safety requirements.

Another aspect of the Eurocodes that can be seen as both advantageous and disadvantageous is that they deal only with structural issues. Unlike the IBC, they do not address plumbing, electrical, or mechanical issues. The advantage is that for the first phase of standards

adoption, Georgia will not have to separate out sections on non-structural issues. The disadvantage is that when it comes time to adopt standards for electrical, plumbing, mechanical and other trades, Georgia will have to look elsewhere for base standards from which to start.

Another disadvantage of the Eurocodes is that they do not provide standards for workmanship. Although I have not reviewed this issue in detail, it is my understanding that the Eurocode sections devoted to the design of concrete buildings would not provide directions for on-site execution. Examples of execution would include limitations on the freefall of concrete when it is being poured and specifications for vibrating concrete while it is wet to eliminate any trapped air. I observed a number of defects in workmanship in the placement of concrete in Georgia. Adoption and enforcement of workmanship standards is an important consideration.

The Eurocodes are designed to be used with a "national annex" produced by each member state that picks up the gaps left in the Eurocodes themselves. The U.K. is developing a new specification called "execution of concrete structures," which will pick up this gap left by the Eurocodes with regard to workmanship on concrete structures. It is currently scheduled for publication in 2008.

The Concrete Centre pamphlet advises that the Eurocodes do not provide "derived formula" and that such formulae are expected to be provided in a textbook or similar publication and incorporated into the national annex. Because I am not trained as an engineer, I am unable to comment on the significance of this issue. It should be assessed with the help of a qualified civil engineer and the stakeholders.

c. Georgia may be able to implement a structural code by adapting five of the nine Eurocode segments.

The Eurocodes are divided into 9 segments, EN 1990–EN 1999. EN 1990, 1991, 1997, and 1998 concern basic engineering principles and are applicable to all projects. EN 1992–1996 and EN 1999 are devoted to specific types of construction. The overwhelming majority of significant construction projects in Georgia are of concrete construction. By translating and adapting five of the nine Eurocode segments, EN 1990, 1991, 1992, 1997, and 1998, Georgia would have a set of technical standards for the structural integrity of concrete structures. In order to have a complete basic set of technical standards for concrete structures, standards for workmanship and non-structural fire safety would need to be adapted from other sources. The most likely source for the workmanship standards would be the national annex of one of the EU states, perhaps the U.K. Alternatively, portions could be borrowed from the IBC to provide workmanship standards. The non-structural fire safety provisions could also come from the IBC or one of the EU national annexes as well.

In Georgia concrete masonry units are commonly used to complete the exterior walls of tall buildings. Although the structure of the building is composed of reinforced concrete columns and beams, the masonry infill sections are commonly not reinforced. This presents a safety hazard. This condition was observed on many construction sites in and around Tbilisi. EN–1996 is the Eurocode segment devoted to masonry. Because masonry is used in this manner

in Georgia, it may be necessary to address the masonry safety issue by adapting portions of the EN–1996 standard as well as the five structural standards.

Attachment three is a pamphlet from which some of the information for this section was taken and which provides a further useful overview of the entire Eurocode family. It is produced by a British organization, The Concrete Centre. Because the overwhelming majority of projects in Georgia are poured-in-place concrete structures, The Concrete Centre may also prove to be a source of further useful information about how the Eurocodes might prove out in practice in Georgia. Their website address is http://www.concretecentre.com.

d. The Eurocodes adopt engineering techniques that may be unfamiliar to Georgian engineers and Eurocode educational materials may be limited.
Also worth noting is the fact that Eurocodes adopt an approach for geotechnical engineering that varies significantly from current practices in geotechnical design. A geotechnical report is required for all significant projects. It would be important before deciding on a base code to seek input from geo-engineers currently practicing in Georgia in order to ascertain how difficult it will be for them to adapt to the new approach.

There are abundant educational materials available to acquaint users with the IBC. It is unclear how much educational material is available for Eurocodes. The presence of standardized tests and organizations specializing in delivering seminars and other educational materials based on the IBC may solve the dilemma of certifying architects and engineers (without an extensive government apparatus).

2. Assessing the Eurocodes as a base code.
An assessment of the Eurocodes as a base code for comparison to the IBC should include the following factors: 1) how soon Georgia will seek EU accession and how soon thereafter the EU will require Georgia to adopt the Eurocodes in any event; 2) the extent to which outside standards will have to be obtained or developed in order to fill the gaps in the Eurocodes and the difficulty of obtaining and adapting or developing them; 3) the approach to engineering solutions adopted by the Eurocodes relative to current practices in Georgia (in particular, geo-engineering) and the difficulty of any transition for Georgian engineers; 4) a determination of how ready for practical application the Eurocodes actually are; 5) an assessment of whether covering concrete structures is enough for the initial publication of Georgia's new standards or if structural steel construction and other construction methods (currently very rare in Georgia) should also be covered; 6) an assessment of the availability and extent of educational materials and tests designed to measure proficiency in the Eurocodes; and 7) the number of pages that will be involved in the finished product and the degree to which the Eurocode approach is user friendly.

D. The IBC.

1. Advantages and disadvantages.
a. The IBC has been proven in practice and is comprehensive.
The major advantages of the IBC are that it has been in use for a long time and has been fine-tuned over many years. It also provides standards for workmanship, and covers all aspects of

fire safety. Modules on plumbing, electrical, mechanical, and other trades are in widespread use and would be available for adaptation in the future when Georgia is ready to move beyond basic structural and fire safety standards. The structural and fire safety standards can be separated from other aspects of the code; however, some effort will be required to achieve this result.

b. The IBC is basically a U.S. code but projects to adopt it internationally are underway.
The major disadvantage is that it is basically a U.S. and not a European code. Metric equivalents have been provided throughout and the publisher is seeking to have it adopted internationally. However, the IBC relies heavily on references to a number of U.S.-based standards that are not contained within the covers of the IBC. For example, the standards for concrete reference another standard, ACI 318, published by the American Concrete Institute (http://www.concrete.org/general/home.asp). For the standards on concrete to be complete, Georgia would have to translate and adapt ACI 318 as well as the IBC. ACI 318 is available in a metric version. Basic principles for minimum design loads also come from an outside publication, ASCE Standard 7-05. ASCE 7-05 is also expressed in metric units or contains metric conversion formulas where units are expressed in non-metric form. ASCE 7-05 is published by the American Society of Civil Engineers. Their website address is http://www.asce.org/asce.cfm. A hard copy of ASCE 7-05 has been previously provided to GoG.

The publishers of the IBC, the International Code Council, informed me that projects to adopt the IBC are underway in several developing countries around the world. IBC's international services group webpage is at http://www.iccsafe.org/government/international.html. Some sense for the progress of these efforts to adopt the IBC in other developing countries might prove valuable in assessing its appropriateness for Georgia.

c. The publishers of the IBC will charge royalties.
A final consideration unique to the IBC is that its publishers will seek to charge royalties if it is selected. This is not the case with the Eurocodes. If the IBC proves to be the clear choice on non-royalty considerations, I believe it should be selected and some way found to finance the royalty issue. The issue should, however, be addressed early on with the publisher to avoid any surprises. What royalties, if any, are involved in the IBC's companion standards, such as ASCE 7-05 and ACI 318, should also be investigated.

2. Assessing the IBC as a base code.
An assessment of the IBC as a base code in comparison to the Eurocodes should include the following factors: 1) the level of difficulty in separating standards for structural integrity and fire safety from other aspects of the code; 2) the number and length of outside standards that are referenced in the IBC that will need to be translated and adopted to make a complete code; 3) the approach to engineering solutions adopted by the IBC relative to current practices in Georgia and the difficulty of any transition for Georgian engineers; 4) the extent to which the well-developed commercially available educational and testing materials present an advantage over the Eurocodes; 5) the number of pages that will be involved in the finished product and the degree to which the IBC approach is user friendly; and 6) the amount of royalties that will be charged.

E. Compliance Measures.

Once fully adopted, I envision that compliance with the new technical standards will be enforced through licensing requirements for architects and engineers, which will require them to demonstrate proficiency in the standards (training and testing for architects and engineers is discussed below at section IV), the application of "private expertise" (discussed below at section V), and plan check by local officials.

F. Timelines.

A timeline for adopting technical standards is attached. The timelines for the other projects contemplated in this memo are also included: certification of construction professionals, development of safety rules, promulgation of civil liability and insurance legislation, and certification for private expertise firms. The timelines have been constructed to interrelate these projects, as the projects are interdependent upon each other. If GoG/USAID should decide to pursue some, but not all, of the contemplated projects, the timelines can be adjusted.

The timelines should be considered a rough first draft for GoG to refine and develop. As with any project schedule stretching out over many months, there is no doubt that adjustments will need to be made. With luck, some steps may be found unnecessary. Readjustment to allow for challenges that crop up along the way should also be expected. More importantly, the timelines should be viewed as a tool rather than an artifact. By studying and adjusting the timelines as more information is gathered, the project schedules can be improved and the projects managed on an ongoing basis. The timelines are arranged for display on a 2 foot by 3 foot standard-sized blueprint page. This report is first being transmitted electronically in pdf format. Attachment one is the timeline page cut up into 8-1/2" X 11" sheets, which can be printed out and taped together for immediate perusal. A full size, single-page hard copy will follow by FedEx. The timelines were created using VectorWorks software. VectorWorks is a professional CAD program used by many engineering firms. With VectorWorks the timelines can be easily adjusted digitally in any way that one can imagine. The larger engineering firms in Georgia will have VectorWorks software or other CAD programs that can read the source file. I would suggest that GoG work with one of these firms and at the outset begin experimenting with adjustments to the timelines. I will follow up with USAID about transmitting the source file by email to the appropriate destination.

I have also included suggestions and a timeline for establishing a website to be used by the stakeholder committees to facilitate the exchange of information and to expedite progress between meetings. As projects advance, the website can also be used to solicit and receive comments from the wider construction industry community and to distribute information. An example of website design devoted to seeking and receiving comment on pending regulations can be found at http://www.regulations.gov. If GoG elects not to pursue the website, information can be exchanged in hard copy or by email.

II
WORKPLACE SAFETY RULES

A. Overview: Workplace Safety Rules Should Be Clear, Simple, And In A Form Ready For Widespread Distribution.

Most national workplace safety rules are long and complicated, running to hundreds of pages. Generally, the regulatory nature of the rules makes them too complicated to communicate clearly to employers and employees what they are supposed to do. Consequently, numerous pamphlets and other interpretive materials are produced to "explain" the rules to the people who are supposed to follow them. Without the interpretative materials, the regulations remain as obscure legal pronouncements gathering dust among other volumes of regulations that are promulgated only to fall quietly into desuetude. I suggest that rather than starting from a set of complicated regulations, GoG can start from some of the interpretative materials and can produce a rules pamphlet ready for widespread distribution.

Attachment four is a set of interpretive "guide sheets" produced by the United States Occupational Safety and Health Administration ("OSHA"). I suggest that GoG use these guide sheets as a template for Georgia's safety rules pamphlet.

To complete an integrated safety program, safety posters for display on jobsites should be produced to educate workers, and requirements for a responsible safety officer on each jobsite should be developed.

The steps involved in adopting a workplace safety program are: 1) review base guide sheets and eliminate sheets that do not apply to Georgia; add additional rules to make a complete set; 2) edit text; 3) take photographs and make drawings to illustrate rules; 4) include requirements for responsible safety officer; 5) define compliance measures; 6) design an attractive cover and bind the rules in a handy pamphlet; 7) develop a set of companion safety posters; and 8) print and distribute copies of the safety rules pamphlet and safety posters widely throughout the construction industry.

B. Hiring Experts Is Probably Not Necessary: Workplace Safety Rules Could Be Produced In-House Or By An Outside Safety Firm.

A number of firms specialize in producing safety materials for the construction industry and could be retained to produce a turn-key finished product. On the other hand, Ministry of Construction officials, USAID staff, and construction industry personnel might enjoy working together on producing an illustrated safety rule pamphlet described below as an in-house collaborative effort. To the extent the industry can be involved in producing the pamphlet, the "buy in" by the industry will be increased.

If the in-house approach is taken, a local desktop publishing/graphic design firm could be hired to help with production of the pamphlet.

Staff at OSHA were also very helpful when contacted. Staff members at OSHA indicated an interest in working with USAID/GoG on a collaborative effort or participating through ITAP. OSHA's construction page is located at http://www.osha.gov/doc/index.html.

If GoG/USAID prefers the assistance of a short-term private sector expert, the American Society of Safety Engineers may be a good resource. Their website is currently advertising the "2006 Summer Construction Standards Spectacular." http://www.asse.org. If a short-term expert is hired, the temptation to produce voluminous rules should be avoided and it should be made clear that the assignment is to produce a concise, simple, illustrated set of rules with accompanying posters and materials as described below.

C. The Attached OSHA Guide Sheets May Serve As A Template For GoG Safety Rules.

Attachment four is a set of "guide sheets" produced some time ago by OSHA for the U.S. construction industry. OSHA did a survey and determined the most common violations of safety rules on construction sites. It then produced this set of guide sheets aimed at eliminating the top 25 hazards. Each guide sheet states the hazard, states the applicable rule, explains the rule, and then provides photographs and/or illustrations showing jobsite conditions that violate the rule alongside photographs showing how to bring the condition into compliance. This OSHA publication is the best concise and clear statement of a set of safety practices that I have been able to find thus far. It could be used as a template for GoG safety rules. Using this approach, the safety rules could be bound in a pamphlet with an attractive cover ready for widespread distribution.

The text of the guide sheets would need to be edited to eliminate references to other standards that are not provided and to maintain clarity. This should not prove to be a very difficult undertaking. Some of the rules may not apply to Georgia, and several additional rules would probably have to be added to make a complete set.

Unfortunately, the photographs and illustrations on the OSHA guide sheets have become blurred in reproduction, and the originals are no longer available. New photographs and/or illustrations would have to be produced (or found) to illustrate each rule.

D. Workplace Safety Rules Should Be Part Of An Integrated Workplace Safety Program.

1. Jobsite safety posters.

In addition to the pamphlet, a set of safety posters should also be produced. Jobsite safety posters are very effective at communicating information to workers and establishing a safety culture on the worksite. Attachment five is a safety poster that illustrates rules relating to working in trenches. This poster was taken from OSHA's construction page. OSHA materials are in the public domain and may be reproduced without concern for copyright or royalty issues. A wealth of private firms in the U.S. and Europe also produce construction site safety posters for reasonable fees.

2. Responsible safety officer.
A good safety program encourages a culture of safety responsibility. In order to encourage responsibility, someone must be designated as the responsible party. On projects of a certain size, the general contractor should designate one employee as the safety officer. Georgia's draft Rules of Examination of the Specific Objects of Construction Projects divide buildings into five classes according to their characteristics. A safety officer could be required, for example, for all projects of the fourth class or above. The safety officer's responsibilities should include the following:

- Ensure that each subcontractor has received a copy, read, and understands the safety regulations.
- Ensure that the guide sheets are being followed by conducting periodic inspections of the construction site.
- Conduct weekly safety meetings on the jobsite with a representative of each subcontractor present. These meetings can be informal and brief. Often referred to as "toolbox" safety meetings, ten or fifteen minutes is sufficient. The point is to keep safety in mind. Toolbox safety meeting agendas designed to help conduct short meetings on a different topic each week are commercially available. Several example agendas for toolbox safety meetings can be downloaded at http://www.safetyservicescompany.com/tailgate.asp.

On most projects the safety officer may have other responsibilities as well. For example, the project supervisor can serve as the safety officer, or can delegate this responsibility to an assistant. Only on very large projects will the position of safety officer be a full-time job.

E. Compliance Measures.

Compliance with the safety program can be monitored through the construction permit process, putting into-use-process, and by insurance companies providing project coverage.

At the time the permit is issued, the applicant could be required to submit a statement affirming that they have read and are familiar with the safety regulations, and could be required to submit the name and contact information for the responsible safety officer. This is not an additional step, and represents only a half page or less of additional paperwork.

The draft resolution "On Making Changes and Amendments in Resolution N140, 11.08.2005" requires that at the completion of specified stages of construction inspections will be conducted. It also specifies that certain minutes and other documentation shall be submitted to the government at the completion of each of these stages of construction. To this list of documents the following could be added. This is not an additional step, and the additional paperwork required could be one page or less:

- A statement from the responsible safety officer affirming that he or she is the responsible safety officer for the project.

- A statement from the responsible safety officer affirming that all subcontractors who have commenced work on the project have been furnished with a copy of the safety regulations.
- A statement from the responsible safety officer affirming that weekly safety meetings are being conducted and specifying the day and time of the meetings.
- A statement from the responsible safety officer affirming that he or she is conducting periodic safety inspections of the project site.

The safety officer could be required to furnish log sheets showing the date and time the required meetings/inspections were carried out. Safety meeting agendas are available in a form designed to be signed and turned in as proof that each meeting was conducted.

Insurance companies could also impose all of the above-discussed compliance measures as a policy condition.

III
CIVIL LIABILITY AND INSURANCE

A. Overview.

Keeping in mind GoG's general deregulatory strategy, inspection of new buildings for fire safety and structural integrity implicates the government's core function of protecting the life and safety of its citizens. Government inspection of new construction projects to assure that they are safe should be one of the areas not left entirely to the market. GoG should take an aggressive role, prioritizing the subjects of inspection so that the most critical life-safety issues are addressed. The Insurance Services Office provides a wide variety of services to government and industry in relation to insurance. Among the services advertised by the Insurance Services Office is a building code effectiveness grading. This appears to be a kind of independent audit of government building code enforcement. The idea is that insurance rates will be lower in jurisdictions with effective building codes and code enforcement. The Insurance Services Office provides contact information for offices in the U.K. and Israel, as well as the U.S. If their services are available in Georgia, this may prove to be a valuable resource for promoting effective government inspections. Their Web address is: http://www.isomitigation.com/bcegs/0000/bcegs0001.html (note that the Insurance Services Office uses the acronym ISO, however they are unrelated to the International Standards Organization discussed later in this memo).

While not replacing the need for government inspection, civil liability and insurance can play an important role in construction safety. In developed countries, civil liability and the insurance industry play a major role in preventing construction defects and jobsite accidents. In the U.S., almost all aspects of the construction industry are insured. Because insurance companies have to pay out claims when faulty construction causes damage or when workers are injured, they impose requirements on their insureds designed to minimize losses. They also increase premiums to contractors and professionals with bad safety records, giving the more competent a competitive advantage in the marketplace.

However, in order for insurance to have the desired effect, a number of complex issues must first be addressed. Numerous types of insurance applicable to construction projects are available. Numerous endorsements, exclusions, policy limits, and deductibles can make a given insurance policy valuable or useless in a given situation. Liability insurance coverage usually applies only where there is legal liability as defined by the civil liability statutes of the jurisdiction where the incident occurs. The insurance law of the jurisdiction also often controls whether or not a particular insurance policy will provide coverage in a given situation and controls the insurance company's duty to pay for lawyers to defend the insured against liability suits. Some efficient method of dispute resolution is also necessary to make insurance and civil liability provisions effective. Workers compensation insurance is a separate field with which I am not intimately familiar. I have included placeholder steps for workers compensation insurance to be fleshed out if consultation with a qualified workers compensation expert determines that it is feasible to pursue workers' compensation at this time.

In light of the above considerations, the steps involved in drafting civil liability and insurance legislation are: 1) hire short-term experts; 2) assemble outline of insurance and civil liability issues; 3) assemble stakeholder group; 3a) assemble outline of workers' compensation issues if GoG elects to pursue workers compensation at this time; 4) obtain insurance policy forms proposed by insurance companies; 5) experts review forms; 6) conduct stakeholder meetings; 7) expert drafts civil liability and insurance provisions based on outcome of stakeholder meetings; 8) GoG reviews draft; 9) revise per GoG; 10) circulate draft for wider comment from industry; 11) revise; 12) draft arbitration requirements if GoG elects to pursue this course; 13) define compliance measures for mandatory insurance; 14) GoG and short-term expert draft pamphlet explaining new law and draft short segment to be included in test for architects and engineers; and 15) upon approval by Parliament revise pamphlet if needed and distribute.

B. Hiring Experts.

GoG will likely need two short-term experts for this project. The main expert should be a lawyer from a jurisdiction with a mature construction industry insurance market. In addition to the lawyer, an insurance consultant should be on tap to support the lawyer. Suggested minimum qualifications are:

Construction Industry Lawyer: experience litigating liability issues in construction industry, litigating insurance coverage issues in construction industry, and experience with international commercial arbitration (if GoG elects to pursue arbitration as a dispute resolution mechanism). The Martindale website provides a search feature with areas of specialization for lawyers. http://www.martindale.com.

Insurance Consultant: Experience designing insurance-based construction risk management programs and purchasing insurance for the construction industry, and familiarity with premium structures. Familiarity with the design of workers' compensation systems optional, depending on whether GoG decides to pursue workers' compensation at this time.

C. The Owner Controlled Insurance Program ("OCIP") And Its Components.

1. The OCIP.

There are many different ways to go about providing insurance for a construction project. Traditionally, the project owner, subcontractors, design professionals, and other participants each had their own insurance policy. In recent years, the OCIP has been gaining popularity as an insurance product. Many construction industry participants and insurance professionals believe that the OCIP provides more control over losses at a lower price than traditional insurance. The main feature of the OCIP (sometimes called a "wrap" policy) is that the project owner purchases one insurance policy that covers all the insurance on the project.

Requiring or encouraging the use of OCIPs may turn out to be a good policy choice for GoG for a number of reasons. In writing an OCIP policy, the insurance company will usually review the qualifications of the entire construction team. The insurance company will either charge higher premiums or refuse to write the policy if it feels that key contractors or design professionals are not adequately qualified. This helps focus the owner/developer's attention on hiring well-qualified professionals and subcontractors at the earliest stages of the project. This insurance project team review may also serve as an interim control on the quality of architects and engineers while GoG develops more formal certification and licensing requirements.

Where insurance is obtained in the traditional manner, there are many insurance policies with different limits of coverage. How much coverage is provided may depend on which subcontractor caused the problem. In an OCIP, the highest limit applies to everyone, so a loss will likely not exceed the limits of the policy regardless of who is at fault.

The following sections discuss the component parts of an OCIP policy. In many insurance markets, these parts may be purchased separately if an OCIP approach is ultimately not used. The principles discussed should be applicable to insurance products available in Georgia, though they may occur in a different form under different names.

a. Commercial General Liability ("CGL").

The CGL component covers property damage and bodily injury. Whether or not a particular hazard is covered is a function of the wording of the CGL policy combined with the laws of the jurisdiction in which it is applied. CGL policies are often written on standardized forms. Much of the insurance industry uses standardized forms produced by the Insurance Services Office. http://www.iso.com.

Over the years, litigation over the various clauses of CGL or equivalent policies in various jurisdictions has determined what hazards are or are not covered under given circumstances. What is covered under an identically worded policy may be different in California than it is in New York or France. For this reason, it is important that GoG review the scope of coverage under the CGL (or equivalent policy provisions if Georgian insurers do not use CGL forms) and include legislation that addresses coverage for losses that GoG considers important but that might otherwise be in doubt.

Several aspects of exclusions and the scope of coverage are discussed below to provide a feeling for the types of issues that need to be addressed; however, this complex area should not be approached without the aid of a qualified lawyer and insurance expert.

i. Latent construction defects.

There are two types of construction defects: "latent" and "patent." Patent construction defects are those that are open and obvious. Latent construction defects are hidden and do not become known until the defect manifests itself by causing damage. Latent construction defects may not manifest themselves until many years after the project is completed.

Some jurisdictions interpret the CGL form not to cover latent construction defects at all because they do not manifest themselves until after the insurance policy in effect during construction has expired and are therefore not considered an "occurrence" during the policy period. Others interpret the CGL form to cover latent construction defects that cause bodily injury or property damage but not latent defects that cause only economic damage. An example of a latent construction defect that causes only economic damage would be an improperly installed balcony railing that deteriorates and has to be replaced when it is only four years old, but does not cause any injury and does not cause damage to any property other than itself. Many jurisdictions hold that this type of problem is best left to the contract and warranty between the buyer and seller and should not be the subject of insurance. On the other hand, if the deteriorated railing gives way and causes someone to fall, the injuries sustained in the fall would be covered as a personal injury. Likewise, if the railing gives way and falls onto a parked car in the street below, the damage to the car would be covered as property damage.

I recommend that latent construction defects that cause personal injury (or death) be covered by the policy in effect during construction. Latent defects that cause property damage should also be covered. I recommend against including purely economic losses, as these are best left to be sorted out in the market or through legislation that requires a warranty.

One common latent construction defect in Georgia is the failure of contractors to install reinforcing rods in concrete masonry units. This defect is latent because after the wall is constructed the defect is hidden. This defect will likely manifest itself in an earthquake when the lack of reinforcing allows the concrete blocks to fall from the building into the street below. Any injury or property damage resulting from the falling blocks should be covered in order to encourage insurance companies to police this issue and assure that the reinforcing is installed. This may require addressing the distinction between earthquake insurance, which is quite expensive and covers all damage caused by an earthquake regardless of fault, and damage caused by defects in construction that manifest themselves in an earthquake.

ii. "Your work," "your product," "completed operations hazard," and other exclusions and endorsements.

In addition to clarifying what is covered under the language of the basic policy, various endorsements to the form that expand coverage are also available and a dozen or so exclusions that limit coverage are common. The advisability of requiring any of the endorsements or addressing the exclusions should be considered in a systematic fashion by

GoG in conjunction with an insurance expert. For example, some insurance policies exclude coverage for property damage arising out of the insured's own work, referred to in policy language as "your work," or "your product." Other provisions exclude coverage for so called "completed operations." These exclusions can operate to deny coverage for property damage to the project caused by construction defects.

It is not yet entirely clear how the "your product," "your work," and "completed operations hazard" exclusions will be applied in an OCIP policy. Georgian legislation could clarify how these exclusions or their equivalents will apply.

A dozen or so other exclusions, of complexity equal to the ones discussed here, should also be addressed to verify that the requirement for mandatory insurance will indeed have the effect of policing the construction quality and safety issues that GoG wants policed.

b. Professional liability insurance.

Professional liability insurance covers damage caused by errors and omissions of design professionals, including architects and engineers. One advantage of having a single insurance policy for the whole project that includes all the contractors and the design professionals is the minimization of disputes over whether the problem was caused by a design error or an error in execution by the contractor.

Traditionally, professional liability insurance is purchased on a yearly basis by each design professional. Rates are adjusted by insurance companies according to the professional's loss history, the type of projects the professional works on, and the volume of work done.

In the U.S., OCIP policies typically include professional liability insurance for all the design professionals on the project. However, each design professional also has an "underlying" professional liability policy. The OCIP policy serves as an umbrella policy that increases the limit of the insurance dramatically. It would be interesting to find out if Georgian insurance companies would write an OCIP that includes professional liability insurance without underlying professional liability policies for each design professional. If so, GoG could consider the implications of requiring only the OCIP as opposed to requiring that each professional also carry underlying insurance.

Where professional liability insurance is not written on a project-specific basis, i.e., when a design professional obtains the policy on a yearly basis, the policy may be written on either a "claims made" or "occurrence" basis. This may mean that the design professional must not only have insurance in place while the project is being designed and constructed, but must also continue to carry insurance years after the project is completed and even into retirement to assure that some eventual catastrophe caused by a design error will be covered. The OCIP may offer an advantage here because the project policy could cover eventual losses due to design error regardless of the design professional's subsequent insured status.

c. Builder's risk insurance.

Builder's risk insurance typically covers natural disasters that occur during the course of construction as well as theft of materials from the jobsite. Builder's risk insurance is in force

only during construction and ceases when the building is completed. Depending on the structure of policies that Georgian insurance companies are able to write and the cost involved, builder's risk insurance might be left to the market.

Typically, banks that provide loans for construction projects are very interested in protecting the building from loss during the course of construction. As insurance becomes more commonplace in Georgia, lenders may require that developers procure builder's risk insurance as a condition of obtaining financing.

d. Workers' compensation.

Workers' compensation insurance is a specialized area of insurance law not specific to the construction industry. I am not intimately familiar with the details of workers' compensation insurance; however, some general observations may be useful.

Workers' compensation arose in the nineteenth century in Germany and soon spread to the U.K. and U.S. It is widely regarded as a highly desirable element in any industrialized society. Workers' compensation is designed to be a non-adversarial system of insurance. In exchange for being covered by workers' compensation, workers give up the right to sue employers when they are injured at work. Instead, workers are entitled to have their medical expenses paid and to receive money for living expenses during the period they are unable to work due to work-related injuries. There is no question of fault. If the worker is hurt while at work, he or she is entitled to the benefits of workers' compensation.

Workers' compensation sometimes involves large individual claims. A worker may be badly injured, requiring expensive medical treatment. Workers' compensation often provides for vocational rehabilitation and retraining of workers who must change occupations because injuries prevent them from returning to their customary occupation. If rehabilitation and retraining are not practical and the worker is unable to return to any kind of work, the worker may be provided benefits to cover living and medical expenses for life. These kinds of serious cases require extensive resources in the form of medical evaluation, rehabilitation centers, career guidance counseling, and similar services.

Workers' compensation also typically involves smaller claims. Sprains or strains may involve one or two visits to the doctor and a few days off work. These small claims do not involve complicated treatment but they consume significant administrative resources for processing because of their sheer numbers.

Because of the large number of small claims for minor injuries and the complicated nature of more severe injuries, in many jurisdictions workers' compensation insurance systems are supported by extensive government administrative agencies. The insurance itself is often provided by private firms, but government plays a significant role in keeping the system running.

I do not know if it is feasible to mandate some type of workers' compensation insurance in Georgia without significant ongoing government involvement. At a minimum, I would expect that a workers' compensation statute would be required to provide details of how the

system will operate. Discussions with the insurance industry and consultation with a workers' compensation expert will be needed to determine what is involved in implementing workers' compensation. It may turn out that the best course is to implement the other insurance provisions first, and then tackle a workers' compensation system as an independent project, perhaps extending beyond the construction industry. The Insurance Services Office advertises a number of services aimed at government, http://www.iso.com/products/0000/prod0051.html - consulting, and with regard to workers' compensation. http://www.iso.com/products/2100/prod2113.html. They may be able to help facilitate a workers' compensation system in Georgia or provide appropriate referrals.

e. Employers' liability insurance.
Employers' liability insurance picks up certain claims for injuries to workers where the employer is at fault in some way. If workers' compensation proves too difficult to administer at this time, employers' liability might provide a second best alternative.

f. Other insurance.
In conjunction with Georgian insurance companies, GoG may wish to consider a variety of other insurance products that may be available in the construction market. Attachment six is an article written by a construction industry insurance consultant discussing various forms of coverage available under an OCIP. Attachment seven is a brochure from a major insurance company advertising insurance products used in construction risk management.

D. Policy Limits And Deductibles.

Policy limits are also an important consideration. How much insurance should be required? If an OCIP is used, perhaps insurance in an amount equal to the value of the building or some percentage or multiple of the value of the building could be considered.

Deductibles may also be an important policy consideration. While encouraging insurance companies to impose discipline on the one hand, universal insurance may also paradoxically present a "moral hazard" by relieving those responsible for performing work from being held financially responsible for their own carelessness. Deductibles serve to correct this potential hazard by requiring the responsible party to pay the first increment of damages while the insurance company pays the balance. Higher deductibles also serve to reduce the premiums charged.

In considering the scope of coverage, policy limits, and deductibles, more coverage and higher limits will translate into higher premiums that are ultimately passed on to the consumer in the price of the finished product. Frank consultation with the insurance industry to avoid requiring a product that will be unduly expensive is advisable.

E. The Duty To Defend Should Be Broader Than The Duty To Indemnify.

Most insurance policies obligate the insurer to both defend and indemnify the insured. The indemnity provisions require the insurance company to compensate the insured for covered losses. The defense provisions obligate the insurance company to pay for an attorney to

defend the insured where the insured is subject to legal proceedings that could result in an award against the insured that would be covered under the terms of the policy.

At the outset of legal proceedings the outcome is unknown. It is possible that the insured may be exonerated. It is possible that the insured may be held liable for damages in such a way that the award is covered by the insurance policy and the insurance company must pay rather than the insured paying out of pocket. It is also possible that the insured may be held liable in a way that puts the award beyond the coverage of insurance. For example, if during the course of litigation it is proven that the insured *intentionally* set fire to the building causing injury to others, there would be no coverage, whereas if the insured had started the fire by accident, there would be coverage.

In all of the situations described above, the insurance company should have a duty to pay for the insured's defense so long as there is a claim or defense that *could* bring the ultimate outcome of the litigation within the coverage of insurance.

The duty to defend is broader than the duty to indemnify in just this way in many jurisdictions because avoiding the cost of litigation provides an incentive for insurance companies to settle valid claims at an early stage. Over the years, insurance companies have launched various attempts to limit the duty to defend and many jurisdictions have responded through judicial opinions or legislation confirming that the duty to defend is much broader than the duty to indemnify.

F. Compliance Measures For Mandatory Insurance.

In order to enforce the requirement that construction projects be insured, GoG can add to the list of documents required to obtain a construction permit a certificate of insurance issued by the insurance company stating that insurance is in effect and stating the limits, deductibles, and other relevant information needed to show that the insurance meets all requirements.

In order to assure that insurance remains in place throughout the project, at each inspection stage as defined by the draft resolution "On Making Changes and Amendments in Resolution N140, 11.08.2005," a further certificate attesting that insurance remains in force could be required. A final certificate could be required as part of the documentation required for putting into use.

Requiring these certificates would give the insurance companies leverage to enforce safety and quality requirements. If a developer refused to comply with the insurance company's request to improve safety or correct faulty construction, the company could rescind the policy. If the developer is unable to obtain the continuing certificate from the insurance company at the inspection stages or putting-into-use stage, the developer cannot register the project.

G. Civil Liability

1. The need for a civil liability legal framework.

In some instances insurance policies come into play simply because there has been a covered loss. For example, if there is a theft from a jobsite the insured need only make a reasonable showing that the goods were indeed stolen and provide evidence of value. No one need be convicted of the crime. However, where professional liability or CGL issues are involved, insurance coverage usually applies only where there is legal liability. This means that there must be some legal framework that defines who is liable for what to whom.

In jurisdictions with long construction industry liability experience, there are statutes that provide a framework for determining liability. In common law jurisdictions, case law fills in the framework with many determinations that provide answers as to liability in specific situations.

Drafting of civil liability statutes should be undertaken in a systematic fashion by looking to jurisdictions with mature construction markets and outlining the issues that arise with respect to liability in the construction industry. Restatements of the law or practice guides may provide a more concise and clear statement of the principles used by various jurisdictions to determine liability rather than looking to civil codes or case law directly. A number of policy choices will arise with regard to the scope of liability. Liability rules that are too sweeping will eventually raise the cost of insurance and of doing business beyond the benefits derived. Liability rules that are too weak will fail to provide the desired incentives for increased safety and quality.

The following sections are intended to demonstrate the need for a civil liability framework and highlight some issues that should be considered in a more comprehensive manner when drafting liability rules.

2. Establishing who is liable to whom for what.

i. Who is liable ?

<u>Broad liability for developers of for-sale residential units?</u>

One trend is to hold the developer broadly liable for almost any failure even if it is directly caused by one of the contractors or design professionals.

In considering developer liability, a distinction is often drawn between the situation where the "developer" is the end-user and where the developer is producing a product for sale to others. For example, where a sophisticated corporation contracts for a new factory or office building for its own use, it is not a developer in the same sense as the company that arranges for the construction of an apartment building where the units will be sold to ordinary consumers.

Where a developer purchases land, arranges financing, and provides for construction of multiple units and then sells the units individually to consumers, the incentives are to hold costs down and sell the units as quickly as possible. On the other hand, where a corporation arranges for the construction of its own headquarters, the incentives are to control costs but

also to assure quality and long-term serviceability. Over the long term, market forces do reward developers of residential units who pay attention to quality and long-term customer satisfaction. However, short-sighted behavior on the part of a significant number of developers of residential units has led many jurisdictions to recognize the need for liability rules specific to developers of for-sale residential units.

In California, for example, a developer is held to very broad liability for "damages arising out of, or related to deficiencies in, the residential construction, design, specifications, surveying, planning, supervision, testing, or observation of construction . . . ." Cal. Civ. Code § 896. Each contractor, subcontractor, and design professional is also liable for damages arising out of failures in their portion of the work. However, the developer has control over the size and location of the project, and the selection of the general contractor and design professionals. The developer also makes cost-benefit decisions regarding committing resources to a safer design balanced against the need to control costs. It is thought that holding both the developer and architect (or engineer) liable for design errors gives the developer an incentive to seek out qualified design professionals. Likewise, holding both the developer and respective contractors liable for errors in execution gives the developer an incentive to exercise control over the selection and supervision of contractors.

General contractors are also often held to be liable for failures of subcontractors who are under the general contractor's control or supervision.

Developer attempts to avoid liability

Disputes often arise as to how financial responsibility for an accident or failure is apportioned between developer, general contractor, and subcontractors. Typically, a general contractor or developer, while 100% liable, can recover from subcontractors the share of damages attributable to the subcontractor's fault.

In jurisdictions where general contractors and developers are held liable for the failures, regardless of whether they were directly responsible, they often insert indemnity provisions into subcontracts. These provisions make the subcontractor responsible for indemnifying the general contractor or developer for 100% of any loss associated with the subcontractor's work, even if the subcontractor is only 1% responsible for the accident. In this way developers attempt to get around the provisions of law that make them financially responsible. Some jurisdictions do not give effect to such clauses because they run contrary to the public policy reasons for making the developer liable in the first place. Other jurisdictions hold them to be valid as a matter negotiated between parties to a business transaction. If broad insurance coverage is in place through an OCIP this tangled area may become less important because the loss will be paid from the same insurance policy regardless of how it is apportioned between the various contractors.

Another tactic used by residential developers to avoid liability centers on disguising the identity of the real party in interest behind the project. Some developers put a project together and then transfer control (at least on paper) to a shell homeowners association before construction begins or at an early stage of construction. The consumers who purchase the apartments all become members of the homeowners association, and on paper they are the

developers of the project. In reality, the homeowners have no real control over the project. Courts and legislatures often deal with this problem by looking through the form of the transaction to its substance. The individual or company that actually makes the development decisions and profits from the project is the developer in fact, and should not escape liability through paper transactions.

ii. For what?

There are two aspects to the "for what" question. The first is which of the three types of damages (personal injury, property damage, and purely economic loss) are compensable? The second is what constitutes a breach of duty that gives rise to liability?

Which type of damages are compensable?

Personal injury should always be compensable. If a building is built in an unsafe manner and someone is killed or seriously injured as a result, those responsible should be held liable.

Property damage is usually compensable. If the excavation for the foundations of a new building causes subsidence that damages neighboring buildings (but injures no one) the owners of the neighboring buildings should be entitled to compensation (note, however, that excavation may be excluded from coverage in some insurance policies). A closer question arises when failure in one part or component damages another part or component of the same building. For example, if windows in an apartment building are not correctly installed and over time rain penetrates into the structure damaging electrical wiring inside the walls, this may be subject to civil liability or may be left to the contract/warranty between the developer and consumers, depending on the jurisdiction.

Finally, purely economic loss is usually not compensable. In the leaking window example, if the only damage is the cost of repairing the window itself, most jurisdictions leave this to the market to sort out through contract and warranty provisions.

The issue of whether there is liability for property damage or economic loss is not identical to the issue of whether there will be insurance coverage for these losses. If both liability and coverage are desired, both should be addressed.

What constitutes a breach of duty?

Sometimes building failures happen that cannot be reasonably foreseen or guarded against. For example, hurricane-force winds may blow out windows causing injury or death. People may panic during a fire and be unable to find their way out of a building. Should a developer be liable if a building fails to safely withstand winds of 150 KPH? 100? 50? Should a developer be held liable if exit signs clearly marking the escape route in a fire are provided but not designed to be independently lit at night?

Technical standards approach

The first step in answering questions like these is often to determine if the building as designed and constructed meets the requirements of the relevant technical standards. The structural integrity sections of modern building codes provide extensive information on how much wind resistance is required for various types of buildings. Likewise, modern fire codes

provide detailed requirements for the design, location, and lighting of exit signs. If the requirements of the relevant technical standards have not been satisfied, liability should usually attach.

Standard of care approach

Another avenue to determining liability is the "standard of care" approach. Here, the question is whether the contractor or designer exercised the standard of care that is customary in the industry for the issue in question. In this inquiry, the technical standards (and safety rules) serve as an important component in determining whether the standard of care was met. Failure to conform to technical standards will almost always be a prima facie showing of failure to meet the standard of care. However, in some instances complying with the technical standards alone will not be enough to escape liability. Although modern technical standards are quite comprehensive, they cannot cover every conceivable situation and some independent judgment on the part of designers and contractors is required.

Strict liability approach

Finally, some jurisdictions hold the construction industry to a strict liability standard in specified circumstances. If a building component fails and kills someone, the relevant contractor or professional will be liable. In this kind of situation, plaintiffs' attorneys often refer to the "standard of care" approach as the "everyone does it" defense. This reflects the feeling that if meeting the standard of care relieves one of liability there is no incentive for the industry to improve or correct widespread dangerous practices. Strict liability generally applies where a building component fails and injures someone under reasonably foreseeable conditions of use.

iii. To whom?

Reasonably foreseeable damaged party

Except where specified categories of plaintiffs are excluded, liability will generally attach where it was reasonably foreseeable that the person who is complaining of injury would be damaged by the defendant's culpable acts or omissions.

3. The matrix approach.

The issues addressed in 2(i)–2(iii) above may be approached as a matrix. For example, a stricter standard of liability may apply where the damages are in the nature of personal injury. Less severe damage, such as purely economic loss or property damage, might become compensable only where there is gross negligence or intentional misconduct.

4. Government civil liability.

The government itself often acts as the developer of large infrastructure projects such as roads and bridges. In many jurisdictions the government is not subject to civil liability under the principles of sovereign immunity. Some jurisdictions expressly waive sovereign immunity in limited circumstance to allow themselves to be sued. This is one mechanism whereby legislatures and executive branch policymakers seek to impose discipline on the executive branch. Where sovereign immunity is waived, different standards usually apply where the government is a defendant, making it more difficult to prove liability against the government than against a private party. If Georgia's constitution permits it and GoG does wish to grant a

limited waiver, the extent of liability and standards that apply to the government should be specified separately. If no waiver is desired, an express statement that the government is not subject to civil liability may be advisable, depending on whether or not the constitution or other statutes are already dispositive on the issue.

G. Compliance Measures For Civil Liability: Arbitration, Arbitration Clauses And An Arbitration Law.

1. Arbitration and the importance of a reliable dispute resolution process.
Disputes among parties as to the existence and extent of liability for damage in a construction context in a given case are quite common. Disputes as to whether or not insurance coverage applies under the terms of a particular insurance policy to a particular loss are also very common. In order for insurance and civil liability provisions to fulfill their intended function of encouraging safe workplaces and sound construction practices, there must be some reliable form of dispute resolution. In addition to handling actual disputes, the existence of a robust dispute resolution process serves to put all parties on notice that those responsible will be held accountable, thus encouraging parties to avoid losses and insurance companies to implement loss control measures.

In international disputes involving construction projects, commercial arbitration is the universally preferred method of dispute resolution. In the domestic context, resolution of construction disputes through arbitration is also very common as is dispute resolution through the courts. In developed countries with a long tradition of fiercely independent courts, arbitration is still thought to offer significant advantages over courts in certain circumstances. For example, the Federal Arbitration Act makes it national policy in the U.S. to encourage the use of arbitration, rather than the court system, in certain categories of disputes.

GoG could consider, in light of the present capacity of the Georgian court system, whether some system of arbitration should be specified for resolution of disputes as to either or both civil liability and insurance coverage in the construction industry context. Arbitration offers a readymade, efficient means of commercial dispute resolution. However, the presence of an independent and robust judiciary is essential to the success of all democratic societies. The specification of arbitration in a commercial context should not distract from the need to continue development of an independent judiciary.

I have provided below the key points that should be considered if arbitration is to be adopted as a dispute resolution mechanism for the construction industry. However, GoG is in the best position to judge the feasibility of the court system as a reliable and efficient means of dispute resolution in the near term. If the court system can provide an efficient and reliable means of dispute resolution in the near term, then arbitration can be optional where it is agreed to by parties to a contract.

2. Arbitration can serve as a readymade and efficient dispute resolution mechanism.
A number of international organizations provide readymade systems of commercial arbitration that include administration of the arbitration process, rules of procedure, and a pre-approved pool of arbitrators. In order to make it onto the list of approved arbitrators,

individuals must demonstrate to the arbitration organization their competence and neutrality. The cost of conducting an arbitration is paid for by the parties to the dispute according to pre-arranged fee schedules.

Among those organizations that provide arbitration services, the International Chamber of Commerce (http://www.iccwbo.org/court/english/arbitration/introduction.asp), the Arbitration Institute of Stockholm (http://www.sccinstitute.com/uk/Home), and the London Court of International Arbitration (http://www.lcia.org) are well-established and highly respected European institutions. The American Arbitration Association (http://www.adr.org) specializes in arbitration of construction industry disputes. Most of its activities are domestic, but it has been expanding into international practice in recent years.

Some of these institutions can provide their own rules of procedure or an independent set of rules can be selected to be applied by the institution. The United Nations has developed a set of arbitral rules known as the United Nations Commission on International Trade Law rules ("UNCITRAL") that is often specified (http://www.jus.uio.no/lm/un.arbitration.rules.1976). The American Arbitration Association has developed a set of procedural rules specifically for construction industry disputes (http://www.adr.org/.construction). Other sets of well-established arbitration rules are also available, or "ad hoc" rules can be created.

A pool of approved arbitrators can be provided by the arbitration institution that is administering the arbitration, or arbitrators can be selected from other well-respected organizations that maintain highly selective international rosters of arbitrators, such as the Milan Club of Arbitrators and London Club of Arbitrators.

The international arbitration organizations mentioned above are geared toward resolving disputes that cross international borders. However, they will accept jurisdiction over purely domestic Georgian disputes.

In addition to providing an efficient means of dispute resolution, a further goal of instituting commercial arbitration through one or more of the internationally recognized organizations would be the inclusion of Georgians on the lists of approved arbitrators. Arbitration of significant disputes is often conducted by a three-member arbitration panel. Perhaps an agreement could be fashioned that provides for one or more arbitrators to be selected from a pool of Georgian lawyers and business people. Membership on the list of arbitrators would project citizens of Georgia into positions of international prominence, increasing contacts with the international legal and business community and could lead to the development of stable arbitration institutions in Georgia.

It should be noted that Georgia is signatory to the United Nations Convention on the Recognition and Enforcement of Foreign Arbitral Awards ("1958 New York Convention"). Arbitration awards rendered in Georgia with regard to domestic disputes between private parties, therefore, may be enforceable in foreign courts.

3. Arbitration clauses.
Arbitration is invoked by one or more of the parties to a dispute by giving notice to the other parties and the specified arbitration organization. The authority for invoking arbitration comes from an arbitration clause in the contract between the parties. If there is not a validly drawn arbitration clause in the contract, the arbitration organization will not assume jurisdiction. One approach to instituting arbitration for construction disputes in Georgia would be for GoG to include in its mandatory insurance law a provision requiring that insurance policies written pursuant to the law contain an arbitration clause. The construction code could also include a provision requiring arbitration clauses in certain classes of contracts between developer, architects, general contractors, subcontractors, and purchasers of mass-produced residential units.

Arbitration clauses are brief, usually a paragraph or two. They are also crucially important. An arbitration clause should specify the place of arbitration, the governing body of substantive law, the procedural rules governing the arbitration proceeding, the arbitration organization, the list from which arbitrators will be chosen if different from the list maintained by the arbitration organization, the place of arbitration and the language in which the arbitration is to be conducted, and the types of disputes subject to arbitration (e.g., "all disputes arising out of this contract" or "all disputes arising out of this contract concerning property damage and where more than $250,000 is at issue," etc.). Model arbitration clauses are available from the major arbitration organizations.

4. The law of arbitration.
If not currently in place, domestic legislation defining the role of arbitration should also be considered. The aspect of arbitration law that most significantly defines the character of arbitration is the specification of recourse to appeal an arbitration award in the courts. Many countries severely limit any appeal of an arbitration award in the court system. In the U.S., for example, an arbitration award cannot be challenged on the basis that it was wrongly decided. Even if the arbitrators make an obvious mistake of law or fact, the award stands. Generally, arbitration awards in the U.S. can be challenged in U.S. courts only if the arbitrators exceed the authority granted by the arbitration clause, or if there is evidence of fraud.

The law of arbitration should also specify the role of the courts in enforcing arbitral awards. Generally, courts are obligated to convert arbitration awards into judgments so long as the award was entered pursuant to a contract with an arbitration clause. The judgment can then be enforced through attachment and other means ordinarily used to collect judgments.

5. Arbitration and third parties.
Arbitration will not be applicable to third parties not signatory to the contract. For example, visitors to an office building or persons passing by who are injured by a construction failure or accident cannot be required to participate in arbitration.

IV
CERTIFICATION/LICENSING OF ENGINEERS AND ARCHITECTS

A. Overview.

Worldwide, engineers and architects are the most frequently licensed professionals participating in the construction industry. Most countries have some licensing or registration requirements for architects. The specific requirements vary by country. Regulation of the practice of civil engineering also varies by country. For example, the U.K. apparently does not require licensure for the practice of civil engineering but only licensed engineers may use certain titles in the U.K. Currently, Georgia has no requirements for the licensure, registration, or practice of architecture or engineering.

Georgia's construction code makes the role of the architect central in coordinating and carrying out the design and construction process. The practice of architecture also implicates a number of life-safety functions including some structural decisions and the fire safety of buildings. Engineers' roles are also crucially important to life-safety considerations, such as assessing the stability of soils or determining the amount of reinforcing required in a concrete structure. This division of authority between architects and engineers is similar to practices in the U.S.

In the U.S. all architects and engineers must pass an examination before they are qualified to place their stamp on plans. Safety review of building design is carried out by government, but the stamp of the registered architect and engineer on a set of plans forms the bulwark of safety and structural integrity protections and a building permit may not be issued without it. GoG has indicated the desire to move in a similar direction. Because of the importance of the architect's and engineer's stamp in this system, I would recommend that a test for both engineers and architects be required for certification. For a worldwide survey of architectural educational/licensing/registration/testing requirements and certification bodies, see http://www.coac.net/internacional/praprof_w.htm. This website provides a great deal of useful information about the practice of architecture in many countries by clicking the link for each country and scrolling all the way down the page. Contact information is provided. It should be noted that a number of developed countries in the survey do not require a test for architects and some have no certification requirements at all.

In addition to testing, most jurisdictions require a degree from a government-recognized, accredited educational institution and some require a period of practical experience under the supervision of a licensed professional (often 3 years). The educational requirement plays a prominent role. In some jurisdictions, a degree from an accredited institution is the primary (or only) requirement for registration or licensure.

Several of the architects and engineers interviewed expressed the opinion that Georgia's educational programs for architects and engineers needed to undergo a substantial process of improvement in order to be ready for internationally recognized accreditation. There appears

to be significant support in the architectural and engineering community for an effort aimed at improving educational programs. The quality and resources of educational institutions are fundamental to reaching the long-term goal of developing internationally recognized engineering and architectural institutions in Georgia. It is beyond the scope of my assignment (and beyond my area of expertise) to make an independent assessment of the status of Georgia's educational programs for architecture and engineering. GoG and USAID may wish to pursue available avenues for evaluation and development of institutions of higher education engaged in training architects and engineers.

Until educational evaluation and reforms can be undertaken, I believe a training, testing, and certification process tied to implementation of new technical standards for building design can be developed. In the sections that follow, references to a number of commercial resources for standardized tests as well as test preparation and administration services are provided.

The references are by no means exhaustive and better-suited firms might be found with further research. It is possible that one of these firms could efficiently develop a complete preparation and testing program for GoG. Commercial testing firms make a living from the fees they charge candidates for test preparation and administration. Using one of them may turn out to be a market-based approach to implementing testing requirements at little cost to GoG because the firms may be motivated by future fees from test takers. A range of innovative contractual arrangements with such firms might be negotiated.

On the other hand, GoG/USAID will have a long-term expert on board for developing the technical standards and Georgian construction industry stakeholders will be at work on subcommittees. I do not believe it would be a great leap for the crew working on the technical standards to proceed directly to locating and adapting educational and testing materials as well.

As the process unfolds, likely a comfortable balance will be found to implement the following steps as between turn-key solutions offered by commercial testing firms and development/adaptation by GoG working in conjunction with USAID and the stakeholder committees. In any event, input will be required from the stakeholders so that approved tests will be useful in weeding out those who should not be in practice but will be calibrated according to reasonable expectations. A full spectrum of testing is discussed below. GoG may decide to adopt some or all of the test segments discussed after exploration of resources, consultation with stakeholders, and due consideration. A phased implementation of test segments might also be considered.

The steps required to implement certification/licensing requirements for engineers are: 1) develop/locate study materials and test segment to measure overall familiarity with new technical standards; 2) develop/locate study materials and test segment to test proficiency in engineering fundamentals; 3) develop/locate study materials and test segment to test proficiency in general engineering practice; 4) develop/locate study materials and test segment to test proficiency in specialized engineering practice; 5) develop study materials and test segment(s) for legal and business issues, covering civil liability and insurance, permit application and putting into use, and safety rules; 6) provide a transition period during which

all engineers must pass the test; 7) maintain a register accessible by local government and the public showing which engineers have passed the test and are thereby qualified to place their stamp on plans; and 8) define compliance measures.

The steps required to implement certification/licensing requirements for architects are: 1) develop/locate study materials and test segment to measure overall familiarity with new technical standards (this can be the same as the engineer's segment); 2) determine which test segments to adapt from the Architectural Registration Exam (or other architectural licensing test) and adapt them; 3) develop study materials and test segment(s) for legal and business issues, covering civil liability and insurance, permit application and putting into use, and safety rules (this can be an in-depth version of the segments for engineers); 4) provide a transition period during which all architects must pass the test; and 5) maintain a register accessible by local government and the public showing which architects have passed the test and are thereby qualified to place their stamp on plans.

B. Hiring Experts To Develop Certification Requirements For Architects And Engineers.

I believe the test and study materials for engineers can be developed by the long-term expert and subcommittees working on the technical standards in conjunction with commercial test preparation companies and/or borrowing from existing materials.

Developing the test for architects may prove more difficult, and, depending on the approach taken, GoG/USAID may decide to retain an additional short-term expert when the time comes.

Expert qualifications: If an additional expert is determined to be necessary the minimum suggested qualifications are: 1) licensed to practice architecture in the country of the base test; 2) portfolio of substantial experience as a design professional; 3) active in home country professional association; 4) international affiliations; and 5) experience in developing countries.

C. Training And A Test Segment For Architects And Engineers Testing Overall Familiarity With The New Technical Standards.

Training and a test segment measuring overall familiarity with the new technical standards will serve a dual purpose. It will serve to provide a basis for certifying professionals and will serve to implement the new technical standards by assuring that all design professionals are familiar with them.

A series of one or two-day seminar courses or self-study materials may be developed to prepare architects and engineers for testing in overall code application. Commercially prepared study materials and tests designed to measure familiarity with the requirements of various building codes are available. The International Code Council provides materials designed to educate and test professionals on the requirements of their codes. Pre-packaged seminars aimed at architects and engineers are available from ICC by contract.

http://www.iccsafe.org/training/contract-ae.html. They also advertise specialized training packages tailored to meet customers' needs. http://www.iccsafe.org/training. ICC may be able to tailor a seminar series taught by a civil engineer to GoG's needs. A number of short seminar courses appear to be available for training in the Eurocodes from academic and commercial sources as well. http://www.imperial.ac.uk/cpd/seismic/index.htm, http://www.tttrain.co.uk/courses/coursedetails.asp?COURSE_ID=273-1, http://www.eurocode2.info/main.asp?page=1216.

This segment would be aimed at currently practicing professionals and new graduates who had completed several years of apprenticeship.

D. Fundamentals And Practice Segments For Engineers.

1. Fundamentals.
All applicants are required to pass the fundamentals test. This is an academic test. It covers the basic building blocks of engineering, such as math, physics, chemistry, and computer skills. Attachment eight is the specifications for the fundamentals test produced by the U.S. National Council of Examiners for Engineering and Surveying.

2. General practice of engineering.
All applicants are required to pass the general practice test. This portion tests knowledge of the general application of engineering principles in real-world situations. It is not expected that applicants can pass this test until they have several years of practical experience. Attachment nine is the specification for the general practice test.

3. Specialized practice of engineering.
Each applicant selects one of a number of specialized areas for the final, in-depth, portion of the examination. The in-depth areas relevant to the construction industry include structural engineering, geotechnical engineering, and environmental engineering. Again, it is not expected that the applicant can pass this test until they have several years of practical experience. Attachment ten includes the specifications for the tests for these three areas of specialization. Specifications for other areas of specialization are available at http://www.ncees.org/exams/professional.

4. Developing study materials and tests for the fundamental and practice segments.
A degree in engineering should prepare the applicant to pass the fundamentals test. If educational reforms are undertaken, the fundamentals test could be administered as an exit exam, prerequisite to a degree in engineering, by the university. In the meantime, many commercial test preparation services produce "review" courses and practice examinations that can fill gaps left in a student's (or professional's) academic preparation. These study materials are produced by the American Society of Civil Engineers ("ASCE") in conjunction with the Kaplan test preparation company's dedicated engineering preparation and testing unit. http://www.kaplanaecengineering.com/kaplanAECengineering/home.aspx. Kaplan has worldwide offices, including a branch in Istanbul. I would not expect this segment to vary regardless of which set of technical standards is selected, as basic math, physics, and chemistry should be universal.

Practice materials and standardized tests for the general and specialized practice segments on U.S.-based engineering exams tied to the IBC are also available. See the ASCE website to download a catalog of practice materials covering the fundamentals, general practice, and specialized practice segments: http://www.asce.org/pdf/peexamreviewss.pdf. Additional commercial sources of engineering test preparation materials are Red Vector and Professional Publications Inc. http://www.redvector.com/web_store/exam_prep.asp. Examples of some of the commercially available test preparation materials for engineers were previously provided to USAID/GoG in hard copy.

Further investigation will be required to determine if similar materials are readily available for use if the Eurocodes are selected.

5. Legal and business requirements.
Various portions of the construction code, the building permit application process, the putting-into-use process, and civil liability and insurance requirements do or will affect engineers. Engineers should also be familiar with the new safety rules. A short test segment on these areas may be included. This would be a rather brief section. I believe this can be prepared by GoG in conjunction with USAID staff in relatively short order using the training sessions that are currently being conducted by GoG/USAID for local officials as the base.

E. Test Segments For Architects.

The U.S.-based Architectural Registration Exam ("ARE"), prepared by the National Council of Architectural Registration Boards, contains nine segments: pre-design, general structures, lateral forces, mechanical and electrical systems, building design/materials and methods, construction documents and services, site planning, building planning, and building technology. Portions of this test are closely tied to the IBC.

In addition, the central role of the architect in permit application and project administration makes thorough familiarity with Georgia's permit application process, the staged inspection process, and the putting-into-use process important areas for testing. These areas should be covered in more depth for architects than engineers.

A number of segments on the ARE test deal with aesthetic and social concerns, and others focus on building technology beyond structural and life-safety issues. All of these areas are important and should ultimately be included in the requirements for architectural licensing. For example, some of the concerns expressed in my memo of July 10, 2006, with honoring public space, planning buildings to respect neighborhood scale, and site selection that considers impacts on infrastructure are addressed by the ARE. Determinations can be made as to which sections are feasible to include at this time and which segments might await future implementation.

Study guides and practice materials are available for the ARE from the Architectural Registration Board. http://www.ncarb.org/publications/arestudyguides.html. Commercial test

preparation companies also provide materials and services to teach the ARE. http://www.kaplanaecarchitecture.com, http://ppi2pass.com/ppi/PPIShop_psp_MV708.

Portions of the ARE are tied to the IBC. If the Eurocodes are selected and the ARE proves to be unwieldy for adaptation to the Eurocodes, the catalog of European architectural certification bodies may provide a source of alternative base examinations. http://www.coac.net/internacional/praprof_w.htm.

Because of the broad scope of an architect's responsibilities, I have not been able to delineate the components of a test in the same concise fashion as was possible for engineers. If GoG elects to limit the test for architects to structural, life-safety, and administrative areas, it can probably be developed by the technical standards committees expanded to include additional architects for this task. If broader design and social concerns are included, an additional short-term expert may be desired. In the timeline, I have included both an additional short-term expert to help delineate the test and augmentation of the working group to include architectural representation. As the time approaches GoG/USAID can decide how best to approach the task, including the role of commercial services.

F. Test Administration And Record Keeping.

A number of private sector firms specialize in administering professional examinations. These firms usually handle the entire process, from registration to keeping records of results. The firms charge a fee to test takers to cover the cost of exam administration. This approach is probably the most cost-effective and trouble-free way for GoG to administer exams. One firm advertising international test administration services can be found at http://www.ptcny.com/PTC/AboutPTC.html. This firm also advertises services for developing certification and licensure programs. Among the tests they currently administer are several tests for construction industry certifications. http://www.ptcny.com/clients/AICCCC. Several firms should be evaluated before making a decision.

G. The Role Of Professional Self-Regulation In Testing And Licensing Architects and Engineers.

In most developed countries, professional self-regulation is the norm for architects and engineers. Although the state may adopt educational, testing, and other licensing requirements, these requirements are usually developed by professional associations. The state generally shows great deference towards professional associations in promulgating requirements that are developed by the associations.

To the greatest extent feasible, professional associations, members of the professions, various institutes, educational institutions, and all other organizations interested should be included as stakeholders in developing and implementing testing and licensing requirements. The ultimate goal should be to devolve the bulk of the ongoing responsibility for policing the professions to professional self-regulation. Currently, Georgia's professions and their institutions are undergoing a dynamic transition from Soviet norms to a market-based way of

thinking. The pace at which full responsibility can be delegated to the professions depends on the development of broad-based professional organizations capable of accepting the responsibility.

Involving a wide variety of individuals and organizations in the development of licensing and testing requirements (as well as development of new technical standards) can serve to galvanize interest in professional organizations while providing valuable input on content. A more general delegation of authority to professional organizations in the future should evolve from the cooperative development of the technical standards and licensing and testing requirements.

H. Compliance Measures.

After the transition period is complete, only licensed architects and engineers will be authorized to place their stamp on plans submitted to obtain a building permit. Without the stamp of a licensed architect and engineer, the permit cannot be issued.

V
SAFETY REVIEW OF BUILDING DESIGN

A. Overview.

GoG has decided to transfer the function of "state expertise" review of building design for structural integrity and a number of other factors to the private sector. I recommend that the non-life-safety matters previously reviewed by the state expertise agency, such as the cost of the building and its impact on cultural resources, not be continued in the private sector review. These issues are either best left to the market or are already reviewed by other government agencies, such as the Ministry of Culture.

GoG wishes to abolish the state expertise government agency immediately and has requested recommendations for establishing a temporary transitional private expertise function as well as a more substantial permanent private expertise function. The steps required to implement private expertise are: 1) define requirements for organizational competence; 2) define requirements for professional competence; 3) define requirements regarding conflict of interest; and 4) define compliance measures tied to issuance of building permits.

B. Considerations For Certifying Private Expertise Firms.

1. Organizational competence.
Organizational competence addresses the efficiency of a *firm's* business processes. A competent organization has up-to-date computer systems with internet access and email, telecommunications, fax, and other office equipment. In the architectural and engineering fields, competent organizations would have up to date engineering and architectural systems, such as Computer Aided Design ("CAD") software and hardware. Office procedures should be in place to ensure that files are properly indexed and stored with off-site backup for crucial files. Systems should be in place to assure that project files are retained for a significant

period of time. Accounts should be kept on a sound bookkeeping system according to generally accepted accounting procedures so that audits can be performed if necessary. Other measures of organizational competence found in architectural and engineering firms may occur to Ministry of Construction personnel and should be added to the list.

Organizational competence is easier to measure and verify than professional competence. Organizational competence does not translate directly into professional competence; however, it does demonstrate basic aptitude and is likely to co-occur with professional competence. It also demonstrates the presence of a substantial, well-established organization.

2. Professional competence.
Professional competence addresses training, knowledge, skill, and practical experience of the *individual* in a professional discipline. The professional competence of architects and engineers is measured by their formal education and degrees, continuing education, ability to perform on standardized tests, apprenticeship, portfolio of experience as the responsible designer of various projects, and reputation among clients and other members of the profession.

Individuals may possess professional competence but not organizational competence. For example, a talented semi-retired engineer or engineering professor may have a great deal of talent and experience but not have the facilities to keep books and files in the way required. Competent organizations can hire or contract with such individuals so their talent is harnessed while the organization assures that professional business processes stand behind the expertise.

3. Conflict of interest.
Firms performing private expertise should have no conflict of interest with regard to the project being assessed. The private expertise firm should have no financial interest in the project, nor should they have any current financial relationship with the proponents of the project other than the fees paid for the private expertise. Principals of the private expertise firm should not be immediate relatives (spouse, sibling, parent, grandparent, child, grandchild) of any of the principals of the proponents of the project.

The large architectural and engineering firms currently designing projects in Georgia are likely to have the greatest organizational and professional competence. This brings up the question of whether firms actively engaged in the design of projects should be allowed to perform private expertise. Obviously they cannot perform private expertise on projects that they have designed, but should they be allowed to perform private expertise on projects designed by their competitors?

I believe that so long as the firm has no current financial relationship with the project proponent they should be allowed to perform private expertise. Perhaps a “revolving door” requirement would also be appropriate. For example, an architectural or engineering firm or individual could not perform private expertise for a project proponent who had been a client of the firm’s or individual’s design services within the previous year.

Other requirements to avoid impropriety could also be considered. Perhaps a requirement that fees be charged on an hourly basis, with documentation of hours spent, rather than in a lump sum amount or as a percentage of project value,would discourage buying approval rather than buying an honest appraisal.

C. Requirements For Permanent Certification Of Private Expertise Firms and Professionals.

1. ISO Certification Of Organizational Competence.
ISO certification of business processes is internationally recognized and will assure that the private expertise firm has sound business processes. ISO 9000 is a family of business process certification standards. I believe that the appropriate certification for architectural and engineering firms would be ISO 9001-2000. Many individuals and firms specialize in ISO consulting services. A brief telephone consultation should be sufficient to confirm which standard should be specified.

It may take a year or more for a firm to implement procedures compliant with ISO 9000 standards. I visited one engineering firm in Georgia that currently has ISO certification and I believe there is one other engineering firm currently ISO certified as well. Keeping this in mind, GoG can determine a date by which all expertise firms must have ISO certification.

In addition to the initial certification, there is a periodic ISO review process required to keep the ISO certification in force. This should be required as well. The International Standards Organization publishes the standard by which business processes are measured; however, it does not perform the certifications. Third-party certification firms actually conduct the examination of the organization and issue the certificate. A brief conversation with an ISO consultant should reveal any considerations regarding third party certification firms.

2. Professional competence.
a. Education.
An advanced degree should be required, with a Ph.D. for individuals conducting private expertise on the highest risk category of projects. Eventually, a degree from an institution with internationally recognized accreditation should be required.

b. Experience.
Individuals conducting private expertise should have a minimum of ten years of practical experience. As the category of risk of the project the individual is qualified to review increases, the length and quality of experience required should be enhanced. An individual should have substantial experience with the category of project (or above) being reviewed. The individual should be required to submit a portfolio describing at least 5 projects he or she has performed substantial design services on, with contact information for the project clients.

c. Professional license or certification.
The individual carrying out private expertise should have a certification or license in the relevant discipline. For example, soils expertise requires an engineering license with a specialization in geo-engineering. The proposed requirements for licensing of all engineers,

with areas of specialization, are discussed above in section IV. GoG could consider requiring a higher passing score for individuals qualified to carry out private expertise, or reserving some of the more advanced test segments for private expertise professionals.

d. Continuing education.
An individual certified to perform private expertise should demonstrate a history of appropriate continuing education and should be required to engage in continuing education on an ongoing basis.

A number of organizations offer advanced continuing professional education for engineers. These courses will usually be tied to either the U.S.-based IBC and its ASCE engineering standards or to the Eurocodes and European standards. Examples of several IBC-related courses are found at http://cpe.njit.edu/engine/index.htm. A catalog of numerous commercially available short courses designed for professional continuing education distance learning over the Internet can be found at http://www.redvector.com/web_store/view_courses.asp (click the link on the left side of the page titled "Online CE Courses"). Examples of Eurocode-based courses can be found at http://www.tttrain.co.uk/courses/index.asp, http://www.eurocode2.info/main.asp?page=1216. Further investigation should reveal a number of additional sources of advanced continuing education seminars and online courses for engineers.

After surveying available continuing education sources, I would recommend that GoG formulate a continuing education requirement based on private expertise professionals completing a specified number of continuing education hours per year. From twelve to twenty-four hours of continuing education per year is within the generally accepted range. Some standard of how the providers of continuing education courses should be qualified or accredited should be included as well. U.S. states require continuing education for professionals and I would expect some European countries do as well. Perhaps a requirement that the course be approved by some government body for meeting the continuing education requirement of professionals would suffice. There are also a number of non-governmental bodies that certify continuing education courses. A survey could be made and a list compiled, allowing any course certified by the named bodies to qualify.

Generally, professionals are allowed to choose from a wide variety of courses to meet their continuing education requirement so they can pursue professional development that is of interest to them.

3. Reputation among peers and clients.
Individuals should provide letters of recommendation from 3 peers and from 3 clients assessing their professional competence.

D. Requirements For Interim Certification Of Private Expertise Firms and Professionals.

Until the new technical standards are adopted, licensing requirements put into effect, and a chance given for firms to obtain ISO certifications, these requirements cannot be applied. I

would expect the permanent certification requirements could be in place by early 2008, perhaps sooner with luck. In the interim, a process similar to the following may suffice:

1. Organizational competence.
The applicant firm should demonstrate the existence of competent business processes, including up-to-date computer systems with Internet access and email, architectural or engineering software and hardware, telecommunications equipment, and bookkeeping systems.

2. Professional competence.
The individual applicant should demonstrate compliance with the education, experience, and reputation requirements described for permanent certification.

3. Conflict of interest.
The firm and individual should be required to be bound to non-conflict requirements described for permanent certification above.

E. Application Process.

An application form should be developed to organize all the required information. After the application is completed by the applicant, a personal interview should be conducted by a committee of Ministry of Construction officials and other relevant officials. Until the ISO certification is in place, a visit to the applicant's place of business should be arranged. Successful applicants should be placed on a list which specifies the risk category they are qualified to carry out expertise on. The list should be distributed to municipal officials and available to the public. The list should be updated as additional applicants are approved. The application process should be advertised so that all interested firms and individuals can apply. A website could be used for these functions.

F. Compliance Measures.

In order to obtain a building permit, the project proponent would be required to submit a certificate from a recognized private expertise firm attesting that the project meets the requisite standards.

The private expertise certificate should bear *both* the signature of a responsible officer of a firm qualified by GoG to perform private expertise services and the signature of the individual professional(s) responsible for the certification of the project.

VI
CONCLUSION

A discussion of the five areas requested by GoG with a number of alternative courses of action and sources for further information has been provided. After giving some thought to the five areas as interrelated projects, and consultation with respective specialists in each area, the scope of each project can be further defined. It is hoped that this memo and the resources cataloged herein will serve as an ongoing asset for GoG, USAID, and future experts in carrying out the respective projects.

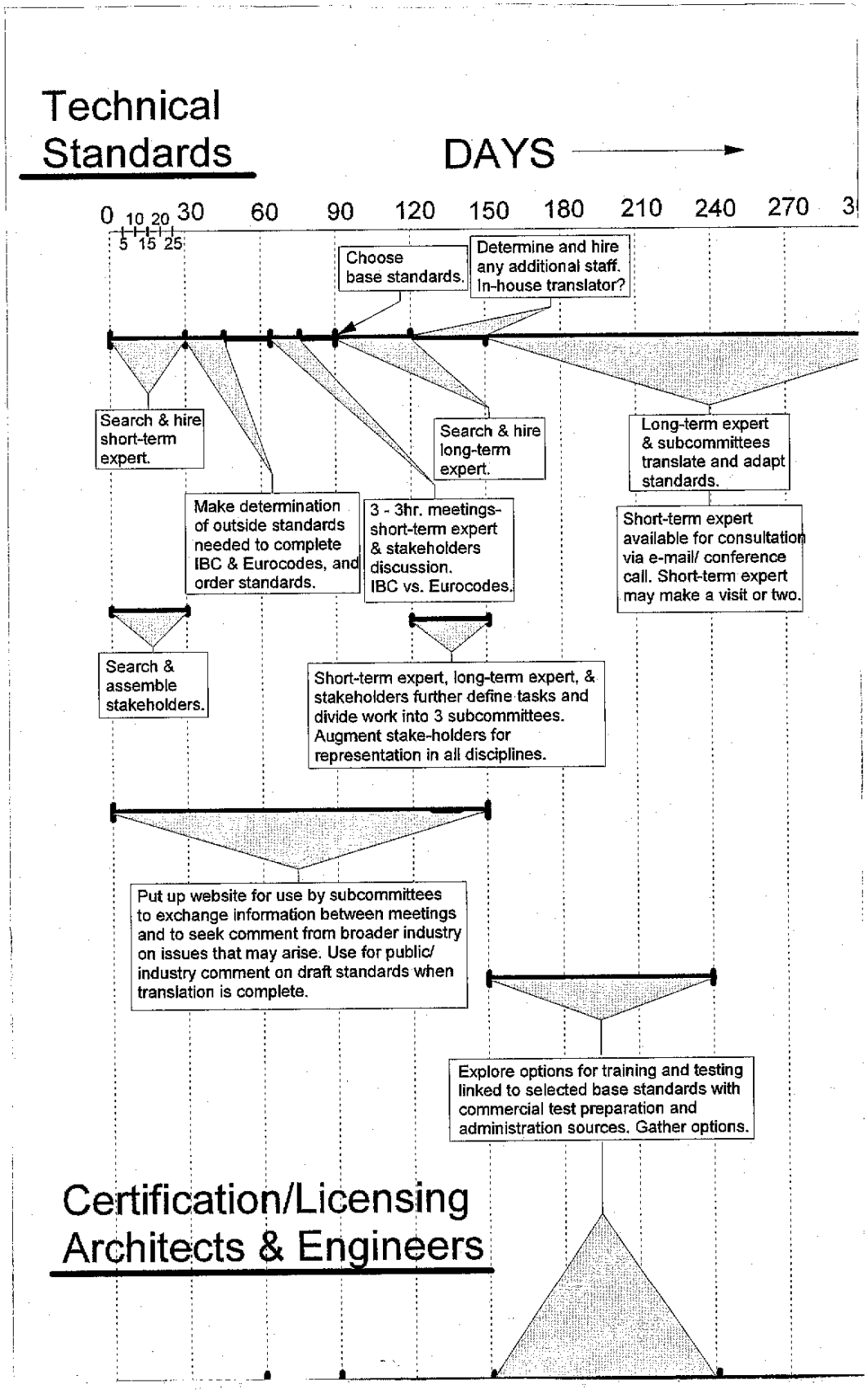
ATTACHMENT

ONE

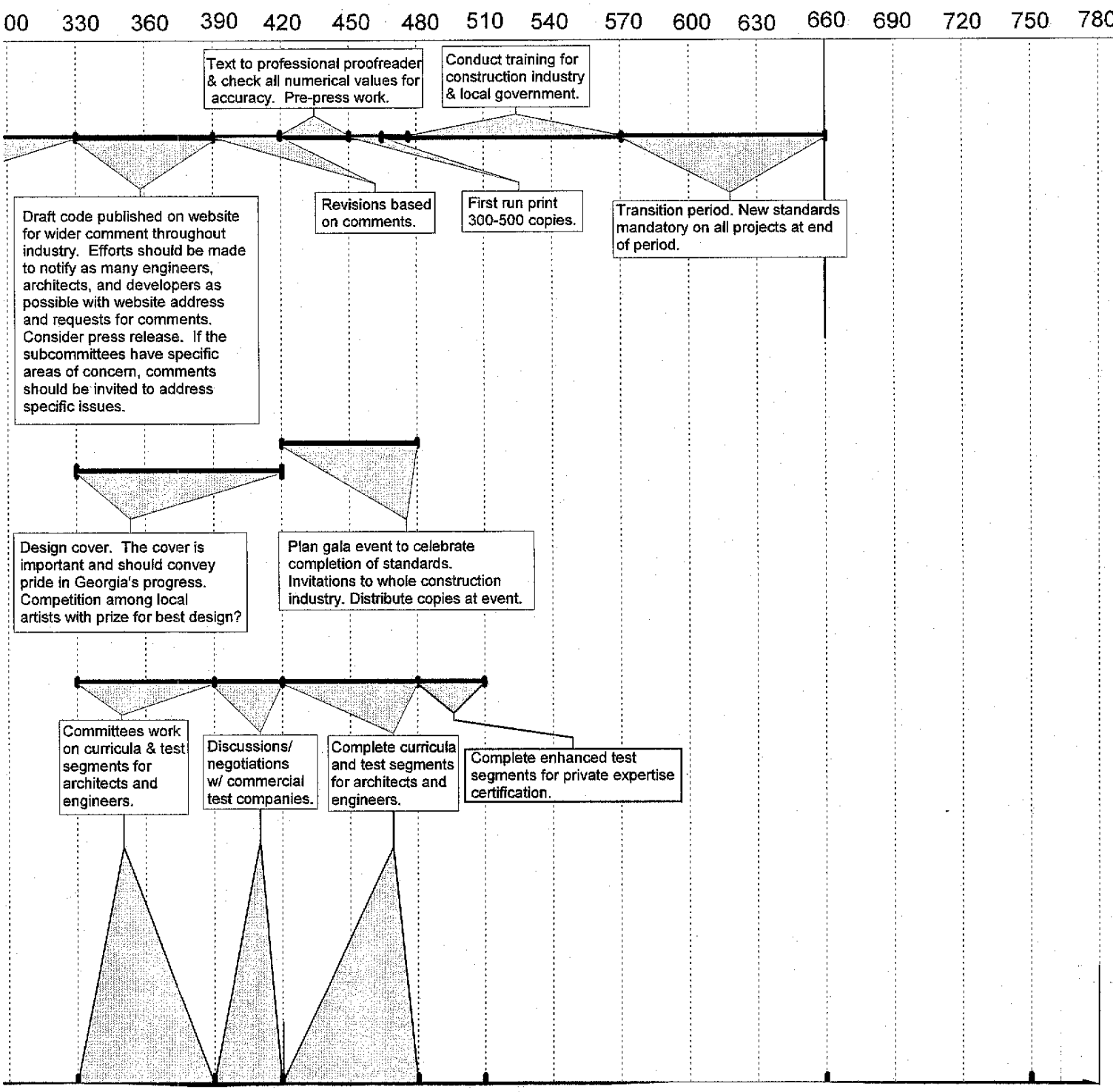
TIMELINES

A.	B.
C.	D.
E.	

Attachment follows this cover sheet.


Technical Standards
DAYS
0 10 20 30 60 90 120 150 180 210 240 270
5 15 25
Choose base standards.
Determine and hire any additional staff. In-house translator?
Search & hire short-term expert.
Make determination of outside standards needed to complete IBC & Eurocodes, and order standards.
Search & hire long-term expert.
3 - 3hr. meetings- short-term expert & stakeholders discussion. IBC vs. Eurocodes.
Long-term expert & subcommittees translate and adapt standards.
Short-term expert available for consultation via e-mail/ conference call. Short-term expert may make a visit or two.
Search & assemble stakeholders.
Short-term expert, long-term expert, & stakeholders further define tasks and divide work into 3 subcommittees. Augment stake-holders for representation in all disciplines.
Put up website for use by subcommittees to exchange information between meetings and to seek comment from broader industry on issues that may arise. Use for public/ industry comment on draft standards when translation is complete.
Explore options for training and testing linked to selected base standards with commercial test preparation and administration sources. Gather options.
Certification/Licensing Architects & Engineers

B.1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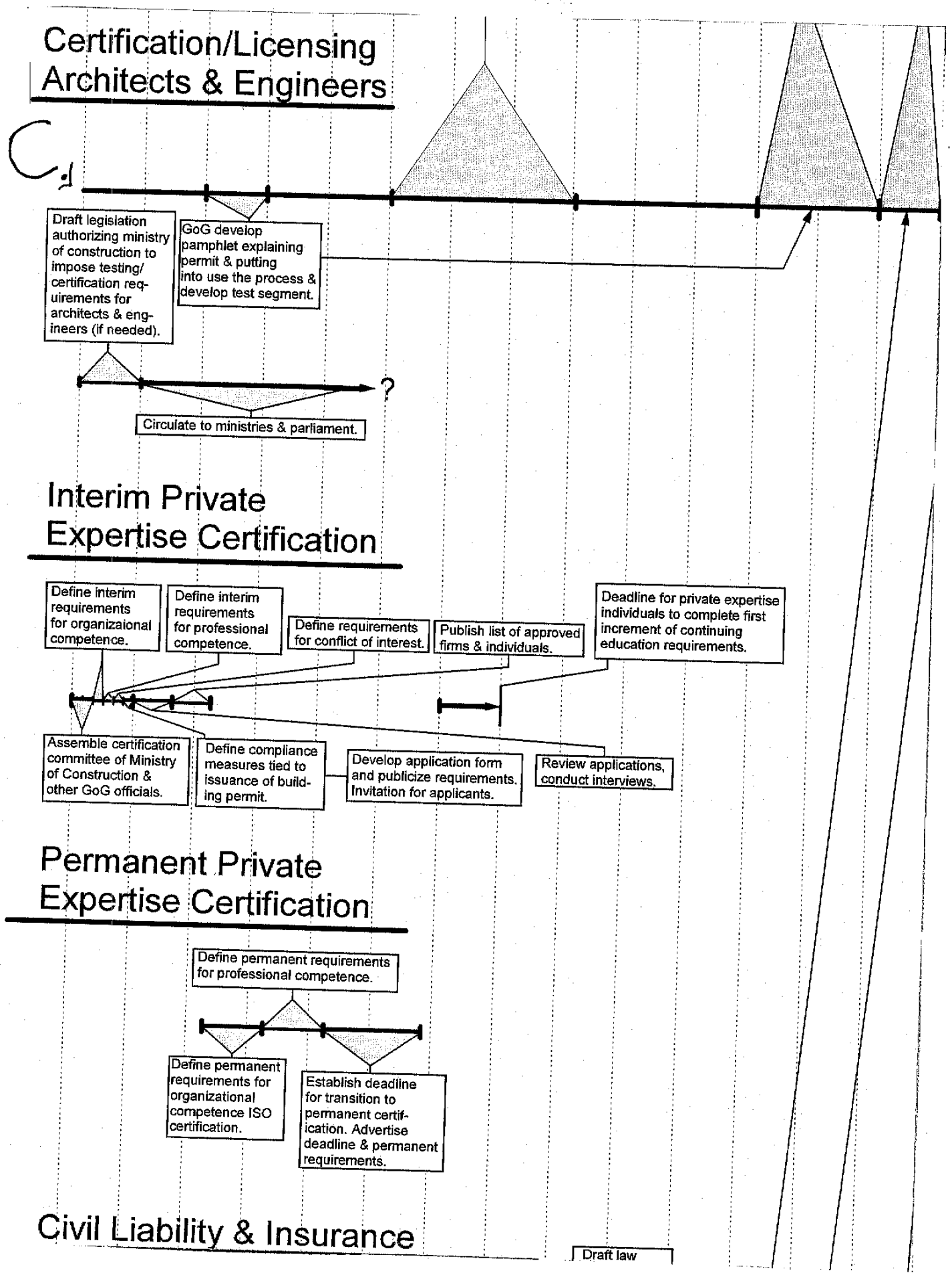
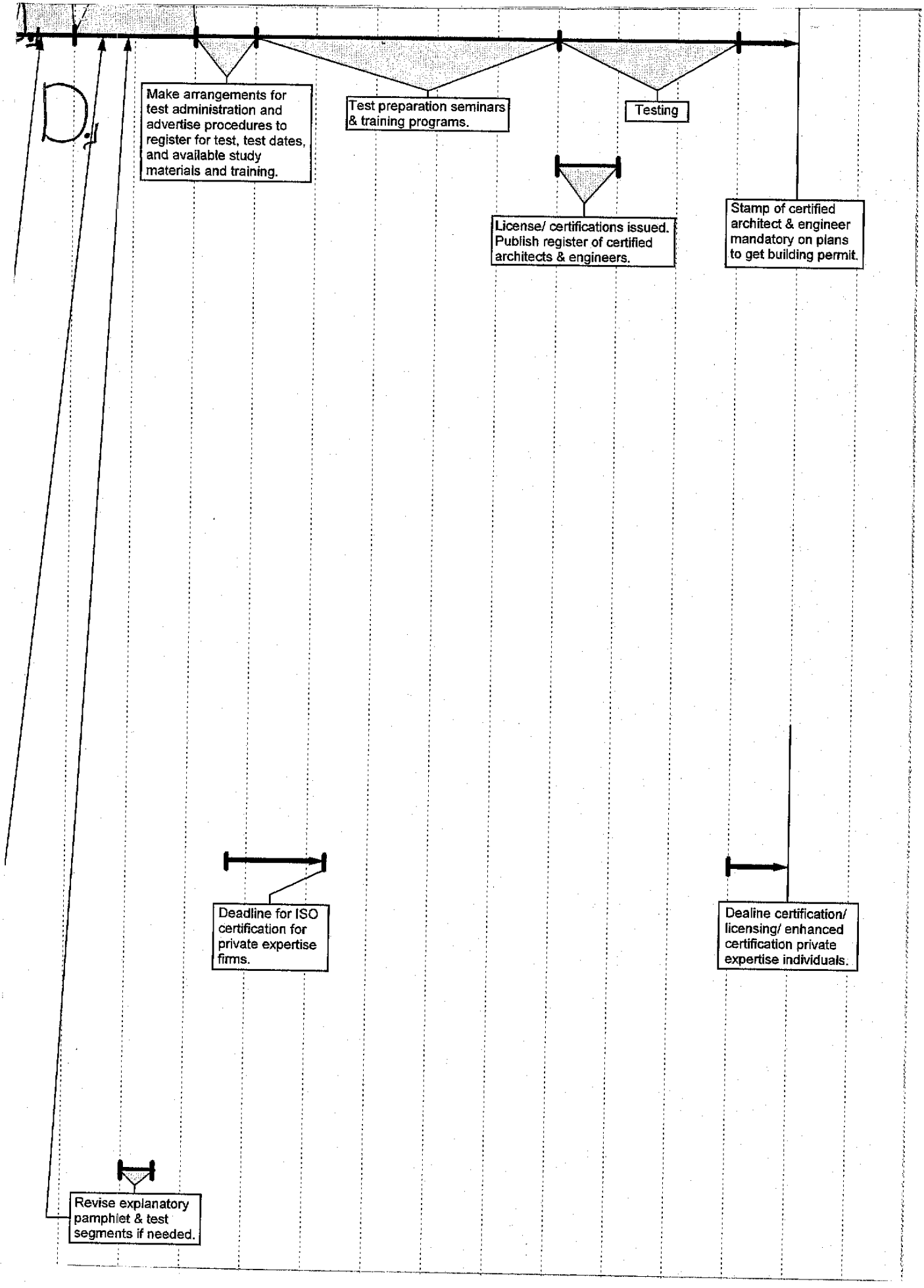
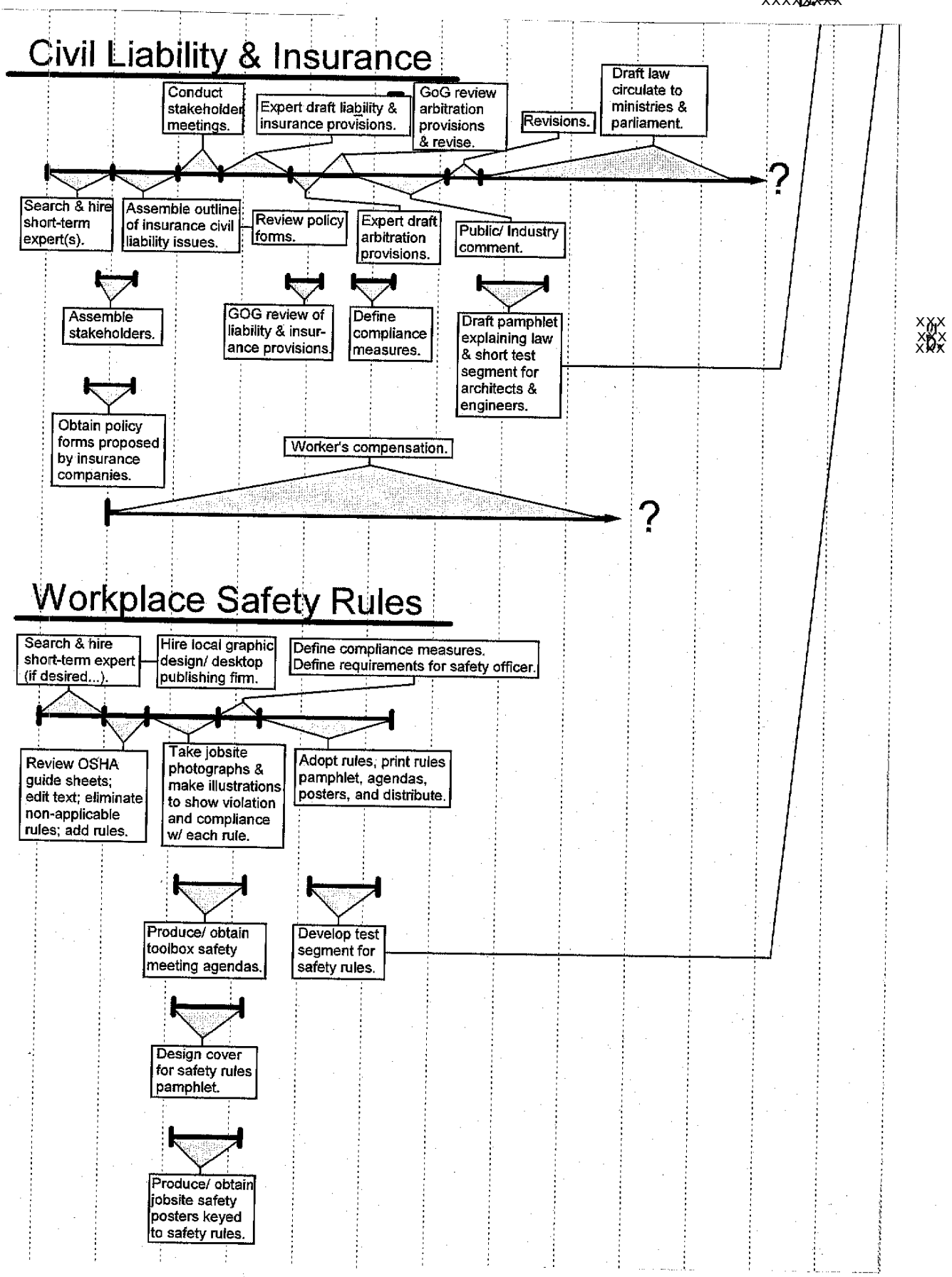
Text to professional proofreader & check all numerical values for accuracy. Pre-press work.
Conduct training for construction industry & local government.
Draft code published on website for wider comment throughout industry. Efforts should be made to notify as many engineers, architects, and developers as possible with website address and requests for comments. Consider press release. If the subcommittees have specific areas of concern, comments should be invited to address specific issues.
Revisions based on comments.
First run print 300-500 copies.
Transition period. New standards mandatory on all projects at end of period.
Design cover. The cover is important and should convey pride in Georgia's progress. Competition among local artists with prize for best design?
Plan gala event to celebrate completion of standards. Invitations to whole construction industry. Distribute copies at event.
Committees work on curricula & test segments for architects and engineers.
Discussions/ negotiations w/ commercial test companies.
Complete curricula and test segments for architects and engineers.
Complete enhanced test segments for private expertise certification.


Certification/Licensing Architects & Engineers
Draft legislation authorizing ministry of construction to impose testing/ certification requirements for architects & engineers (if needed).
GoG develop pamphlet explaining permit & putting into use the process & develop test segment.
?
Circulate to ministries & parliament.
Interim Private Expertise Certification
Define interim requirements for organizaional competence.
Define interim requirements for professional competence.
Define requirements for conflict of interest.
Publish list of approved firms & individuals.
Deadline for private expertise individuals to complete first increment of continuing education requirements.
Assemble certification committee of Ministry of Construction & other GoG officials.
Define compliance measures tied to issuance of building permit.
Develop application form and publicize requirements. Invitation for applicants.
Review applications, conduct interviews.
Permanent Private Expertise Certification
Define permanent requirements for professional competence.
Define permanent requirements for organizational competence ISO certification.
Establish deadline for transition to permanent certification. Advertise deadline & permanent requirements.
Civil Liability & Insurance
Draft law


Make arrangements for test administration and advertise procedures to register for test, test dates, and available study materials and training.
Test preparation seminars & training programs.
Testing
License/ certifications issued. Publish register of certified architects & engineers.
Stamp of certified architect & engineer mandatory on plans to get building permit.
Deadline for ISO certification for private expertise firms.
Dealine certification/ licensing/ enhanced certification private expertise individuals.
Revise explanatory pamphlet & test segments if needed.


Civil Liability & Insurance
Conduct stakeholder meetings.
Expert draft liability & insurance provisions.
GoG review arbitration provisions & revise.
Revisions.
Draft law circulate to ministries & parliament.
?
Search & hire short-term expert(s).
Assemble outline of insurance civil liability issues.
Review policy forms.
Expert draft arbitration provisions.
Public/ Industry comment.
Assemble stakeholders.
GOG review of liability & insurance provisions.
Define compliance measures.
Draft pamphlet explaining law & short test segment for architects & engineers.
Obtain policy forms proposed by insurance companies.
Worker's compensation.
?
Workplace Safety Rules
Search & hire short-term expert (if desired...).
Hire local graphic design/ desktop publishing firm.
Define compliance measures.
Define requirements for safety officer.
Review OSHA guide sheets; edit text; eliminate non-applicable rules; add rules.
Take jobsite photographs & make illustrations to show violation and compliance w/ each rule.
Adopt rules; print rules pamphlet, agendas, posters, and distribute.
Produce/ obtain toolbox safety meeting agendas.
Develop test segment for safety rules.
Design cover for safety rules pamphlet.
Produce/ obtain jobsite safety posters keyed to safety rules.

ATTACHMENT

TWO

July 10 Memo

Attachment follows this cover sheet.

USAID Georgia Business Climate Reform

Date: July 10, 2006

To: Stephanos Orestis, DCOP, United States Agency for International Development, Georgia Business Climate Reform Project

From: Michael Brodsky

Re: Interim Recommendations for Construction Industry Reform Legislation

Summary

This memo is prepared at the request of Stephanos Orestis as a report on my findings so far.

Much excellent work has been done thus far in developing a new streamlined administrative procedure for construction permitting. In order for the new administrative process to effectively fulfill its substantive function, further elaboration of substantive law is needed. Given adequate time and effort, it is feasible to complete substantive legislation/regulations that will allow construction permitting to effectively fulfill its function by: 1) assuring that buildings as designed and constructed meet basic standards for the protection of human life and safety, including structural integrity, fire safety, and seismic safety; and 2) assuring that new construction projects respect height and bulk limits, preserve public spaces including parks, sidewalks, and streets, and enhance the general quality of urban life with respect to the built environment.

To the extent that allotted time permits, and with input from GoG as to priorities, over the coming weeks I will endeavor to offer additional recommendations aimed at helping GoG achieve its policy goals of moving from government regulation toward effective market self-regulation in the following six areas: A) technical standards for building design that meet international best practices; B) certification of civil engineers, architects, and other key construction professionals; C) workplace safety rules; D) certification of private engineering firms intended to take over safety review of building design, thus privatizing this current government function; E) civil liability and mandatory insurance provisions; and F) development regulations (zoning).

Some of the needed additional legislative/regulatory drafting can be done in the near term. Other areas will require a longer-range effort.

I recommend that USAID continue to support GoG in its construction industry reform efforts in both the short and long term so that this important work can been seen through to completion.

Discussion

1. Specific Areas Of The Draft Construction Code That Need Further Elaboration In Order To Assure That Buildings As Designed And Constructed Protect Human Life And Safety.

A. Technical standards for building design.
Technical standards for building design now in force are out of date and cumbersome; for example, technical standards for seismic safety have not been updated since the early 1980s. The draft construction code allows for the use of foreign technical standards, which is a good idea and may encourage foreign investment. However, the content of foreign standards is virtually unknown to the domestic Georgian construction industry. In order to bring the Georgian construction industry up to international standards and provide for its long-term prosperity and safety, the most basic requirement is the adoption of new technical standards that will be adapted for use in Georgia, translated into Georgian, widely circulated, and consistently enforced.

Many of the issues addressed in this memo are complicated by the lack of current technical standards. It is difficult to assess the capability of engineers and other professionals for certification purposes because such assessment is normally based on measuring their competence in applying accepted technical standards. Safety review of building design also depends on determining whether the design meets accepted technical standards. Inspections of construction projects also depend on enforcing compliance with standards.

The adoption of permanent technical standards that meet international norms is a long term project. Forthcoming recommendations will describe the necessary steps.

B. Certification of engineers and other professionals.
Currently, there are no requirements for professional qualifications or certification of structural engineers or other construction industry professionals. The working draft construction code expresses the intent to establish mandatory certification requirements, but the means and procedure for carrying out certification have not been determined. In the long term, internationally recognized certification will require basic improvements in Georgian universities so their programs for engineering and other disciplines can be accredited to international standards. In the long term, internationally recognized certification will also require the adoption of up-to-date technical standards so that professional knowledge can be tested against recognized standards. Forthcoming recommendations will discuss the advisability of an interim certification process that could be adopted in the near term to assure that key construction professionals possess basic capabilities related to the protection of life and safety.

C. Workplace safety rules.
No workplace safety rules are currently enforced and workplace safety practices are uneven. The working draft construction code has not yet elaborated workplace safety rules. Existing workplace safety rules from other jurisdictions that I have reviewed so far are not easily adapted for use in Georgia. U.S. federal standards for construction workplace safety are

overwhelmingly detailed and bulky. EU directives reviewed so far are brief, but too general to provide meaningful information in a number of important particulars. Forthcoming recommendations will provide suggestions on how to distill internationally accepted workplace safety practices to a manageable size and format designed for wide distribution.

D. Safety review of building design.
Safety review of building design is currently part of an inefficient "state expertise" procedure that is proposed for elimination. A first draft of rules that would transfer state expertise to the private sector has been provided. The draft rules provide an innovative and excellent approach to classifying projects according to risk. Further elaboration is needed to define how design review will be transferred to the private sector and how the qualification of firms performing this safety function will be ascertained and certified. Measures to address conflict of interest concerns and the integrity of firms performing this function are also needed. Forthcoming recommendations will suggest transitional and longer-term measures to assure the quality and integrity of "private expertise" firms.

E. Insurance and civil liability provisions.
This is perhaps the most promising of GoG's efforts to move from government regulation to market self-regulation in the construction industry.

Insurance of construction projects is customary in developed countries; however, it is rare in Georgia. The draft construction code expresses the intent to require insurance. However, a number of important factors need to be addressed in order for insurance provisions to achieve their objective. Chief among these is the elaboration of civil liability rules establishing who is liable for what to whom. Included in the liability rules should be provisions that address the current practice of Georgian developers who seek to sidestep liability by transferring responsibility for projects to ill-equipped homeowners associations very early in the development process. In addition, some fast and efficient method of dispute resolution should be specified so that payment of valid insurance claims is swift and certain.

Insurance serves three primary purposes: 1) the spreading of risk, which minimizes the sudden failure of business enterprises engaged in the construction industry; 2) the compensation of parties damaged by construction accidents and failures; and 3) the establishment of market-driven incentives to control construction quality and worker safety.

Market-driven incentives to control construction quality and worker safety are particularly important for Georgia. Currently, there is no effective government field inspection of construction projects. The lack of an effective inspection program has allowed significant safety flaws to become commonplace. For example, the use of unreinforced concrete masonry units is prevalent. In even a moderate earthquake, heavy concrete blocks may shake loose from tall buildings and fall into the street below. From a technical point of view, this problem can be avoided at minimal cost by inserting steel reinforcing rods during construction. Most projects, as designed, require the use of these reinforcing rods. However, contractors often fail to follow the approved design. The quality of concrete used in some construction projects is also doubtful. The draft construction code establishes a new administrative process for inspections; however, it is not clear that national or local officials

currently have the ability to carry out consistently effective inspections. This has been a stubborn problem in Georgia.

Insurance companies have strong market incentives to manage their risks. They are large institutions with financial resources and administrative capacity. If incentives are aligned correctly by Georgian legislation, insurance companies should bring discipline to the market through risk management programs. If they are held liable for the damage caused by faulty construction, they will have every incentive to impose requirements on their insured contractors, developers, and construction industry professionals that will result in improved building safety. If properly coordinated, all of the life and safety issues addressed in this memo (items 1(a)–(d)) could be significantly advanced through insurance/liability provisions. This will achieve the result sought by GoG in its deregulatory efforts: relying less on government regulation and more on market self-regulation.

I held a meeting with representatives of the major insurance companies and banks doing business in Georgia (the banks are important because construction lenders have a stake in insuring projects that secure their loans). The consensus was that basic insurance and civil liability rules could be produced in 1–3 months with consistent effort (future amendments could be added as needed). Forthcoming recommendations will suggest a process for arriving at basic insurance/liability provisions.

2. Measures To Assure That New Construction Projects Respect Height And Bulk Limits, Preserve Public Spaces, And Enhance The Quality Of Urban Life.

A. Tbilisi's cosmopolitan character and the mixed blessing of rapid growth.
Much of Tbilisi maintains intact traditional development patterns: Along commercial boulevards, buildings are set close to the street and shops occupy the ground floor with housing and offices above. Residential neighborhoods provide housing for different income levels within each block, from modest single-family homes to larger individual residences to appropriately scaled apartment buildings. Small shops provide neighborhood services and local parks serve as gathering places for adults and playgrounds for children. The streets of traditional Tbilisi are vibrant public spaces because proportionately sized buildings frame the streets and the mixture of commerce, parks, and housing variety brings the density of population and diversity of activity that make a cosmopolitan culture.

Over the last several years, the construction of dozens of large new apartment buildings has provided more comfortable housing for Tbilisi's emerging middle class and contributed significantly to economic growth. However, the development boom also threatens the quality of urban life. Before the current administration, anecdotal evidence indicates that at least one private apartment building was built on a public park and other projects have been built taller than allowed or approved. A number of projects under construction appear to break with traditional development patterns and turn their backs on main boulevards, leaving a void in public space. Concentrated development has overwhelmed the ability of local streets to carry the increased traffic. Some residents feel that their peace and quiet is threatened by adjacent development that is too large. Proposed national development regulations and Tbilisi's master planning process seek to address these concerns.

B. The development regulations should be refined as they are locally implemented.
The draft development regulations include some innovative and promising ideas, including deregulation of land use changes consistent with GoG's defined goals. Because of valid concerns with transparency and limited administrative capacity, building controls rely on coefficients relating building size to lot size and on mathematical formulas increasing required setbacks as building height increases. The national development regulations serve as a default that may be supplemented by local regulations to suit local conditions. As they are put into effect, lot coefficients and formulas should be reviewed and adjusted where appropriate to ensure that they allow a mixture of commerce and housing variety. To the extent resources are available, I recommend local refinements that promote positive development, such as "build to" lines (in addition to setbacks), design guidelines that relate building height and setbacks to street width, and neighborhood bulk and height guidelines in addition to (or as an eventual replacement for) lot coefficients. The national development regulations allow for these "new urbanist" techniques. Tbilisi's newly installed Geographic Information System ("GIS") provides the opportunity to implement these and other urban planning measures while maintaining straightforward administration.

C. As administrative capacity develops GIS planning should take a long-range view.
Urban planning can help establish a culture of democratic self-government by involving the public in shaping Georgia's vision for the future. So far, efforts have focused on the first step: installing the technical capacity for urban planning in Tbilisi and other major cities in the form of a Geographic Information System. GIS-based urban planning has the potential to control the negative impacts of rapid development. As with any powerful tool, the success of GIS-based planning depends on how it is used to address neighborhood scale, demands on infrastructure, public transportation and congestion, parks, and public space.

Most GIS software includes prepackaged zoning that may be adjusted to serve short-term needs. For longer-term planning, rather than focusing on preset zoning, I recommend a planning process with broad public input as follows:1) assess the current situation, identifying unhealthy development patterns that need to be corrected and healthy development patterns that should be encouraged; 2) define goals for the future; and 3) make and codify policy, strategic, and tactical choices specific to Tbilisi (and other cities respectively) that will achieve the cities' chosen goals. A variety of economic deregulatory techniques in addition to regulatory zoning may be considered. With adequate attention devoted to long-range planning it is possible to assure that new construction projects preserve public spaces including parks, sidewalks, and streets, and enhance the general quality of urban life with respect to the built environment.

Conclusion

Reforming the construction industry is a long-term project. The suggestions offered herein and forthcoming are intended to help GoG take the next steps towards its excellent policy goals. I recommend that USAID continue to support GoG's construction industry reform efforts in the near and long term.

ATTACHMENT

THREE

Introduction to Eurocodes

Attachment follows this cover sheet.

How to design concrete structures using Eurocode 2

1. Introduction to Eurocodes

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Introduction

The introduction of European standards to UK construction is a significant event. The ten design standards, known as the Eurocodes, will affect all design and construction activities as current British Standards for design are due to be withdrawn in 2010.

This publication is part of the series of guides entitled *How to design concrete structures using Eurocode 2*. Their aim is to make the transition to Eurocode 2*: Design of concrete structures* as easy as possible by drawing together in one place key information and commentary required for the design of typical concrete elements.

The cement and concrete industry recognised that a substantial effort was required to ensure that the UK design profession would be able to use Eurocode 2 quickly, effectively, efficiently and with confidence. With support from government, consultants and relevant industry bodies, the Concrete Industry Eurocode 2 Group (CIEG) was formed in 1999 and this Group has provided the guidance for a co-ordinated and collaborative approach to the introduction of Eurocode 2. As a result, a range of resources is to be made available through The Concrete Centre to help designers during the transition period (see back cover for details).

This guide is taken from The Concrete Centre's publication, *How to design concrete structures using Eurocode 2* (Ref. CCIP–006)

The Eurocode family

This guide shows how to use Eurocode 2[1] with the other Eurocodes. In particular it introduces Eurocode: *Basis of structural design*[2] and Eurocode 1: *Actions on structures*[3] and guides the designer through the process of determining the design values for actions on a structure. It also gives a brief overview of the significant differences between the Eurocodes and BS 8110[4], (which will be superseded) and includes a glossary of Eurocode terminology.

The development of the Eurocodes started in 1975; since then they have evolved significantly and are now claimed to be the most technically advanced structural codes in the world. The many benefits of using Eurocode 2 are summarised below. There are ten Eurocodes covering all the main structural materials (see Figure 1). They are produced by the European Committee for Standardization (CEN), and will replace existing national standards in 28 countries.

Each country is required to publish a Eurocode with a national title page and forward but the original text of the Eurocode must appear as produced by CEN as the main body of the document. A National Annex (NA) can be included at the back of the document (see Figure 2). All the guides in this series assume that the UK National Annexes will be used.

Table 1 details which existing standards relating to concrete design will be replaced by the new Eurocodes. During the implementation period it is recommended that existing standards are considered for use where the European standards have not yet been issued.

Benefits of using Eurocode 2

Learning to use the new Eurocodes will require time and effort on behalf of the designer, so what benefits will there be?

1. The new Eurocodes are claimed to be the most technically advanced codes in the world.
2. Eurocode 2 should result in more economic structures than BS 8110.
3. The Eurocodes are logical and organised to avoid repetition.
4. Eurocode 2 is less restrictive than existing codes.
5. Eurocode 2 is more extensive than existing codes.
6. Use of the Eurocodes will provide more opportunity for designers to work throughout Europe.
7. In Europe all public works must allow the Eurocodes to be used.

Figure 1
The Eurocodes

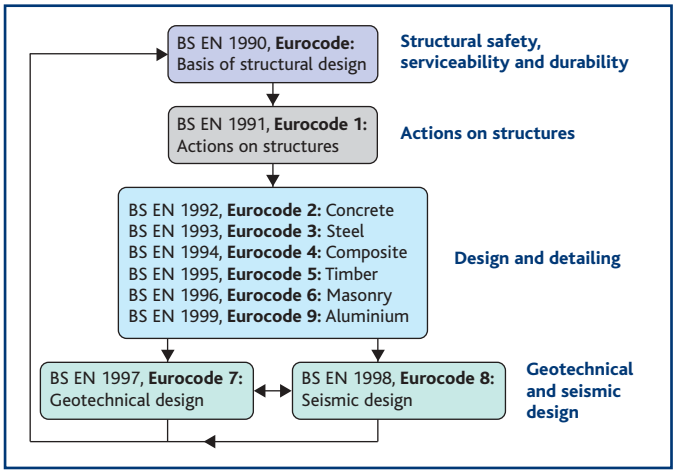


Figure 2
Typical Eurocode layout

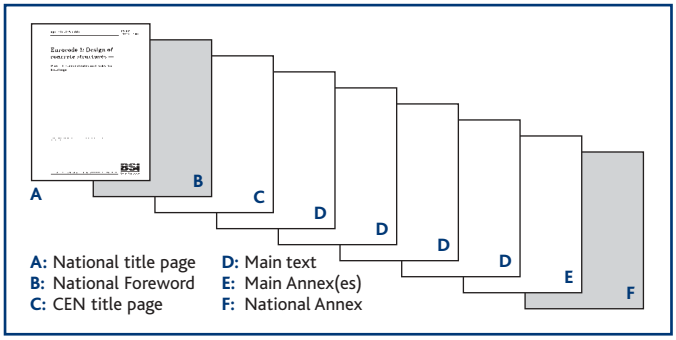


Table 1
Concrete related Eurocodes and their equivalent current standards

Eurocode	Title	Superseded standards
BS EN 1990	Basis of structural design	BS 8110: Part 1 – section 2
BS EN 1991–1–1	Densities, self-weight and imposed loads	BS 6399: Part 1 and BS 648
BS EN 1991–1–2	Actions on structures exposed to fire	–
BS EN 1991–1–3	Snow loads	BS 6399: Part 2
BS EN 1991–1–4	Wind actions	BS 6399: Part 3
BS EN 1991–1–5	Thermal actions	–
BS EN 1991–1–6	Actions during execution	–
BS EN 1991–1–7	Accidental actions	–
BS EN 1991–2	Traffic loads on bridges	BD 37/88
BS EN 1991–3	Actions induced by cranes and machinery	–
BS EN 1991–4	Silos and tanks	–
BS EN 1992–1–1	General rules for buildings	BS 8110: Parts 1, 2 and 3
BS EN 1992–1–2	Fire resistance of concrete structures	BS 8110: Part 1, Table 3.2 and BS 8110: Part 2, section 4
BS EN 1992–2	Bridges	BS 5400: Part 4
BS EN 1992–3	Liquid-retaining and containment structures	BS 8007
BS EN 1997–1	Geotechnical design – General rules	BS 6031, BS 8002, BS 8004, BS 8006, BS 8008 & BS 8081
BS EN 1997–2	Geotechnical design – Ground investigation and testing	BS 5930
BS EN 1998	Design of structures for earthquake resistance (6 parts)	–

Eurocode: Basis of structural design

This Eurocode underpins all structural design irrespective of the material of construction. It establishes principles and requirements for safety, serviceability and durability of structures. (Note, the correct title is Eurocode not Eurocode 0.) The Eurocode uses a statistical approach to determine realistic values for actions that occur in combination with each other.

There is no equivalent British Standard for Eurocode: *Basis of structural design* and the corresponding information has traditionally been replicated in each of the material Eurocodes. It also introduces new definitions (see Glossary) and symbols (see Tables 2a and 2b), which will be used throughout this publication to assist familiarity. Partial factors for actions are given in this Eurocode, whilst partial factors for materials are prescribed in their relevant Eurocode.

Representative values

For each variable action there are four representative values. The principal representative value is the characteristic value and this can be determined statistically or, where there is insufficient data, a nominal value may be used. The other representative values are combination, frequent and quasi-permanent; these are obtained by applying to the characteristic value the factors ψ_0, ψ_1 and ψ_2 respectively (see Figure 3). A semi-probabilistic method is used to derive the ψ factors, which vary depending on the type of imposed load (see Table 3). Further information on derivation of the ψ factors can be found in Appendix C of the Eurocode.

The combination value ($\psi_0 Q_k$) of an action is intended to take account of the reduced probability of the simultaneous occurrence of two or more variable actions. The frequent value ($\psi_1 Q_k$) is such that it should be exceeded only for a short period of time and is used primarily for the serviceability limit states (SLS) and also the accidental ultimate limit state (ULS). The quasi-permanent value ($\psi_2 Q_k$) may be exceeded for a considerable period of time; alternatively it may be considered as an average loading over time. It is used for the long-term affects at the SLS and also accidental and seismic ULS.

Combinations of actions

In the Eurocodes the term 'combination of actions' is specifically used for the definition of the magnitude of actions to be used when a limit state is under the influence of different actions. It should not be confused with 'load cases', which are concerned with the arrangement of the variable actions to give the most unfavourable conditions and are given in the material Eurocodes. The following process can be used to determine the value of actions used for analysis:

1. Identify the design situation (e.g. persistent, transient, accidental).
2. Identify all realistic actions.
3. Determine the partial factors (see below) for each applicable combination of actions.
4. Arrange the actions to produce the most critical conditions.

Where there is only one variable action (e.g. imposed load) in a combination, the magnitude of the actions can be obtained by multiplying them by the appropriate partial factors.

Where there is more than one variable action in a combination, it is necessary to identify the leading action ($Q_{k,1}$) and other accompanying actions ($Q_{k,i}$). The accompanying action is always taken as the combination value.

Ultimate limit state

The ultimate limit states are divided into the following categories:

EQU Loss of equilibrium of the structure.

STR Internal failure or excessive deformation of the structure or structural member.

GEO Failure due to excessive deformation of the ground.

FAT Fatigue failure of the structure or structural members.

The Eurocode gives different combinations for each of these ultimate limit states. For the purpose of this publication only the STR ultimate limit state will be considered.

For persistent and transient design situations under the STR limit state, the Eurocode defines three possible combinations, which are given in Expressions (6.10), (6.10a) and (6.10b) of the Eurocode (see Tables 4 and 5). The designer (for UK buildings) may use either (6.10) or the less favourable of (6.10a) and (6.10b).

At first sight it appears that there is considerably more calculation required to determine the appropriate load combination; however, with experience the designer will be able to determine this by inspection. Expression (6.10) is always equal to or more conservative than the less favourable of Expressions (6.10a) and (6.10b). Expression (6.10b) will normally apply when the permanent actions are not greater than 4.5 times the variable actions (except for storage loads (category E, Table 3) where Expression (6.10a) always applies).

Therefore, for a typical concrete frame building, Expression (6.10b) will give the most structurally economical combination of actions.

For members supporting one variable action the combination $1.25\,G_k + 1.5\,Q_k$ (derived from Exp 6.10b) can be used provided the permanent actions are not greater than 4.5 times the variable actions (except for storage loads).

Serviceability limit state

There are three combinations of actions that can be used to check the serviceability limit states (see Tables 6 and 7). Eurocode 2 indicates which combination should be used for which phenomenon (e.g. deflection is checked using the quasi-permanent combination). Care should be taken not to confuse the SLS combinations of characteristic, frequent and quasi-permanent, with the representative values that have the same titles.

Table 2a
Selected symbols for Eurocode

Symbol	Definition
G_k	Characteristic value of permanent action
Q_k	Characteristic value of single variable action
γ_G	Partial factor for permanent action
γ_Q	Partial factor for variable action
ψ_0	Factor for combination value of a variable action
ψ_1	Factor for frequent value of a variable action
ψ_2	Factor for quasi-permanent value of a variable action
ξ	Combination factor for permanent actions

Table 2b
Selected subscripts

Subscript	Definition
A	Accidental situation
c	Concrete
d	Design
E	Effect of action
fi	Fire
k	Characteristic
R	Resistance
w	Shear reinforcement
y	Yield strength

Figure 3
Representative values of variable actions[5]

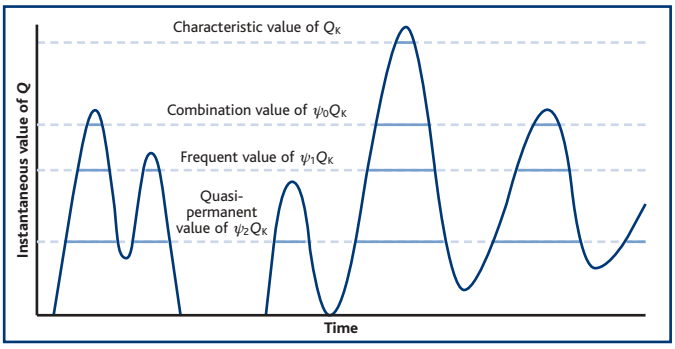


Table 3
Recommended values of ψ factors for buildings (from UK National Annex)

Action	ψ_0	ψ_1	ψ_2
Imposed loads in buildings (see BS EN 1991–1–1)			
Category A: domestic, residential areas	0.7	0.5	0.3
Category B: office areas	0.7	0.5	0.3
Category C: congregation areas	0.7	0.7	0.6
Category D: shopping areas	0.7	0.7	0.6
Category E: storage areas	1.0	0.9	0.8
Category F: traffic area, vehicle weight < 30 kN	0.7	0.7	0.6
Category G: traffic area, 30 kN < vehicle weight < 160 kN	0.7	0.5	0.3
Category H: roofs*	0.7	0	0
Snow loads on buildings (see BS EN 1991–3)			
For sites located at altitude H > 1000 m above sea level	0.7	0.5	0.2
For sites located at altitude H < 1000 m above sea level	0.5	0.2	0
Wind loads on buildings (see BS EN 1991–1–4)	0.5	0.2	0
Temperature (non-fire) in buildings (see BS EN 1991–1–5)	0.6	0.5	0

Key
*See also 1991–1–1: Clause 3.3.2

Table 4
Design values of actions, ultimate limit state – persistent and transient design situations (Table A1.2 (B) Eurocode)

Combination Expression reference	Permanent actions		Leading variable action	Accompanying variable actions	
	Unfavourable	Favourable		Main (if any)	Others
Exp. (6.10)	$\gamma_{G,j,sup}\, G_{k,j,sup}$	$\gamma_{G,j,inf}\, G_{k,j,inf}$	$\gamma_{Q,1}\, Q_{k,1}$		$\gamma_{Q,1}\, \psi_{0,1}\, Q_{k,i}$
Exp. (6.10a)	$\gamma_{G,j,sup}\, G_{k,j,sup}$	$\gamma_{G,j,inf}\, G_{k,j,inf}$		$\gamma_{Q,1}\, \psi_{0,1}\, Q_{k,1}$	$\gamma_{Q,1}\, \psi_{0,1}\, Q_{k,i}$
Exp. (6.10b)	$\xi\gamma_{G,j,sup}\, G_{k,j,sup}$	$\gamma_{G,j,inf}\, G_{k,j,inf}$	$\gamma_{Q,1}\, Q_{k,1}$		$\gamma_{Q,1}\, \psi_{0,1}\, Q_{k,i}$

Note
1 Design for either Expression (6.10) or the less favourable of Expressions (6.10a) and (6.10b).

Table 5
Design values of actions, derived for UK design, ultimate limit state – persistent and transient design situations

Combination Expression reference	Permanent actions		Leading variable action	Accompanying variable actions	
	Unfavourable	Favourable		Main (if any)	Others
Combination of permanent and variable actions					
Exp. (6.10)	1.35 G_k[a]	1.0 G_k[a]	1.5 Q_k		
Exp. (6.10a)	1.35 G_k[a]	1.0 G_k[a]		1.5 $\psi_{0,1}$[b] Q_k	
Exp. (6.10b)	0.925[d] x 1.35 G_k[a]	1.0 G_k[a]	1.5 Q_k		
Combination of permanent, variable and accompanying variable actions					
Exp. (6.10)	1.35 G_k[a]	1.0 G_k[a]	1.5 $Q_{k,1}$		1.5[c] $\psi_{0,i}$[b] $Q_{k,i}$
Exp. (6.10a)	1.35 G_k[a]	1.0 G_k[a]		1.5 $\psi_{0,1}$[b] Q_k	1.5[c] $\psi_{0,i}$[b] $Q_{k,i}$
Exp. (6.10b)	0.925[d] x 1.35 G_k[a]	1.0 G_k[a]	1.5 $Q_{k,1}$		1.5[c] $\psi_{0,i}$[b] $Q_{k,i}$

Key
a Where the variation in permanent action is not considered significant, $G_{k,j,sup}$ and $G_{k,j,inf}$ may be taken as G_k
b The value of ψ_0 can be obtained from Table NA A1.1 of the UK National Annex (reproduced here as Table 3)
c Where the accompanying load is favourable, $\gamma_{Q,i} = 0$
d The value of ξ in the UK National Annex is 0.925

Table 6
Design values of actions, serviceability limit states

Combination	Permanent actions		Variable actions		Example of use in Eurocode 2
	Unfavourable	Favourable	Leading	Others	
Characteristic	$G_{k,j,sup}$	$G_{k,j,inf}$	$Q_{k,1}$	$\psi_{0,i}\, Q_{k,i}$	
Frequent	$G_{k,j,sup}$	$G_{k,j,inf}$	$\psi_{1,1}\, Q_{k,1}$	$\psi_{2,i}\, Q_{k,i}$	Cracking – prestressed concrete
Quasi-permanent	$G_{k,j,sup}$	$G_{k,j,inf}$	$\psi_{2,1}\, Q_{k,1}$	$\psi_{2,i}\, Q_{k,i}$	Deflection

Notes
1 Where the variation in permanent action is not considered significant. $G_{k,j,sup}$ and $G_{k,j,inf}$ may be taken as G_k
2 For values of ψ_0, ψ_1 and ψ_2 refer to Table 3

Table 7
Example design combinations for deflection (quasi-permanent) derived for typical UK reinforced concrete design

Combination	Permanent actions	Variable action
	Unfavourable	Leading
Office	G_k[a]	0.3[b] $Q_{k,1}$
Shopping area	G_k[a]	0.6[b] $Q_{k,1}$
Storage	G_k[a]	0.8[b] $Q_{k,1}$

Key
a Where the variation in permanent action is not considered significant $G_{k,j,sup}$ and $G_{k,j,inf}$ may be taken as G_k
b Values of ψ_2 are taken from UK NA (see Table 3)

Eurocode 1

Eurocode 1 supersedes BS 6399: *Loading for buildings*[6] and BS 648: *Schedule of weights of building materials*[7]. It contains within its ten parts (see Table 8) all the information required by the designer to assess the individual actions on a structure. It is generally self-explanatory and it is anticipated the actions to be used in the UK (as advised in the UK National Annex) will typically be the same as those in the current British Standards. The most notable exception is the bulk density of reinforced concrete, which has been increased to 25 kN/m^3. Currently not all the parts of Eurocode 1 and their National Annexes are available, in which case it is advised that the loads recommended in the current British Standards are used.

Table 8
Eurocode 1, its parts and dates of publication

Reference	Title	Publication date	
		Eurocode	National Annex
BS EN 1991–1–1	Densities, self-weight and imposed loads	April 2004	Due November 2005 [a]
BS EN 1991–1–2	Actions on structures exposed to fire	November 2004	Due January 2006[a]
BS EN 1991–1–3	Snow loads	July 2003	Due November 2005[a]
BS EN 1991–1–4	Wind actions	April 2005	Due January 2006[a]
BS EN 1991–1–5	Thermal actions	March 2003	TBA
BS EN 1991–1–6	Actions during execution	July 2005	TBA
BS EN 1991–1–7	Accidental actions due to impact and explosions	Due March 2006 [a]	TBA
BS EN 1991–2	Traffic loads on bridges	October 2003	Due September 2006[a]
BS EN 1991–3	Actions induced by cranes and machinery	Due November 2006[a]	TBA
BS EN 1991–4	Actions in silos and tanks	Due March 2006[a]	TBA

Key
a Planned publication date (correct at time of publication) Source: BSI[8]

Eurocode 2

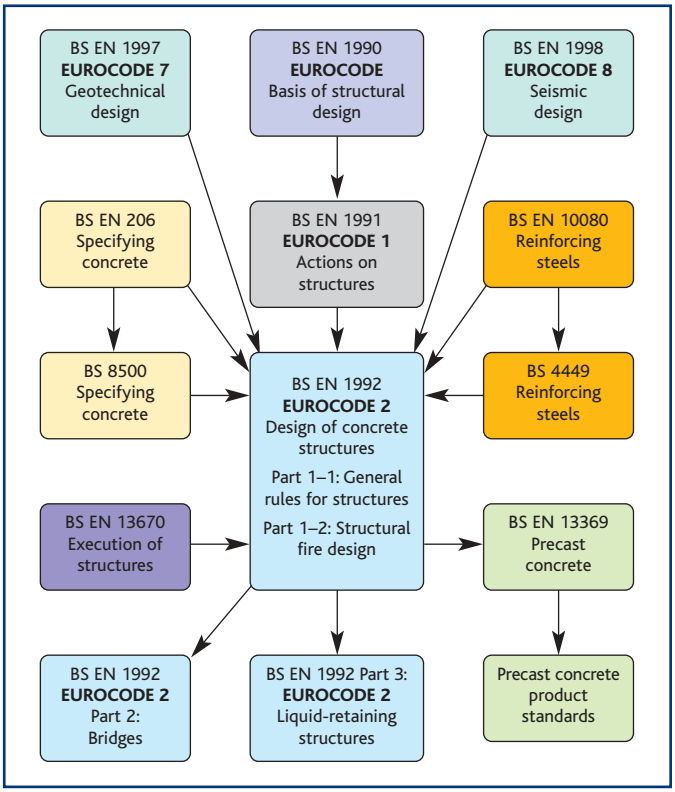
There are four parts to Eurocode 2; Figure 4 indicates how they fit into the Eurocode system, which includes other European standards.

Part 1–1

Eurocode 2, Part 1–1: *General rules and rules for buildings*[9] is the principal part which is referenced by the three other parts. For the UK designer there are a number of differences between Eurocode 2 and BS 8110, which will initially make the new Eurocode seem unfamiliar. The key differences are listed below to assist in the familiarisation process.

1. Eurocode 2 is generally laid out to give advice on the basis of phenomena (e.g. bending, shear etc) rather than by member types as in BS 8110 (e.g. beams, slabs, columns etc).
2. Design is based on characteristic cylinder strengths not cube strengths.
3. The Eurocode does not provide derived formulae (e.g. for bending, only the details of the stress block are expressed). This is the traditional European approach, where the application of a Eurocode is expected to be provided in a textbook or similar publication. The Eurocodes allow for this type of detail to be provided in 'Non-contradictory complementary information' (NCCI) (See Glossary).
4. Units for stress are mega pascals, MPa (1 MPa = 1 N/mm^2).
5. Eurocode 2 uses a comma for a decimal point. It is expected that UK designers will continue to use a decimal point. Therefore to avoid confusion, the comma should not be used for separating multiples of a thousand.
6. One thousandth is represented by ‰.
7. The partial factor for steel reinforcement is 1.15. However, the characteristic yield strength of steel that meets the requirements of BS 4449 will be 500 MPa; so overall the effect is negligible.
8. Eurocode 2 is applicable for ribbed reinforcement with characteristic yield strengths of 400 to 600 MPa. There is no guidance on plain bar or mild steel reinforcement in the Eurocode, but guidance is given in the background paper to the UK National Annex[10].
9. The effects of geometric imperfection ('notional horizontal loads') are considered in **addition** to lateral loads.

Figure 4
Relationship between Eurocode 2 and other Eurocodes



10. Minimum concrete cover is related to bond strength, durability and fire resistance. In addition to the minimum cover an allowance for deviations due to variations in execution (construction) should be included. Eurocode 2 recommends that, for concrete cast against formwork, this is taken as 10 mm, unless the construction is subject to a quality assurance system in which case it could be reduced to 5 mm or even 0 mm where non-conforming members are rejected (e.g. in a precast yard). It is recommended that the nominal cover is stated on the drawings and construction tolerances are given in the specification.
11. Higher strengths of concrete are covered by Eurocode 2, up to class C90/105. However, because the characteristics of higher strength concrete are different, some Expressions in the Eurocode are adjusted for classes above C50/60.
12. The 'variable strut inclination' method is used in Eurocode 2 for the assessment of the shear capacity of a section. In practice, design values for actual structures can be compared with tabulated values. Further advice can be found in the guide *How to design concrete structures using Eurocode 2: Beams*[11].
13. The punching shear checks are carried at 2*d* from the face of the column and for a rectangular column, the perimeter is rounded at the corners.
14. Serviceability checks can still be carried out using 'deemed to satisfy' span to effective depth rules similar to BS 8110. However, if a more detailed check is required, Eurocode 2 guidance varies from the rules in BS 8110 Part 2.
15. The rules for determining the anchorage and lap lengths are more complex than the simple tables in BS 8110. Eurocode 2 considers the effects of, amongst other things, the position of bars during concreting, the shape of the bar and cover.

Part 1–2

Eurocode 2, Part 1–2: *Structural fire design*[12], gives guidance on design for fire resistance of concrete structures. Although much of the Eurocode is devoted to fire engineering methods, the design for fire resistance may still be carried out by referring to tables for minimum cover and dimensions for various elements. These are given in section 5 of Part 1–2. Further advice on using the tabular method is given in the guide *How to design concrete structures using Eurocode 2: Getting started*[13].

Part 2

Eurocode 2, Part 2: *Bridges*[14] applies the general rules given in Part 1–1 to the design of concrete bridges. As a consequence both Part 1–1 and Part 2 will be required to carry out a design of a reinforced concrete bridge.

Part 3

Eurocode 2, Part 3: *Liquid-retaining and containment structures*[15] applies the general rules given in Part 1–1 to the liquid-retaining structures and supersedes BS 8007[16].

Eurocode 7

Eurocode 7: *Geotechnical design*[17] is in two parts and gives guidance on geotechnical design, ground investigation and testing. It has a broad scope and includes the geotechnical design of spread foundations, piled foundations, retaining walls, deep basements and embankments. Like all the Eurocodes it is based on limit state design principles, which is a significant variation for most geotechnical design. Further guidance related to simple foundations is given in the guide *How to design concrete structures using Eurocode 2: Foundations*[18].

Eurocode 8

Eurocode 8: *Design of structures for earthquake resistance*[19] is divided into six parts and gives guidance on all aspects of design for earthquake resistance and covers guidance for the various structural materials for all types of structures. It also includes guidance for strengthening and repair of buildings. In areas of low seismicity it is anticipated that detailing structures to Eurocode 2 will ensure compliance with Eurocode 8.

Related Standards

BS 8500/BS EN 206

BS 8500: *Concrete – Complementary British Standard to BS EN 206–1*[20] replaced BS 5328 in December 2003 and designers should currently be using this to specify concrete. Further guidance can found in the publication *How to use BS 8500 with BS 8110*[21] available from The Concrete Centre.

BS 4449/BS EN 10080

BS 4449: *Specification for carbon steel bars for the reinforcement of concrete*[22] has been revised ready for implementation in January 2006. It is a complementary standard to BS EN 10080 *Steel for the reinforcement of concrete*[23] and Normative Annex C of Eurocode 2. The most significant changes are that steel characteristic yield will change to 500 MPa. There are three classes of reinforcement, A, B and C, which indicate increasing ductility. Class A is not suitable for use where redistribution of 20% and above has been assumed in the design.

BS EN 13670

BS 8110 Part 1 sections 6 and 7 specify the workmanship for concrete construction. There is no equivalent guidance in Eurocode 2, and it is intended that execution (construction) will be covered in a new standard BS EN 13670 *Execution of concrete structures*[24]. This is still in preparation and is not expected to be ready for publication until 2008 at the earliest. In the intervening period the draft background paper to the UK National Annex of Eurocode 2, Part 1–1[10] recommends that designers use the *National structural concrete specification for building construction*[25], which refers to BS 8110 for workmanship.

Glossary of Eurocode terminology

Term	Definition
Principles	Clauses that are general statements, definitions, requirements and analytical models for which no alternative is permitted. They are identified by (P) after the clause number.
Application Rules	These are generally recognised rules, which comply with the principles and satisfy their requirements.
Nationally Determined Parameter (NDP)	Eurocodes may be used to satisfy national Building Regulations, which themselves will not be harmonized. NDPs are therefore used to allow a country to set its own levels of safety. NDPs also allow certain other parameters (generally influenced by climate, geography and geology) to be left open for selection nationally: NDPs are advised in the National Annex.
National Annex (NA)	A National Annex accompanies each Eurocode and it contains a) the values of NDPs b) the national decision regarding the use of Informative Annexes and c) references to NCCIs
Normative	The term used for the text of Standards that forms the core requirements. Compliance with Eurocodes will generally be judged against the normative requirements.
Informative	A term used only in relation to annexes, which seek to inform rather than require.
NCCI	Non-contradictory complementary information. References in a National Annex which contains further information or guidance which does not contradict the Eurocode.
Characteristic value	A value that may be derived statistically with a probability of not being exceeded during a reference period. The value corresponds to a specified fractile for a particular property of material or product. The characteristic values are denoted by subscript 'k' (e.g. Q_k etc). It is the principal representative value from which other representative values may be derived.
Representative value	Value used for verification of a limit state. It may be the characteristic value or an accompanying value, e.g. combination, frequent or quasi-permanent.
Design values	These refer to representative values modified by partial factors. They are denoted by subscript 'd' (e.g. $f_{cd} = f_{ck}/\gamma_c$; $Q_d = \gamma_Q Q_k$).
Action (*F*)	Set of forces, deformations or accelerations acting on the structure.
Combination of actions	Set of design values used for the verification of the structural reliability for a limit state under the simultaneous influence of different and statistically independent actions.
Fixed action	Action that has a fixed distribution and position over the structure or structural member.
Free action	Action that may have various spatial distributions over the structure.
Permanent actions (*G*)	Actions that are likely to act throughout the life of the structure and whose variation in magnitude with time is negligible (e.g. permanent loads).
Variable actions (*Q*)	Actions whose magnitude will vary with time (e.g. wind loads).
Effect of action (*E*)	Deformation or internal force caused by an action.
Accidental action (*A*)	Action, usually of short duration but of significant magnitude, that is unlikely to occur on a given structure during the design working life.
Accompanying action	An action in a combination that is not the leading variable action.
Transient design situation	Design situation that is relevant during a period much shorter than the design working life of the structure.
Persistent design situation	Design situation that is relevant during a period of the same order as the design working life of the structure.
Accidental design situation	Design situation involving exceptional conditions of the structure.
Irreversible serviceability limit state	Serviceability limit state where some consequences of actions will remain when the actions are removed.
Reversible serviceability limit state	Serviceability limit state where no consequences of actions will remain when the actions are removed.
Execution	Construction of the works.

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24 BRITISH STANDARDS INSTITUTION. EN 13670: *Execution of concrete structures – Part 1: Common.* BSI, due 2008.
25 THE CONCRETE SOCIETY. CS 152: *National structural concrete specification for building construction,* third edition. The Society, 2004.

Further guidance and advice

- Guides in this series cover: *Introduction to Eurocodes, Getting started, Slabs, Beams, Columns, Foundations, Flat slabs* and *Deflection*. For free downloads, details of other publications and more information on Eurocode 2 visit www.eurocode2.info
- For information on all the new Eurocodes visit www.eurocodes.co.uk

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For more information on Eurocode 2 and other questions relating to the design, use and performance of concrete contact the free National Helpline on:

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ATTACHMENT

FOUR

OSHA Guide Sheets

Attachment follows this cover sheet.

5.0 GUIDE FOR THE ABATEMENT CF THE TOP 25 MOST CITED PHYSICAL HAZARDS

The **GUIDE** consists of the following: 1) Section 5.1 contains the top 25 most frequently cited physical standards or hazards from the 100 Physical List presented in TABLE 3-1 (see page 18), each **GUIDE** is presented as an individual information/data source for each standard; 2) Section 5.2 consists of two tables related to construction specifications for guardrails and toeboards that are common for eve of the individual **GUIDE** Sheets; and 3) Section 5.8 contains a list of additional sources of further OSHA and industry information.

5.1 THE TOP 25 GUIDE SHEETS

The following section presents individual **GUIDE** Sheets to help employers, employees and OSHA personnel identify and abate the 25 most frequently cited physical hazards on construction sites.

RANK IN FREQUENCY CITED	1926.	
#1	500(d)(1)	GUARGDRAILS NOT PROVIDED FOR OPEN-SIDED FLOORS OR PLATFORMS

RULE: ***Every open-sided floor or platform 6 feet or more above adjacent floor or ground level shall be guarded by a standard ramp, or the equivalent , as specified in paragraph (f)(1) of this section, on all open sides, except where there Is an entrance to a ramp, stairway, or fix ladder. The railing shall be provided with a standard toeboard wherever, beneath the open sides, persons can pass, or there is moving machinery, or there Is equipment with which falling materials could create a hazard.***

INTENT:
Falls from elevations are the leading cause of fatalities in the construction industry. From 1985-1989, 33% of all construction fatalities [10] resulted from a fall from an elevation. One hundred-seventeen fatalities occurred when employees fell from open sided doors and through floor openings. This standard specifies that guarding must be provided for all open-sided floors and platforms 6 feet or more in height. It also specifies minimum requirement for the type of guarding. Paragraph (f) of the same section species the requirement of a standard guardrail system. TABLE 5.2-1 lists guardrail specifications for various materials. Where there is an open-sided floor/platform and there is a potential for a person to pass or a hazard is presented by machinery, toeboards are required. The intent is to contain any materials near the edge from inadvertently getting pushed over the edge where they may strike persons or machinery below. TABLE 5.2-2 lists specifications for toeboards.

HAZARDS:

- Falls from elevations: probable injuries range from death to fractures; Fall from lower elevations such as 4-6 feet have caused serious lost-time accidence and occasionally have been the cause of fatalities.
- Struck by: the lack of material containment (toeboards) has caused both fatalities and lost-time accidents when falling materials have struck employees below.

(AMONG OTHER) SUGGESTED ABATEMENTS:

- Whenever an employee must work at any elevated location, ask the questions: 1) Are they protected from a fall? and 2) What measures must be taken to protect the employee at the elevated work location?
- Fall prevention systems such as standard guardrail systems provide more positive means of protection than fall protection systems such a bodybelt/harness-lanyard-lifeline combination, except when workers are suspended, i.e. working on suspended scaffolds, work platforms, etc.
- Construct/maintain all guardrail systems according to OSHA requirements.
- An acceptable method to preclude the use of toeboards, would be to determine the fall radius of materials on an open-sided door/platform. Place positive physical barrier outside the potential fall radius to keep workers and machines outside the danger zone.

SELECTED CASE HISTORIES:
An employee taking measurements was killed when he fell backwards from an unguarded balcony to the concrete 9'6" below.

COMMENTS:

- Falls from elevations accounted for 14% of all lost-time accidents[6].
- This standard was cited in 103 fatality/catastrophe inspections conducted by OSHA over a 4 year period.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Section 500 & Steel Erection - 750 & 752(k); [11]; [12]; [13]; [26] Part - 701(f)(2) - Concrete and Masonry Const.

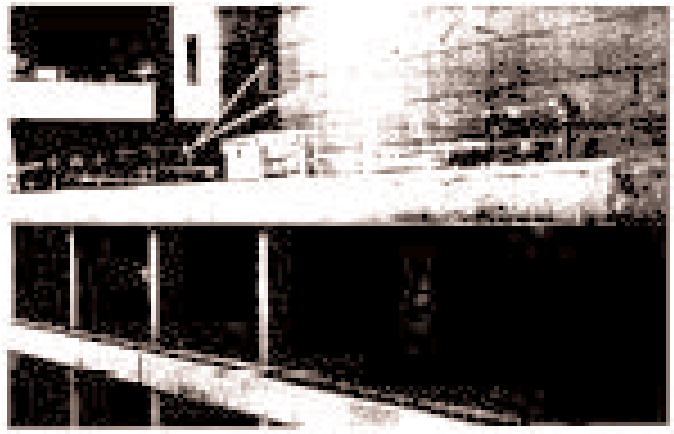
OSHA COMPLIANCE LETTER
Date 5/22/84; From-Directorate of Field Operations to Regional Administrators; Synopsis - Clarification of 1926.750(b)(1)(iii) stating that ½ " wire rope or equivalent safety railing must be used around temporary planked or temporary metal-decked doom during steel erection operation. Raging also must be provided at leading edge if spreading stops for any significant time period. ½ " synthetic or fiber rope would not be acceptable as a required safety railing for steel erection operations.

OSHA COMPLIANCE LETTER
Date 1/13/81; From-Assistant Secretary to Int. Union of Bricklayers & Allied Craftsmen; Synopses - Standards 1926.28, 1926.104, 1926.105 & 1926.500(d)(1) do not apply to overhand bricklaying operations.

OSHA COMPLIANCE LETTER
Date 2/13/86; From-Directorate of Field Operations to Individual Company; Synopses - When structural steel assembly including decking has been completed and other trades are working on the deck while concrete is being poured on the deck, the door must be guarded in accordance with 1926.500(d)(1).

☑ **VIOLATION** ☐ IN-COMPLIANCE

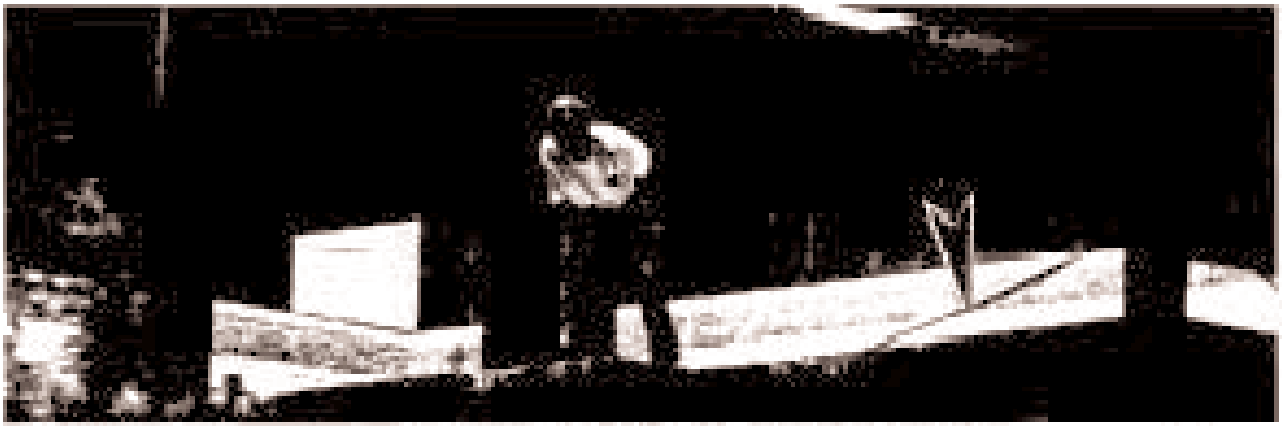
Exposure to open-sided floor



☐ VIOLATION ☑ **IN-COMPLIANCE**

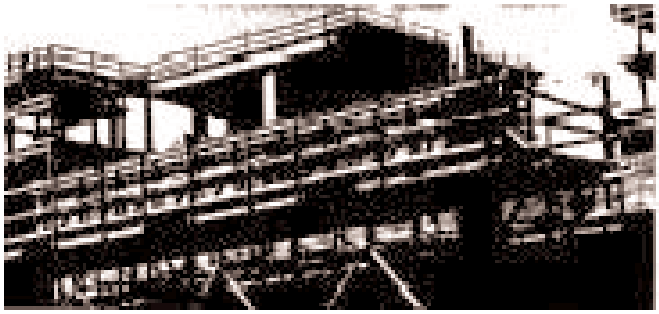
Properly erected wire rope perimeter guardrail system.

NOTE: The high visibility tape on wire rope (arrow) on top floor makes the guardrail easier for the employees to see.



☑ **VIOLATION** ☐ IN-COMPLIANCE

Too much sag in the wire rope (arrows) guard rails



☐ VIOLATION ☑ **IN-COMPLIANCE**

Properly erected wooden guardrail system for platform.

NOTE: The top erection floor has a properly erected wire rope guardrail system.

RANK IN FREQUENCY CITED	1926.	HEAD PROTECTION FROM IMPACT, FALLING OR FLYING OBJECTS AND ELECTRICAL BURNS
#2	100(a)	

RULE: ***Employees working in areas were there is a possible danger of head injury from impact, or from failing or flying objects, or from electrical shock and burns shall be protected by protective helmets.***

INTENT

Thousands of head injuries each year occur in the construction industry. This standard requires employees to wear "hard hats" to mitigate or lessen the effects of being struck by an object, accidentally striking their head against an objects or making contact with an energized electrical line. It needs to be emphasized that the standard is not just for employees that work at sites where there is a possibility of falling objects striking them in the bead, in workers on lower levels of a mufti-story budding project which are exposed to falling materials such as hand tool, bolts, nuts, etc. But it is also intended for employees who work in the vicinity of an operation that is found on a construction site. These type of energy releases are common to almost all construction operation and are not predictable. Almost all construction operations involve the potential of falling and flying objects, and, therefore, employees must wear head protection. Additionally many impact hazards exist. For instance, iron workers are constantly exposed to striking their heads on structural steel during erection, carpenters strike their heads on temporary framing lumber as they move through a building, etc. Employees that work in the vicinity of electrical conductors are exposed to potential shocks and burns to the head should they contact an uninsulated conductor.

HARZARDS

Struck by: injuries ranging from death to major concussion or trauma to minor abrasions; electrocution.

(AMONG OTHER) SUGGESTED ABATEMENT(S):

• Emphasize that the wearing of hard hats is not only for those employees that are exposed to falling objects, but it is also for employees exposed to the other types or hazards.

• Focus on the wearing of hard hats during site inspections. Check hard hats to insure their integrity is not compromised. Metal hard hats are electrical conductors and do not meet the requirement of OSHA and ANSI.

• A formal management discipline program may need to be utilized for those employees who after repeated warnings either refuse or "forget" to wear their hard hats where required.

SELECTED CASE HISTORIES

• An employee was standing under a suspended scaffold that was hosting a workman and 3 sections of ladder. Sections of the ladder became unlashed and fell ≈ 5O feet striking the employee in the skull. The employee, who was not wearing any head protection died from injuries received.

• Two employees were using a wire rope to winch a wooden tool shed onto a flat bed trailer. The wire rope broke, snapped back struck one of the employees in the top of the head, killing him. The employee was not wearing a hard hat.

• Employees were using a 5-ton winch to pull a 10-foot section of a 600 lb. grain spout through a vent hole when the spout became wedged. Employees were attempting to use pry bars to free the spout that was still under tension from the winch when the spout popped free, striking an employee in the head. No head protection was provided.

COMMENTS

1. OSHA [6] found that in a four year period from 1985 to 1988, 3.2% (11,685) of all construction lost time accidents in 10 states were related to head injuries.
2. All lost-time accidents involving head injuries do not result from being struck by falling and flying objects. OSHA [6] found that the head was the "Part of Body" injured in 9% (7125) of the "Struck By" (falling and flying object) type injuries. This compared to 5% (1440) for "Struck Against", (impact) type injuries; in other words, impacts are the cause of about 17% of all lost time head injuries.
3. This standard was cited in 142 fatality/catastrophe inspections by OSHA in a five year period.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE

[l] Section 100 (b)& (c); [7]*; [8]*; [9], [25].

*- Referenced in 29 CFR 1926- Construction Standards

OSHA CLARIFIICATION LETTER

Date 8/23/83 – Synopsis – The employer must determine which employees face possible head injuries and must wear appropriate head protection. OSHA has no exhaustive guidelines for determining when head protection must be worn. A case-by-case analysis must be performed by the employer.

OSHA CLARIFICATION LETTER
Date 7/22/92; From Directorate of Compliance to IBEW Business Manager – Synopsis – Wearing of hard hats with bill to the rear would not meet 1926.100(a) & (b) unless manufacturer certifies that this practice meets ANSI Z89.1-1969. ANSI test and certifies hard hats with bills facing forward.

PHOTOGRAPHS, ILLUSTRATIONS and OTHER DOCUMENTS

☐ VIOLATION ☑ **IN-COMPLIANCE**

Hardhat meets OSHA and ANSI Z89.1-1969, Safety Requirements for Industrial Head Protection

☑ **VIOLATION** ☐ IN-COMPLIANCE

Work is in progress on top of scaffold. The workers drilling below scaffold are exposed to being struck by falling materials. There is a need for head protection which is not provided by the soft hats shown

☑ **VIOLATION** ☐ IN-COMPLIANCE

The inspector on the ground (arrow) is exposed to falling materials. Therefore, head protection is required for him. The carpenters would most likely not be exposed to falling materials in this situation. However, a flying material hazard may exist and the operation must be evaluated to determine if head protection is required. NOTE: Fall hazards do exist at the perimeter and at the floor openings. Also, an improperly constructed ladder is being used.

RANK IN FREQUENCY CITED	1926.	
#3	404(b)(1)(i)	GROUND FAULT PROTECTION NOT PROVIDED

RULE: ***General. The employer shall use either ground faun circuit Interrupters as specified in paragraph (b)(1)(III) of this section or an assured equipment grounding conductor program as specified in paragraph (b)(1)(III) of this section to protect employees on construction sites. These requirements are in addition to any other requirements for equipment grounding conductors.***

INTENT:
Due to the dynamic, rugged nature of a typical construction site, electrical equipment, especially tools and extension cords are much more susceptible to deterioration due to "normal" use and sometimes abuse. When the deterioration occurs, sometimes insulation cracks or breaks exposing bare energized conductors, stress and strain may cause terminal screws to loosen resulting in one conductor short-circuiting another, etc.. The result can be that fault current is generated which may be directed through an employee's body to ground. Wet conditions often found at construction sites, greatly increase this hazard. This standard offers the employer two additional methods beyond the required equipment grounding conductor, to reduce and/or eliminate fault current which might be generated in any electrical system or tool during use. One means is to provide ground fault circuit interrupters **(GFCI**'s) in all temporary receptacle outlets rated 120 volt single phase, 15&20 amps. This is essentially a hardware requirement. The **GFCI** continually monitors and compares the amount of current going to an electrical tool or piece of equipment against the amount of current returning along the "grounded neutral". If the differential in current (amount going to the tool vs. amount coming from tool) is more than 5 milliamps, the GF C1 is designed to trip in about 1/40 of a second. The other option is to establish and fully implement an **Assured Equipment Grounding Conductor Program** (AEGCP). This program relies on daily visual inspections and periodic (three months maximum for temporary cords and cords exposed to damage, six months for fixed cords not exposed) test inspections. Additionally, the AEGCP requires a written description, a competent person to implement the program and a record of the periodic tests.

HAZARDS:
Fatal electrocutions; Electrical burns ranging from critical to mirror; Fire; Explosion; Electric shock has been the initiator of other type hazards, i.e. electrical shocks have been the initiating cause of employees falling from elevated work surfaces, electrical shocks have caused employees to lose control of hand held equipment which in turn has struck and injured other employees in the immediate work area, etc.

(AMONG OTHER) SUGGESTED ABATEMENTS:
• Instruct employees to visually inspect all electrical equipment p prior to u-se. Any defects such as frayed cords; missing ground prongs, cracked tool casing, etc. should be corrected by taking the tool out-of-service. Apply a warning tag to the tool and do not allow it to be used until the problem has been corrected.
• Frequently trip GFCI's while test tool is operating to insure GFCI is operating correctly.
• Use double insulated tools. Double insulated too1s protect the user from fault currents which might energize the case of the tool or equipment.

SELECTED CASE HISTORIES:
A journeyman HVAC worker was installing metal duct work using a double insulated drill connected to a drop light cord. Power was supplied through two extension cords from a nearby residence. The individual's wet clothing/body contacted bare exposed conductors on one of the cords causing an electrocution. No GFCI's were used. Additionally, the ground prongs were missing from the 2 cords.

COMMENTS:
1. Although it was suggested above to use double insulated tools, it does not relieve the employer from providing ground fault protection. Extension cords in use between a fixed electrical system (permanent outlet) and a tool can become worn with exposed energized conductors. Therefore, ground fault protection or an AEGCP would be required. See OSHA CLARIFICATION LETTER below.
2. According to OSHA[10] there were 48 fatalities in the years 1985 to 1989 related to 120 volt electrical systems.
3. Employers have attempted to skirt the requirements of providing ground fault protection by using 30 amp breakers in their 120 volt, single phase systems. This not only defeats the intent of the ground fault provisions it also introduces another set of hazards because the system is no longer rated fro the actual over current protection (30 amp breaker) that is in place.

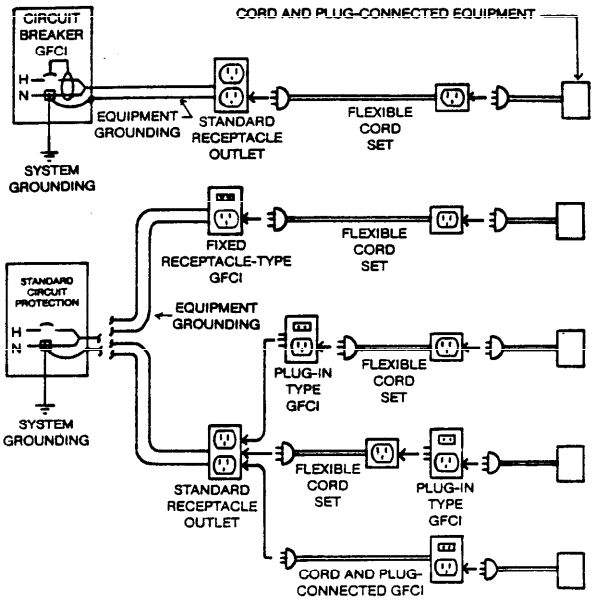
ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Section 404(b); [3]; [4]; [5]

OSHA CLARIFICATION LETTER

Date 11/4/92; Directorate Compliance Programs to Private Company; Synopsis - If all extension cord sets and/or portable tool assemblies are approved and used in such a manner that the entire lengths of all cords which are provided power from either permanent or temporary wiring are provided with GFCI protection then the employer would be in compliance. If any of the cords or tools in a series are not protected by a GFCI, then an AEGCP would be required for all the cords and tools including the ones which are protected by a GFCI.

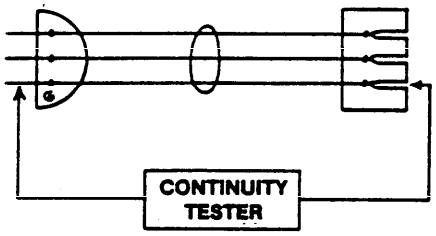
PHOTOGRAPHS, ILLUSTRATIONS and OTHER DOCUMENTS

RECEPTACLES WHICH ARE IN USE BY EMPLOYEES SHALL HAVE GFCI'S FOR PERSONNEL PROTECTION OR THE ASSURED EQUIPMENT GROUNDING PROGRAM[31]



RECEPTACLES WHICH ARE NOT A PART OF THE PERMANENT WIRING CAN BE PROTECTED IN ONE OF SEVERAL WAYS USING GFCI'S.

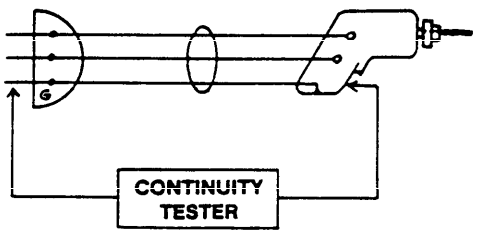
120 VOLT, SINGLE-PHASE, 15 OR 20 AMPERE FIXED RECEPTACLE OUTLET



FLEXIBLE CORD SET FOR 120 VOLT 15 OR 20 AMPERE RECEPTACLE

TEST FOR CORRECT CONNECTION AND ELECTRICAL CONTINUITY OF THE EQUIPMENT GROUNDING CONDUCTOR

A DOCUMENTED TESTING PROCEDURE MAY BE SUBSTITUTED FOR THE USE OF GFCI'S.



120 VOLT CORD AND PLUG-CONNECTED EQUIPMENT

CONSTRUCTION SITES

RANK IN FREQUENCY CITED	1926.	ELECTRICAL PATH TO GROUND MISSING OR DISCONTINOUS
#4	404(f)(6)	

RULE: ***Grounding Path. The path to ground from circuits, equipment, and enclosures shall be permanent and continuous***

INTENT:
Many times on construction sites due to the frequency and severity of use, electrical equipment that is originally designed and provided an electrical path to ground is not capable of physically transferring "fault" current to ground became he positive physical path (a direct positive conn ection through the entire system usually terminating at a ground rod or cold water pipe) to ground, sometimes known as the "ground wire" or "equipment ground" is proved to transfer fault current to ground in the event that an exposed part of the piece of equipment were to be energized by the "hot" conductor or wire in the system, i.e. the case of an electric drill might be energized by fault current if the internal windings came in contact with the case or contact is made with an exposed conductor. The "equipment ground" would, in the case of the drill, provide a favorable path of least resistance for the fault current to ground through the conductor. If the "equipment ground" was not continuous the path of least resistance from the drill might be through a persons body.

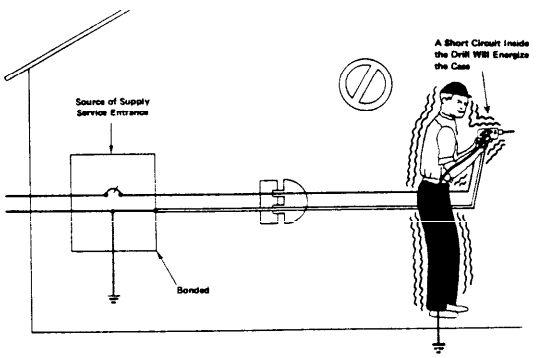
HAZARDS:
Electrical shock; Probable injuries range from death to minor burns; Fire; Explosion; Electric shock has been the initiator of other Type hazards, i.e. electrical shocks have been the initiating cause of employees falling from elevated work surfaces, WNW shocks have caused employees to lose control of hand held equipment which in turn has struck and injured other employees in the immediate work area, etc.

(AMONG OTHER) SUGGESTED ABATEMENTS:
• Instruct employees to visually inspect all electrical equipment prior to use. Any defects such as frayed cords, missing ground prongs, cracked tool casing, etc. should be corrected by taking the tool out-of-service. Apply a warning tag to the tool and do not allow it to be used until the problem has been corrected.
• Frequently inspect electrical systems to insure the path to ground is continuous. A volt-ohm meter rated for the proper capacity could be used to check for ground in an electrical circuit A receptacle circuit tester can be used to check the continuity of the grounding conductor from a 120 volt receptacle back to ifs origin at the breaker box. This type tester depending on manufacturer usually has the ability to check for wiring configurations including correct wiring, reversed polarity, open neutral, open hot, etc. Additionally, it is relatively inexpensive- usually less than $20 dollars and can be easily carried in a pants pocket. A pocket pen light continuity checker is an inexpensive piece of equipment that can be used to check the "equipment bonding" conductor of cord and plug connected equipment, i.e. drills, saws, sanders, etc.
• Use double insulated tools. Double insulated tools protect the user from fault currents which might energize the case of the tool or equipment. If electrical equipment is double insulated it must be distinctively marked.

SELECTED CASE HISTORIES
A fan connected to a 120-volt electrical system via an extension cord provided ventilation for an employee performing a chipping operation from an aluminum. stepladder. The insulation on the extension cord was cut through and exposed bare energized conductors which made contact with the ladder. The ground wire was not attached on the male end of the cord's plug. When the energized conductor made contact with the ladder, the path to ground included the employee's body resulting in death.

COMMENTS
1. A large majority (estimated from many compliance staff sources) of the citations under this standard are issued because ground prongs are missing from cord and plug connected equipment or extension cords.
2. Sometimes ground prongs are intentionally removed from tools and extension cords because, "it makes them easier and quicker to plug into and remove." Statements such as these heard from employees clearly indicate that they do not understand the importance of the of the components of the equipment grounding system.
3. For five years, citations were issued to the contractor who employed the deceased employee in 93 fatality/catastrophe investigations that OSHA conducted, where the absence of a required equipment grounding conductor or lack of continuity of the conductor were listed as a factor.

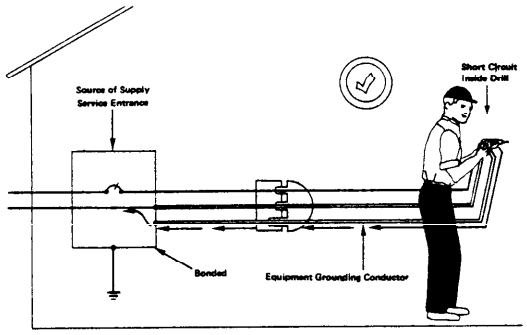
ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE
[1] Section 404(f); [2] pg. 5; [3] pgs. 35-58; [4]; [5] Art. 250



IF A FAULT OCCURS, THE CURRENT WILL FOLLOW THE PATH OF LEAST RESISTANCE TO GROUND. IF THE WORKER PROVIDES A PATH TO GROUND AS SHOWN, SOME PORTION OF THE CURRENT WILL FLOW AWAY FROM THE GROUNDED WHITE CONDUCTOR (NEUTRAL) AND RETURN TO THE GROUND THROUGH THE WORKER. THE SEVERITY OF THE SHOCK RECEIVED WILL DEPEND ON THE AMOUNT OF CURRENT THAT FLOWS THROUGH THE WORKER.

CORD AND PLUG CONNECTED EQUIPMENT WITHOUT A GROUNDING CONNECTOR.

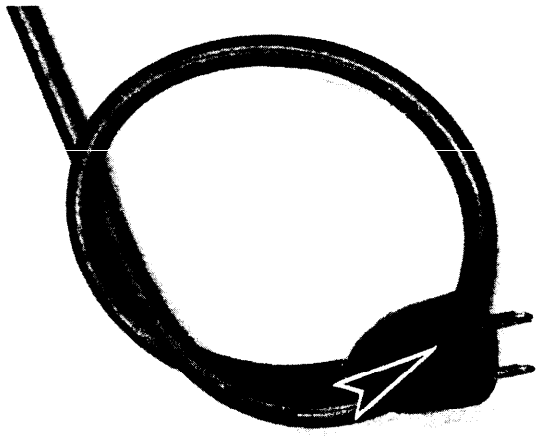
☑ **VIOLATION** ☐ IN-COMPLIANCE



DANGEROUS FAULT CURRENT NOW IS REDIRECTED ALONG THE EQUIPMENT GROUNDING CONDUCTOR BACK TO THE SOURCE OF ELECTRICAL SUPPLY TO OPERATE OVERCURRENT DEVICE.

CORD AND PLUG CONNECTED EQUIPMENT WITH A GROUNDING CONNECTOR.

☐ VIOLATION ☑ **IN-COMPLIANCE**

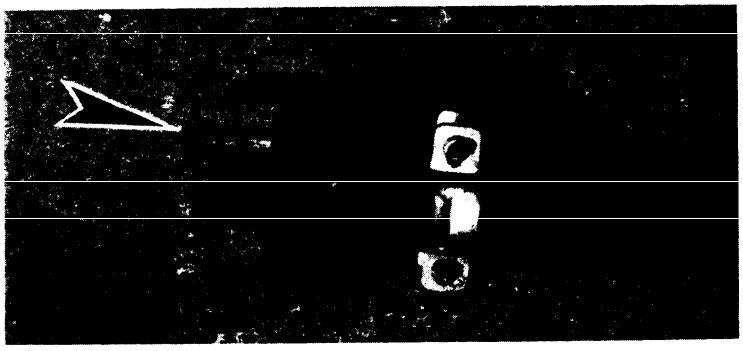


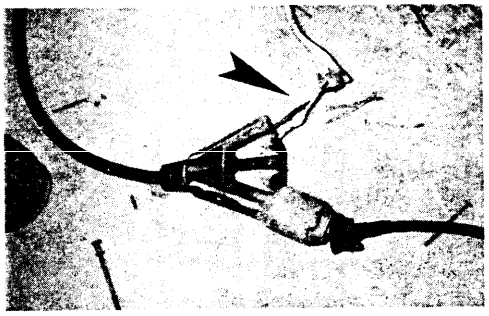
☑ **VIOLATION** ☐ IN-COMPLIANCE

Equipment grounding conductor, i.e. ground prong, missing (arrow).

☐ VIOLATION ☑ **IN-COMPLIANCE**

Ground prong (arrow) in-place and conductor is continuous.





☑ **VIOLATION** ☐ IN-COMPLIANCE

2 conductors (arrow) from non-metallic (NM) sheath cable rigged to multi-receptacle extension cord. No grounding provided. NOTE: Other violations include using NM cable in a manner not prescribed and strain relief was not provided for the other attachment plug shown (see tape at base of plug).

RANK IN FREQUENCY CITED	1926.	
#5	652(a)(1)	PROTECTIVE SYSTEMS FOR TRENCHING/EXCAVATING

RULE: ***Each employee in an excavation shall be protected from cave-fns by an adequate protective system designed in accordance with paragraph (b) or (c) of this section..***

INTENT:
Excavation accidents often result in serious injury or death. California reports a ratio of lost-time accidents to fatalities [14] for cave-ins aqua to 14:1. In contrast that same ratio for all types industry in California a 250:1. From 1985-1989 OSHA investigated 239 excavation fatalities [10]. This rule is basically a general rule and it's intent is to state that the employer will utilize some means of protection when employees are working in an excavation. This standard requires employers to protect employees from cave-ins. Later paragraphs, Paragraph (b) "Design of Sloping and Benching Systems" and Paragraph (c) "Design of Support System, Shield Systems and Other Protective Systems give specific alternatives and corresponding appendices to help the employer comply with the rule (NOTE: Appendices A - F provide valuable information for complying with the standard). The rule does not cover excavations in stable rock and excavations less the 5 feet deep - ONLY when the competent person evaluates the excavation and states there is no potential for cave-ins.

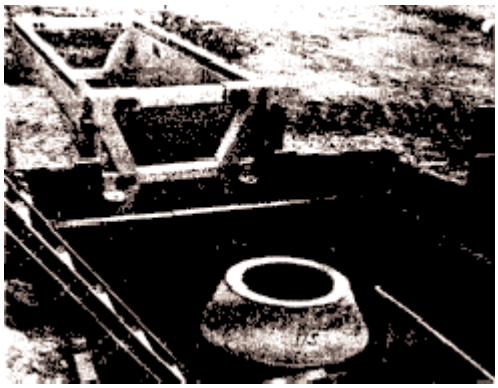
HAZARDS:
A cave-in is the greatest risk associated with excavation, Fatalities can be expected if a cave-in occurs. Other type hazards which are similar to confined space situations should be expected including asphyxiation due to lack of O_2, inhalation of toxic materials, fire, drowning, etc. Moving machinery near the edge of the excavation can cause a surcharge (overloading) of the excavation wall that can cause collapse. Plus, the same machinery and vehicular traffic can strike employees. Many accidence occur when workers contact or sever underground utility lines.

(AMONG OTHER) SUGGESTED ABATEMENTS:
o Pre job planning is vitally important to this operation. The soil must be evaluated so the employer can select an appropriate protective system. Utilities must be contacted so they can identify their underground lines, traffic control may be an issue, an attempt to identify previous site history must be made, in. was the excavation previously backfilled?, etc.
o Construct all protective systems in accordance with the standard.
o Inspect the site daily at the start of each shift, following a rainstorm or after any other hazard increasing event.
o Keep excavations open *the minimum* amount of time needed to complete operations.

SELECFED CASE HISTORIES:
o Two employees were installing 6' PVC pipe in a 40 long x 9t x 2t wide trench. No means of protection was provided in the vertical wall trench. A cave-in occurred fatally injuring one employee and causing serious facial injuries to the second employee.
o An inadequately protected trench wall collapsed killing one employee who had just gotten into the trench to check grade for installation of an 8N sewer line. The trench was = 201-25, deep and had been benched ≈ one bucket width (40 on each side. At the time of collapse the backhoe was extracting soil from the trench.
o Four employees were in an excavation 9, wide x 3V long x 71 deep were boring a hole under a road. Eight foot steel plates used as shoring were placed against the side walls of the excavation at about 30 degree angles. No horizontal bracing was used. One of the plates tipped over crushing an employee.

COMMENTS:
1. Of all the excavation standards, this one is cited the most often because it is the appropriate standard to cite when no protection at all is provided. Unfortunately, many employers engaged in this activity, still provide no protection for their employees.
2. This standard is written in a unique manner -"Each employee..", which gives OSHA, the option to cite this particular standard for each exposed employee.
3. 'This standard was cited in 47 fatality/catastrophe inspections conducted by the Agency from March 1990 to January 1992.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[141, [20]



☐ VIOLATION ☑ **IN-COMPLIANCE**

Properly constructed timber shoring and trench box (left)

NOTE: The plywood (bottom right) is not a structural member of the shoring system. It is to be used only to prevent the soil in the sidewalls from raveling.

☑ **VIOLATION** ☐ IN-COMPLIANCE

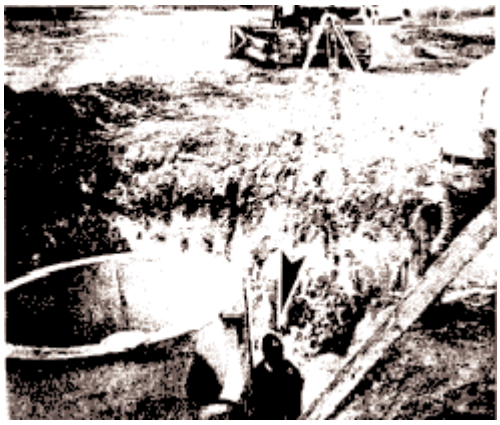
Employees in vertical wall trench with no sidewall protection (above).

☑ **VIOLATION** ☐ IN-COMPLIANCE

Improper shoring including bracing is not secured (above)

☑ **VIOLATION** ☐ IN-COMPLIANCE

Employees is exposed (arrow) between concrete manhole and unprotected sidewall of excavation (right).



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RANK IN FREQUENCY CITED	1926.	GUARDRAIL SPECIFICATIONS FOR TUBULAR WELDED FRAME SCAFFOLDS
#6	451(d)(10)	

RULE: ***Guardrails made of lumber, not less than 2 x 4 inches(or other material providing equivalent protection), and approximately 42 inches high, with a midrail of 1 x 6 inch lumber (or other material providing equivalent protection), and toeboards, shall be installed at all open sides and ends on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(6) of this section.***

INTENT:
OSHA investigated 214 fatalities from 1985-1989 [10] related to falls from scaffolds. The intent of this standard is to provide specifications far a fall prevention system, i.e. standard guardrails and toeboards, on tubular welded frame scaffolds. Because this is a specification standard it only applies to tubular welded frame type scaffolds. Note: This standard requires both standard guardrails and toeboards at a height of 10'. The general scaffold requirement 1926.451(a)(4) which requires guardrails between 41-10, when the minimum horizontal dimension of the scaffold is < 45', does not include tubular welded frame scaffolds, see **OSHA CLARIFICATION LETTER** below. Other guardrail materials which would provide equivalent protection are listed in TABLE 5.2-1. When persons must work or pass under a tubular welded scaffold, wire mesh construction is required. This includes a minimum No. 18 gauge US. Standard wire ½-inch mesh or equivalent extending along entire opening from toeboard to top rail. If persons are not required to work or pass under the scaffold only a toeboard is necessary (see TABLE 5.2-2 for acceptable toeboard specifications).

HAZARDS:
- Fall from elevation. Probable injuries range from death to severe sprains/strains.
- Struck by falling objects from scaffold platforms with insufficient material containment systems, i.e. wire mesh screen or toeboards. Probable injuries could include death or lost-time injuries duet) head concussion, broken bones in the upper body areas, etc.

(AMONG OTHER) SUGGESTED ABATEMENTS:
- Whenever employees must work any elevated location, ask: 1) Are they protected from a fall? and 2) What measures must be taken to protect the employee at the elevated work location?
- Fall prevention systems such as standard guardrail systems provide a more positive means of protection than fall protection systems such as the use of a bodybelt/harness-lanyard-lifeline combination.

SELECTED CASE HISTORIES:
- An employee preparing masonry facia for removal from a building fell from the third level of a tubular welded frame scaffold. No guarding system was provided for the scaffold. Further, the platform was coated with ice creating a slippery condition.
- A contract employee was taking measurements inside a reactor vessel from an unguarded tubular welded frame scaffold when he either lost balance or stepped backwards and fell ≈ 14 ½', sustaining fatal injuries.

COMMENTS:
1. Many scaffolding guardrail violations are issued because no railings were provided on the ends of the scaffolds. Remember, a fall prevention system is not complete until the scaffolding is completely enclosed. Additionally, this is a specification standard, therefore, it is more easily identified and substantiated as a violation when the guarding is not provided.
2. Scaffold cross-bracing (X braces) are not acceptable alternatives for guardrails.
3. Many times scaffold guardrail are provided for tubular welded frame scaffolds where only one or two 10" planks are provided for a 60" wide scaffold end frame. This is ineffective because there is a potential for an opening 40"-50" between the edge of the "platform" and the guardrail (if in-place). Instead of falling over the edge of the scaffold, employees are exposed to falling through the scaffold.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Section 451(a) & (d), [17]

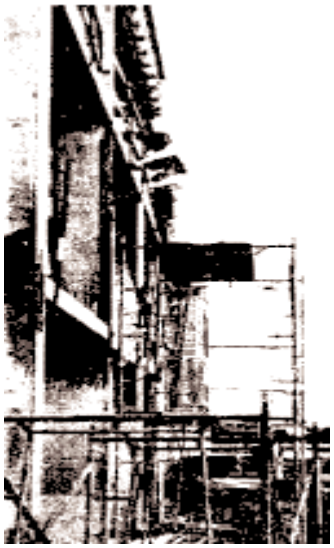
OSHA DIRECTIVE #100-58 (STD 3-10.3)
Date 10/30/78-Synopsis - Wire, chains, synthetic and fiber apes may be used as guardrails as per equivalent requirements of 1926.451 (a) (5) provided it meets the following guidelines: 1) it is secured to each support and taut at all times; 2) it a free of sharp edges; and 3) it has a maximum deflection of 3" in any direction when a 200 1b. load is applied.
Note: No size requirements of the ropes are listed in directive.

OSHA CLARIFICATION LETTER

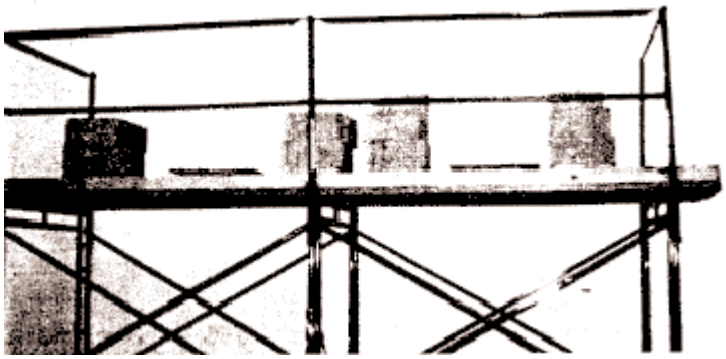
Date 3/11/83; From Acting Regional Administrator Region III to Area Director; Synopsis – 1926.451(a)(4) – General Scaffold Requirements, guarding in particular – If a specific type scaffold is covered by a standard such as tubular welded frame guarding doesn't need to be provided as per 451(a)(4) from the 4' – 10' level unless adjacent to dangerous equipment. NOTE: This position was reaffirmed in a letter dated August 7, 1992 from the Acting Assistant Secretary to an individual company.

PHOTOGRAPHS, ILLUSTRATIONS and OTHER DOCUMENTS

End frame not guarded. NOTE: The hole between the scaffold planks is large enough to fall through (left).

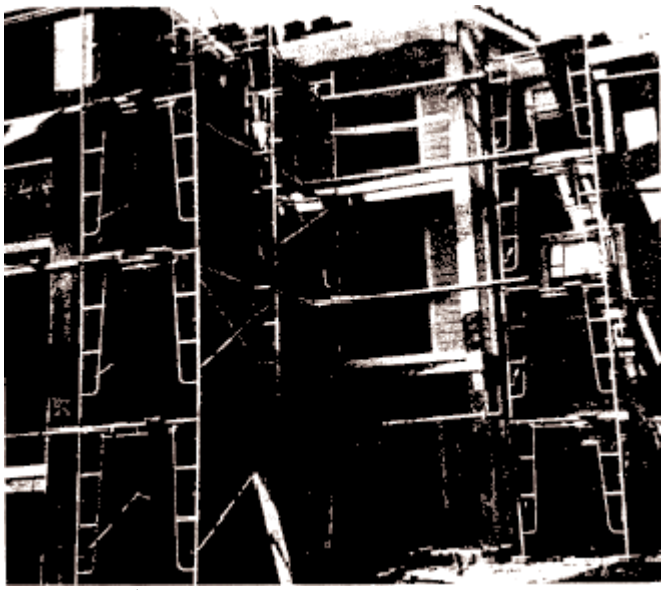


121/2 ft. tall scaffold (left) with no fall protection provided.



☐ VIOLATION ☑ **IN-COMPLIANCE**

A properly erected guardrail system with top rail, mid rail and toeboard.



☑ **VIOLATION** ☐ IN-COMPLIANCE

(above left, left, immediately above)

4 buck high scaffold (above) with no guardrail system any of the 4 working heights.
NOTE: The incomplete platforms and deficient erection of the structural members.

RANK IN FREQUENCY CITED	1926.	
#7	28(a)	APPROPRIATE PPE USED FOR SPECIFIC OPERATION

RULE: ***The employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions or where this part indicates the need for using such equipment to reduce the hazards to the employees.***

INTENT:
This rule gives the employer responsibility for insuring that employees wear appropriate PPE to reduce the exposure to hazardous conditions such as falling objects, toxic atmospheres, noise exposure, etc.. **PPE is not only a right for the employee - it is a responsibility for the employer.** This standard is part of Subpart C - General Safety and Health Provisions. Specific PPE and life saving equipment requirements are found in Subpart E, including: head protection; hearing protection; eye and face protection; respiratory protection; safety belts, lifelines, and lanyards; and safety nets. The Subpart E requirements are usually more specific than the Subpart C requirement. 1926.28(a), therefore, the standards in Subpart E are utilized more often than 1926.28(a). For example 1926.100(a) is #2 on the 100 **Most Cited Physical** LIST, conversely 1926.28(a) is #7. The Subpart E standards give specifications/guidance for selecting, use and maintenance of appropriate types and levels of PPE depending on the types of hazards employees are exposed.

HAZARDS:
Hazards can range from falling objects or bodies to inhalation of toxic materials. The injuries related to this standard also vary widely, inducting instant death from the inhalation of a highly toxic substance to a minor burn.

(AMONG OTHER) SUGGESTED ABATEMENTS:
• Evaluate the operations, define the hazards. When it is not feasible to design out all hazards, it may be necessary for employees to wear PPE.
• Discipline workers who fail to wear PPE. Because PPE can be uncomfortable, cumbersome, hot etc., employees sometimes don't wear it even though they know they may be risking injury. When an employee has been given repeated warnings about not wearing PPE, but still does not wear it, it may be prudent for the employer to impose appropriate penalties, leading to release if the employee persistently chooses not to follow company safety rules.
• Another system that has shown to work is to require employees, as a condition of employment, wear PPE at all needed times.

SELECTED CASE HISTORIES:
An employee was working with a crew setting a metal elbow duct for a bag house when he fell ≈ 50' to his death. The victim was wearing a safety belt with lanyard; however, the lanyard was not attached to any tie-off support.

COMMENTS:
1. Several United States Courts of Appeals have vacated citations relying on this standard as a requirement for fall protection. However, as can be seen by the numerous violations related to the standard the Agency was still enforcing it in 1991. In response to the courts, OSHA developed guidelines to use 1926.28(a) & 1926.105 for fall protection. Those guidelines were set forth in STD 3-3.1. See below for a synopsis of that STD. However, STD 3-3.1 has been canceled and is no longer in effect, See **OSHA NOTICE CPL 2** below.
2. This standard was cited in 257 fatal/catastrophe inspections in 5 years by the Agency.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Sections 1926. 100, 101, 102, 103, 104, 105 & 106; [7]*, [8]*, [9], [12], [13], [15]*, [16]; [25]
*- Referenced in 29 CFR 1926- Construction Standards

OSHA. INSTRUCTION STD 3-3.1
Date 7/18/83; Synopsis - Clarifies using 1926.28(a) & 1926.105(a) as fall protection requirements. Gives guidance as to how to apply the standards. General guidance is to provide safety belts-lanyards at heights > 10' and < 25'. Above 25' provide safety new or other means of adequate fall protection. Other specific guidance is provided. Note - this STD has been canceled. OSHA Notice CPL 2 is currently in effect, see next page.

PHOTOGRAPHS, ILLUSTRATIONS and OTHER DOCUMENTS

OSHA Notice CPL 2

October 5, 1992

Office of Construction and
Maritime Compliance Assistance

Subject: Cancellation of OSHA Instruction STD 3-3.1

A. Purpose notice cancels an OSHA Instruction based on court decisions that make the guidance given in the instruction inaccurate.

B. Scope. This notice applies OSHA-wide.

C. Cancellation. OSHA Instruction STD 3-3.1,July 18,1983, "Fall Protection in Construction: 29 CFR 1926.28(a) and 29 CFR 1926.105(a)," is canceled.

D. Expiration Date. This notice expires on October 30, 1992.

E. Action. Users of the OSHA Directives System shall remove from their files and discard OSHA Instruction STD 3-3.1.

F. Background. The Review Commission has held in the LE. Meyers Company case, OSHRC Docket No. 82-1137, that the December 1972 revision to 1926.28(a) was invalid on the grounds that the change from "and" to "or" was substantive change that could not be accomplished without notice and comment rulemaking. This decision holds that 29 CFR 1926.28(a) may not be cited unless there is exposure to a hazardous condition and the need for personal protective equipment is indicated elsewhere in the Part 1926/1910 Construction Industry Safety and Health Standards.

In view of this decision, use of 1926.28(a) is superfluous. If a hazard is addressed by another standard, such as 1926.105 for a fall greater than 25 feet, the other standard should be cited. Recognized failing hazards not covered by an existing standard shall be cited in appropriate cases under the general duty clause as indicated in Chapter N of the Field Operations Manual.

Directorate of Compliance Programs

NOTE: Even though the use of this standard has been curtailed. It is strongly recommended by OSHA that the employer evaluate all operations employees are involved with at a worksite to determine what hazards might exist and the appropriate measures including PPE which can be utilized to eliminate or control the hazard. All other PPE requirements specifically addressed by OSHA as well as industry recognized requirements for wearing PPE are still being enforced by the Agency by utilizing specific standards or the General Duty Clause - 5(a)(1).

RANK IN FREQUENCY CITED	1926.	
#8	1052(c)(1)	STAIR RAILS REQUIRED AT 30" CHANGE OF ELEVATION OR 4 RISERS

RULE: ***Stairways having four or more risers or rising more than 30 inches (76 cm), whichever is less, shall be equipped with at least one handrail and one stairrail system along each unprotected side or edge. However, when the top edge of a stairrail system also serves as a handrail, paragraph (c)(7).***

INTENT:
OSHA estimates that 4 fatalities, 5400 impact injuries and 1900 sprain/strain injuries occur annually on stairways [18]. About 65% of those injured required medical treatment. The intent of this standard is to require the use of stairrail systems and handrails when a set of stagy is > 30" in height or it has ≥ 4 risers and an unprotected edge. Walls or stairrail systems (vertical barrier consisting of a handrail, mid rails and constructed similarly to guardrail systems [See TABLE 5.2-1]) can guard an unprotected edge. Note: the top edge of a stairrail system can serve as a handrail. The top edge of the stairrail system which is used as a handrail shall be < 37"-36" > from the surface of the tread measured in line with the face of the riser.

HAZARDS:
Fall from elevation; can be fatal. Most likely injuries rangefrom broken bones to sprains/strains.

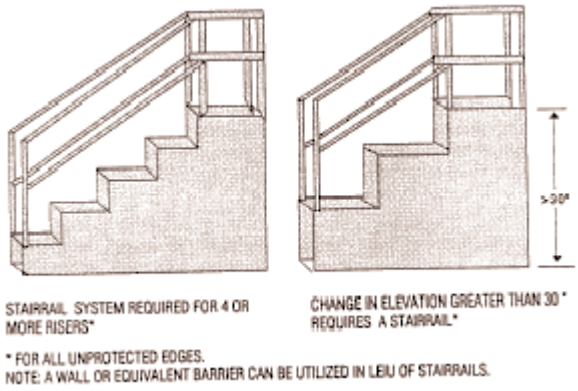
(AMONG OTHER) SUGGESTED ABATEMENTS:
• Identify all access points where there is a break in elevation of ≥ 19". Are all these access points provided a stairway/ladder? Does every access/egress area have a stairway/ladder or some other equivalent safe means of access/egress? Are the stairways constructed/maintained properly?

SELECTED CASE HISTORIES:
The OSHA IMIS system included no fatalities directly caused by failing to adhere to this standard (since January 1991 when standard came into effect).

1. This is another of the more common situations found on construction sites which are covered by specification standards that are easily identified and substantiated as a violation. This is probably a reason it is quite high on the list.
2. This standard became effective in January 1991. The old previous standard (1926.500(e)(1)(iii) ranked #80 on the 1991 List of the Most Frequently Cited Physical Hazards. The two standards taken together would rank #7 on the 100 **Most Cited PhysicaL** List and #13 on the 100 **Most Cited** List.
3. One of the most common stairway violations found on a construction site is the complete absence of stairs or no stairrails for the risers leading into the equipment trailer [Conversations with CSHO's].

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[18], [19]

PHOTOGRAPHS, ILLUSTRATIONS and OTHER DOCUMENTS

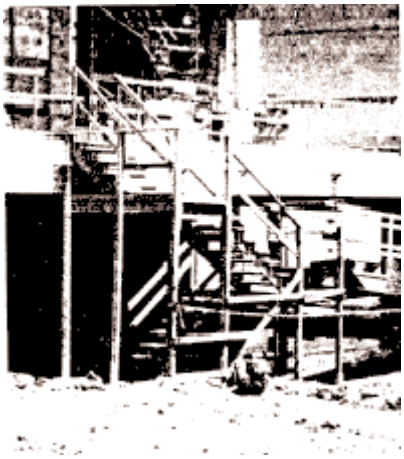


☐ VIOLATION ☑ **IN-COMPLIANCE**

Stairrail systems which meet OSHA erection specifications.

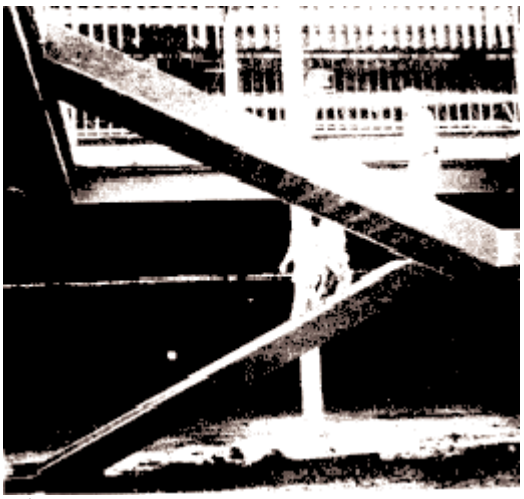
☑ **VIOLATION**
☐ IN-COMPLIANCE

No guarding provided for a 6 riser stairway.



☐ VIOLATION ☑ **IN-COMPLIANCE**

Properly erected stairway and stairrail system.



☑ **VIOLATION** ☐ IN-COMPLIANCE

Guarding not provided for the unprotected edge

RANK IN FREQUENCY CITED	1926.	APPROVED CONTAINERS OR TANKS FOR STORING OR HANDLING FLAMMABLE OR COMBUSTIBLE LIQUIDS
#9	152(a)(1)	

RULE: ***Only approved containers and portable tanks shall be used for storage and handling of flammable and combustible liquids. Approved metal safety cans shall be used for the handling and use of flammable liquids in quantities greater than one gallon, except that this shall not apply to those flammable liquid materials viscid (extremely hard to pour), which may be used and handled in original shipping containers. For quantities of one gallon or less, only the original container or approved metal safety cans shall be used for storage, use, and handling of flammable liquids.***

INTENT:
The intent is to provide acceptable containers (Approved safety cans) for the handling, use and storage of flammable and combustible liquids. Because these materials can ignite and cause fires or explosions this standard requires an "Approved Metal Safety Can". The approved safety can may have a maximum five gallon capacity and must include a spring closing lid and spout a flame arrestor, and a design to relieve internal pressure in a safe manner when exposed to fire. "Approved" means equipment that has been listed or approved by a nationally recognized testing laboratory. The standard does not apply to highly viscid materials in their original shipping containers nor to any flammable or combustible liquids in quantities ≤ 1 gallon in their original containers or in approved metal safety cans. OSHA now recognizes approved plastic containers, see discussions below.

HAZARDS:
Fire and/or explosion; aunt likely injuries range from fatalities to 1st degree burns.

(AMONG OTHER) SUGGESTED ABATEMENTS:
• When handling, storing or using flammable and combustible materials, follow all fire prevention rules such as no smoking. Bond and ground all containers when transferring contents to eliminate the possibility of static charge and a potential ignition source.
• Survey your worksite to determine if flammable and combustibles are being used. Then determine if they are being used, transferred, and stored in a safe manner as prescribed by OSHA and NFPA.

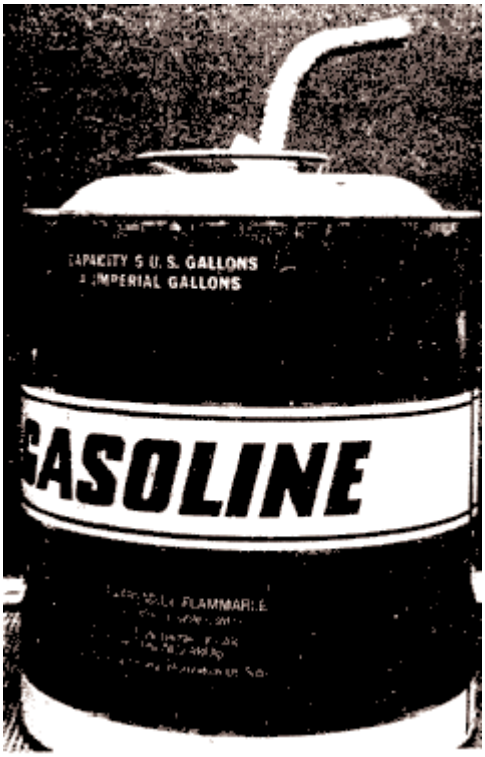
SELECTED CASE HISTORIES:
There were no fatality/catastrophes listed in BUS for the past five years directly tied to violations of this standard. However, the inadequate use, transfer and storage of these materials has caused many serious burns.

COMMENTS:
1. Frequently gasoline I brought on site in a 2½ or 5-gallon unapproved can that was purchased at a local hardware store. Because this is a specification standard the violation is very easy to identify and substantiate (conversations with OSHA CSHOs).
2. Plastic containers can lx used as an "approved" container 11 they have been "approved" by a nationally recognized testing laboratory. See below.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Subpart F
OSHA COMPLIANCE MEMORANDUM
Dates 7/19/89; From Directorate of Compliance Programs to Regional Administrator VI; Synopsis- Clarification stating that the term "approved" applies to the use of plastic containers in lieu of metal safety cans when they are approved as containers for flammable liquids over one gallon by Underwriters Laboratories (UL) or Factory Mutual (FM) (or other nationally recognized testing laboratory).
OSHA ISTRUCTION STD 3-4.1A
Date 9/16/80; From OSHA Compliance Programming; Synopses- 1926.155(l) requires a flash arrestor screen for an approved metal safety can. FM requires flame arrestor screens in their approvals of safety cans; however, UL does not require the arrestor screens in their safety can approval. NFPA 30 recognizes approval of both FM or UL. Therefore, any citation issued under this standard for lack of the flame arrestor screen only is de minimis.

☐ VIOLATION ☑ **IN-COMPLIANCE**

An approved safety can. The arros show the self closing cover and flame arrestor



☑ **VIOLATION** ☐ IN-COMPLIANCE

A common can on the market for gasoline. However, the can is not approved because it does not include a self-closing top.

☑ **VIOLATION** ☐ IN-COMPLIANCE

2 plastic cans which do not meet the criteria for self-closing tops.

RANK IN FREQUENCY CITED	1926.	
#10	25(a)	GENERAL HOUSEKEEPING

RULE: ***During the course of construction, alteration, or repairs, form and scrap lumber with protruding nails, and all other debris, shall be kept cleared from work areas, passageways, and stairs, in and around buildings or other structures.***

INTENT:
Since construction sites are dynamic by nature, the work areas often times become cluttered and disorderly creating a hazard. The array of construction debris is almost endless, including wood from old forms, broken pallets, boards with protruding nails and material shipping container to name just a few. At any given time it would not be unexpected to find any area of a construction site with a housekeeping problem. Housekeeping must be on-going as the job progresses.

HAZARDS:
Poor housekeeping can lead to the increased risk of trips, slips and falls. Resulting injuries range from fractures to sprains/strains. Associated hazards include nails in boards responsible for skin punctures resulting in lockjaw. If combustibles are not controlled at the site fires may occur.

(AMONG OTHER) SUGGESTED ABATEMENTS:
- Encourage the first line managers to make a concentrated effort to focus on housekeeping.
- On larger job sites, give laborers specific duties related to housekeeping only.
- On smaller sites, set up a system designating certain employees on an hourly basis to care for housekeeping chores.

SELECTED CASE HISTORIES:
IMIS did not contain any fatality/catastrophe inspections over the past five years, where violations of this standard were a direct/indirect cause(s) of an accident.

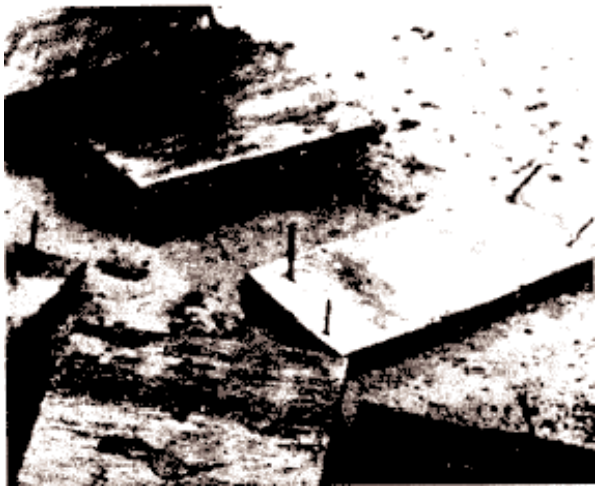
COMMENTS:
1. Although identifying a housekeeping violation is a subjective call (no real specific criteria which delineate what an actual housekeeping hazard is) these violations are rarely challenged when the CSHO has a photograph of the particular situation (Conversations with OSHA Area Directors).
2. This standard was cited in 33 OSHA fatality/catastrophe inspections in five years.

ADDITT0NAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Section 25 (b) & (c)

PHOTOGRAPHS, ILLUSTRATIONS and OTHER DOCUMENTS

☑ **VIOLATION** ☐ IN-COMPLIANCE

All six worksites below are examples of poor housekeeping.



RANK IN FREQUENCY CITED	1926.	DAILY INSPECTION OF PHYSICAL COMPONENTS OF TRENCH AND PROTECTION SYSTEM
#11	651(k)(1)	

RULE: ***Daily Inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.***

INTENT:

This rule gives criteria for employees to use in conducting inspections of excavations to identify signs warning of potential cave-in, failure of a protective system, hazardous atmosphere or other hazards. The criteria include the frequency of inspections (daily prior to each shift, throughout shift as needed, after rainstorms or other hazard-increasing occurrence) and the locations of the inspections (excavations, adjacent areas and protective systems). The competent person is responsible for conducting these inspections. The competent person must have specific training in, and be knowledgeable about sod analysis, the use of protective systems and the requirements of the standard. An important provision of the competent person requirement is that he/she must have real authorization to take prompt corrective measures to eliminate hazards.

HAZARDS:

Cave-ins are the most frequent and most dangerous hazard associated with these excavations. Fatalities can be expected if a cave-in occurs. Other type hazards similar to those associated with confined spaces should be expected including asphyxiation due to lack of O_2 inhalation of toxic materials, fire, drowning, etc. Moving machinery near the edge of the excavation can cause a surcharge (overloading) with resulting stress cracks at/near the edge of the excavation wall which can cause collapse. Many accidents occur when employees contact or sever underground utility lines.

(AMONG OTHER) SUGGESTED ABATEMENTS:

• Use the GUIDE FOR THE DAILY INSPECTION OF TRENCHES/EXCAVATIONS on the next page to assist in identifying the warning signs of excavation failure and specific items to evaluate for different trench/excavation protection systems.
• Keep excavations open the minimum amount of time needed.
• RECOMMENDATION ONLY: Prior to giving authorization as competent person conduct a rigorous testing program to assure that his/her knowledge level is functional for the duties and responsibilities of a competent person.

SELECTED CASE HISTORIES:

• An employee was in a 7' 6" deep trench installing forms for concrete footers when the trench caved-in causing fatal injuries. The trench was in loose sandy soil (Type C) and no inspection was conducted prior to the start of the shift/operation.
• An employee in a trench 6' deep x 32' wide was applying a waterproofing primer material containing methyl chloroform and 1,4 dioxane to
the foundation of a house. The employee was overcome and latter died of trichloroethane intoxication. Deficiencies rated to the cause of the accident included: 1) no one had tested the atmosphere in the trench; 2) the employees were not provided with respiratory protection; and 3) mechanical ventilation was not used.

COMMENTS:

1. The competent person must be knowledgeable and have the authority to take corrective action.
2. At times the production schedule and the duties of the competent persons conflict, If the competent person's authority, is overridden, overtly or he/she fails to act because he/she believes the company would not support him/her, then in reality there is no true competent person at the excavation site.
3. This standard was cited in 37 fatality inspections conducted by OSHA since March 1990.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:

[14], [20]

OSHA CLARIFICATION LETTER

8/5/92; From Directorate of Compliance Programs to Private Company, Synopsis - A competent person need not present at the site at all times when trenching/excavating operations are being conducted. However, it is the competent person's responsibility to inspect the site to identify hazardous conditions and to take the appropriate corrective action. Therefore, the individual conditions at each site will govern the amount of time a competent person must spend at the site.

GUIDE FOR THE DAILY INSPECTION OF TRENCHES AND EXCAVATIONS[30]

See next page.

GUIDE FOR THE DAILY INSPECTION OF TRENCHES/EXCAVATIONS[30]

WARNING SIGNS OF THE FUTURE

- Tension Cracks (In Sidewalls, Slopes and Surface adjacent to Excavation
- Ground Settlement or Subsidence
- Changes in Wall Slope or Bulge
- Increase in Strut Loads
- Bowing of Struts
- Spalling or Sloughing of Soils
- Excessive Seepage and Piping of Fine Soils
- Softening of Sidewalls
- Boiling of Trench Bottom
- Creaking or Popping Sounds
- Visual Deformation of Bracing System or Trench

SHORING/BRACING CHECKLIST

- Strict Adherence to Plans and Specifications
- Changes in Soil Condition
- Maintenance of Proper Slope Ratio
- Excessive Vibrations
- Location of Spoil Pile
- Equipment Location Relative to Excavation
- Secondary Soil/Rock Structure -
- Presence of Water Seepage and Rainfall
- Location of Trees, Boulders, Structures and Existing Utilities
- Right-of-Way
- Signs of Distress

SLOPING/BENCING CHECKLIST

- Strict Adherence to Plans and Specifications
- Changes in Soil Conditions
- Excessive Vibration
- Location of Spoil Pile
- Equipment Location Relative to Excavation
- Excessive Wear or Damage to Equipment
- Signs of Distress
- Improper Installation Procedures
  - Workers in unbraced trench
  - Improper system being used
  - Improper alignment of members
  - Improper installation of connections
- Location of Existing Utilities and Backfill

TRENCH SHIELD (BOX) CHECKLIST

- Strict Adherence to Plans and Specifications
- Changes in Soil Conditions
- Clearance Between Shield Trench Sidewalls
- Adequate Freeboard at Top of Shield
- Proper Slope Above Shield
- Current Certification of Shield
- Excessive Wear or Damage of Shield
- Improper Use of Shield
  - Workers in unshielded trench
  - Improper shield being used
- Location of Existing Utilities

NOTE: These are only general warnings of failure and recommendations for daily inspections of most trenches and excavations. Every trench/excavation must be inspected by a competent person as per 1926.651(k)(l) for the items listed above and all other hazards which are unique to that site.

RANK IN FREQUENCY CITED	1926.	
#12	451(a)(13)	SAFE ACCESS FOR ALL TYPES OF SCAFFOLDS

RULE: ***An access ladder or equivalent safe access shall be provided***

INTENT:
To decrease the risk of a fall, this standard requires a ladder or other equivalent means of access for scaffolds. Too often when ladders are not in place, workers climb the end frames of the scaffold (a common unsafe work practice in the construction industry). This can be hazardous. Depending on the design of the end frame the structural members which are used as ladders rungs can be narrower than the width of an average food i.e. this case requires the employee to actually stand on the side of his foot on the "rung"" The vertical distance between "rungs" also may be excessive (2 ½' – 3'), resulting in the employee reaching for the next "rung". Unless the end frame is designed as a ladder access frame, it must not be used as such. The scaffold manufacturer or dealer can assist the user in determining if a scaffold frame has a built-in ladder. Some of the common frames do not have built-in ladders. Scaffold ladders that attach directly to the frame can be obtained from scaffold dealers. Equivalent safe access to scaffold platforms can include access from a building floor/window directly to the platform, a portable stairway system, etc.

HAZARDS:
Fall from elevation. Probable injuries vary from death to severe sprains/strains.

(AMONG OTHER) SUGGESTED ABATEMENTS:
• Construct all scaffolds and related components (ladder access) as per scaffold manufacturers technical literature.
• Whenever possible, use a window/floor at the elevation of the platform to gain access, thereby, eliminating any hazard associated with climbing.

SELECTED CASE HISTORIES:
While descending the end frame of a scaffold that was not designed to be a built-in ladder, an employee lost his balance, fell 13' to concrete and suffered fatal head injuries.

COMMENTS:
1 If the scaffold user has any questions about the scaffold, i.e. construction, use, etc. they should contact the scaffold manufacturer or dealer. Experience has proven that they are fully cooperative and can assist with technical questions.
2. If workers use an attached ladder on the end frame of the scaffold, the scaffold must be constructed to withstand the effects of the overturning force imparted on the scaffold due to the external loading caused by the weight of the person climbing the ladder. A material hoist on the same side as the ladder might increase the overturning force causing collapse of the scaffold. These loading factors must be considered in the design/construction phase.
3. A portable ladder, constructed and used as per Subpart X of 1926 is an acceptable ladder for access to scaffolding.
4. This standard was cited in 35 fatality inspections conducted by OSHA over five years.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Section 451; [18] Sections 1051 & 1053-1060 (Subpart X)

OSHA COMPLIANCE LETTER
Date 2/25/83; From Chief, Division of Compliance Prgms., to Individual Company; Synopsis - 1) It's not practical for employer to prove ladder access at all times for employees assembling/dissembling scaffolding; however, other safe access must be provided; 2) end frames designed by a scaffold manufacturer as ladder access are acceptable if they are erected in a continuous line and the maximum spacing between rungs < 16½"; 3) portable wood or metal ladders must comply with Subpart X (formerly Subpart L); 4) fixed ladder standards do not apply to scaffolds; and 5) Subpart X does not apply to built-in scaffold ladders.

OSHA CLARIFICATION LETTER
Date 4/7/87; From Director of Directorate of Field Programs to Regional Administrator; Synopsis - The following relate to designed and manufactured built-in scaffold access ladders: 1) allow a maximum 16½ " rung spacing; 2) rungs may be spaced unevenly where end frames join provided they do not exceed maximum rung spacing; 3) climbing over top guardrail or scaffold board overlay is not a safe practice; and 4) guardrail systems shall be provided with removable rails, chains or gates in accordance with manufacturers' recommendations.

PHOTOGRAPHS, ILLUSTRATIONS and OTHER DOCUMENTS

☐ VIOLATION
☑**IN-COMPLIANCE**

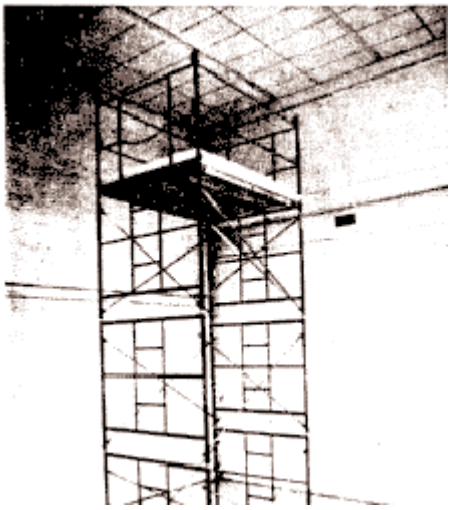
The 2 photos (left) show employees accessing scaffolds by using a hook-on scaffold. NOTE: the inward swinging gate which allows employees to step directly from the ladder on to the platform. Also, the scaffold (far left) has a platform which is not fully planked and creates a hazard.

☑ **VIOLATION** ☐ IN-COMPLIANCE

The 2 photos (above & left) show employees using the structural members of end frames as ladders. The scaffold manufacturer did not design these type end frames as built-in ladders. NOTE: The platform violations

☐ VIOLATION ☑**IN-COMPLIANCE**

The scaffold below shows end frames which where designed by the manufacturer to be built-in laddders. NOTE: The chain above the platform gurading opening.



RANK IN FREQUENCY CITED	1926.	
#13	404(b)(1)(ii)	GROUND FAULT CIRCUIT INTERRUPTERS (GFCI's)

RULE: ***All 120-volt, single-phase, 15-and-20-ampere receptacle outlets on construction sites, which are not a part of the permanent wiring of the building or structure and which are in use by employees, shall have approved ground-fault circuit Interrupters for personnel protection. Receptacles on a two-wire, single-phase portable or vehicle-mounted generator rated not more than 5kw, where the circuit conductors of the generator are Insulated from the generator frame and all other grounded surfaces, need not be protected with ground-fault circuit Interrupters.***

INTENT:
This standard requires the use of electrical hardware that is designed for monitoring ground fault current and is capable of stopping the fault current in the circuit, i.e. through an employee's body. This rule states that all 120 volt 15 & 20 amp receptacles outlets on construction sites will be protected by ground fault circuit interrupters (GFCI's), when not part of the permanent wiring of a structure. Because a receptacle is in effect part of the branch circuit wiring, this rule is effectively identical to 1926.404(b)(1)(1) - GROUND FAULT PROTECTION. For more information related to the operation of GFCI's see #3 **GUIDE** Sheet. This rule exempts portable or vehicle-mounted generators that meet the following: 1) rated < 5kW; 2) system wiring is two wire, single phase; and 3) circuit conductors are insulated from the generator frame and all other grounded surfaces. **NOTE: GFCPS ARE NOT TO BE USED IN LIEU OF EQUIPMENT GROUNDING - GFCPS ARE SUPPLEMENTAL PROTECTION AND MUST ONLY BE CONSIDERED AS A BACKUP TO EQUIPMENT GROUNDING.** GFCI's can be placed anywhere in the circuit and still be effective. They may be put in a panel box as a breaker, at the receptacle or in-line anywhere along an extension cord up to the tool. GFCI's are very important on construction sites because of the likely probability of encountering wet/damp locations that greatly increase the risk of electrical shock.

HAZARDS:
Fatal electrocutions, electrical burns ranging from critical to minor, Fire; Explosion; Electric shock has been initiator of other type hazards, i.e. electrical shocks can cause employees to fall from elevated work surfaces, loose control hand held equipment which in turn can strike other employees in the immediate work area, etc.

(AMONG OTHER) SUGGESTED ABATEMENTS:
o Frequently trip GFCI's while test tool is operating to insure GFCI is operating correctly.
o Use double insulated tools. Double insulated tools can protect the user from fault currents which might energize the case of the tool or equipment.
o GFCI's for 220-volt circuits are available. Note: they are not required by this standard.

SELECTED CASE HISTORIES:
An employee attempted to plug an extension cord into a temporary power spider box. The employee was kneeling on the ground and held the box in his hand. Fault current energized the case of the box and electrocuted the employee. No GFCI's were used.

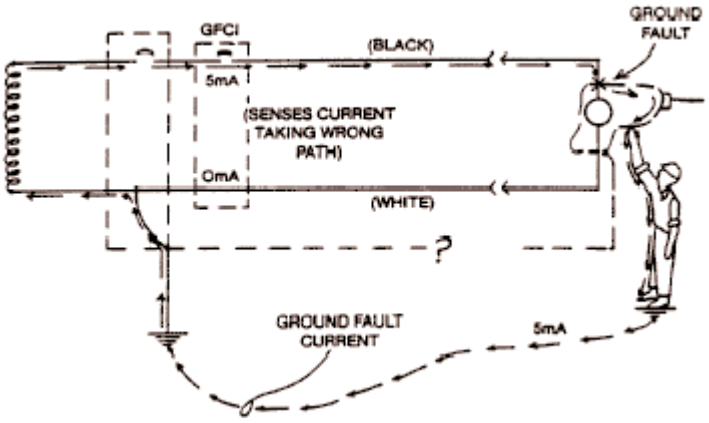
COMMENTS:
1. Although double insulated tools are recommended, using them does not relieve the employer from providing ground fault protection. Extension cords connecting a fixed electrical system (permanent outlet) and a tool can become worn with exposed energized conductors. Therefore, ground fault protection or an AEGCP would be required. See OSHA CLARIFICATION LETTER below.
2. According to OSHA [10] there were 48 fatalities in the years 1985 to 1989 related to 120-volt electrical systems.
3. Employers have attempted to skirt the requirements of providing ground fault protection by using 30 amp breakers in their 120-volt, single-phase systems. This not only defeats the intent of the ground fault provisions, it also introduces new hazards because the system is no longer rated for the actual over current protection (30 amp breaker) that is in place. (Personal experience & conversations with CSHO's).
4. Had all 3 requirements for ground fault protection been combined (1926.404(b)(1)(i) & (ii) & (iii)), they would have been ranked # 1 on the 100 **Most Cited Physical List** and #4 on the 100 **Most Cited LIST**

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Section 404(b); [3]; [4]; [5]

OSHA CLARIFICATION LETTER
Date 11/4/92; Directorate Compliance Programs to Private Company; Synopsis - If all extension cord sets and/or portable tool assemblies are approved and used in such a manner that the entire lengths of all cords whether provided power from either permanent or temporary wiring, have GFCI protection, then the employer would be in compliance. If any of the cords or tools in a series are not protected by a GFCI, then an AEGCP would be required for all the cords and tools, including the ones already protected by a GFCI.

The Gound-Fault-Circuit Interrupter ("GFCI") provides an additional precaution

The GFCI is a solid-state, sensitive device which can be applied to open the circuit in case of ground-fault leakage too small to trip the circuit breaker, (but large enough to be dangerous to people).



HOW THE GFCI PROTECTS PEOPLE

(BY OPENING THE CIRUIT WHEN CURRENT FLOWS THRU A GROUND-FAULT PATH.)

Note that the GFCI will open the circuit if 5 mA or more of current returns to the service entrance by any path other than the intended white wire. If the equipment-grounding conductor is properly installed and maintained this will happen as **soon as the faulty tool is plugged in**. If by change this grounding conductor is not intact and low-impedance, the GFCI may not trip out **until a person provides the path**. In this case the person will receive a shock, but the GFCI should trip out so quickly that the shock will not be harmful.

Where are GFCI's required?

OSHA required GFCI's on **construction sites** because of the combined special hazards of two conditions.

a. Questionable integrity of the ground-fault path through **temporary wiring**.

b. Presence of **wetness** due to working on earth, wet concrete, etc.

☐ VIOLATION ☑**IN-COMPLIANCE**

The use of portable GFCI's (arrow) meets this requirements.

RANK IN FREQUENCY CITED	1926.	
#14	701(b)	GUARDING OF PROTRUDING STEEL REBARS

RULE: **Reinforcing steel. All protruding reinforcing steel, onto and into which employees could fall, should be guarded to eliminate the hazard of impalement.**

INTENT:
In conversations with construction personnel, they seem to all have an account of a situation where an employee has fallen and Impaled himself on a piece of steel rebar. The accounts are some of the most gruesome stories told related to accidents in the construction industry. This rule requires guarding for the ends of the rebar where the potential impalement could exist. The most common guarding is specially manufactured rebar caps which fit onto the rebar and have rounded surfaces facing upward, or lumber is used and set on top of the rebar. The theory is to dissipate the force of the fall by distributing it over a larger area than the diameter of the rebar, i.e. less force reduces tile chance of impalement.

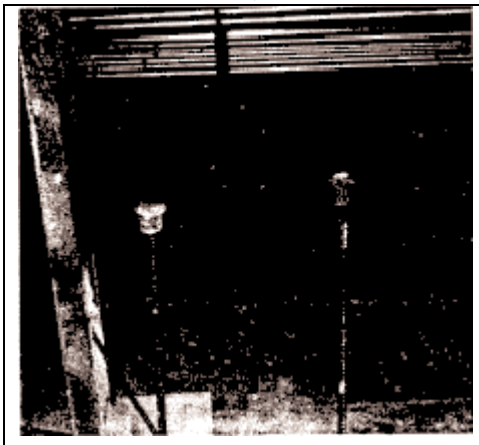
HAZARDS:
Impalement/puncture. Probable injuries can range from death to serious internal injuries.

(AMONG OTHER) SUGGESTED ABATEMENTS:
• Prior to installing rebar at the site, insure enough rebar caps or materials to construct caps will be available.

SELECTED CASE HISTORIES:
• An employee pulling a concrete hose along a form fell 2 stories and hit his head on steel bars which punctured his brain.
• A laborer fell through a roof opening about 8' to a patio foundation that had about 20 half-inch rebar protruding straight up. The laborer was impaled by one of the bars and died.

COMMENTS:
1. This is another example of a specification standard which is easy to identify and substantiate (its either in-place or its not) as a violation. Even though exposed vertical rebar would not be present at many OSHA construction inspections, this situation is being cited very frequently as evident by its #14 ranking on the Most Cited Physical Hazard List. This might be an indicator of industry wide non-compliance.
2. This standard was cited in 12 fatality investigations.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Subpart Q, [26]; [27]



☐VIOLATION ☑**IN-COMPLIANCE**

Rebar caps which are acceptable as meeting OSHA requirements.

☑ **VIOLATION** ☐ IN-COMPLIANCE

The arrows show 3 rebars without protective caps which create a hazard.

RANK IN FREQUENCY CITED	1926.	
#15	451(a)(4)	GENERAL REQUIREMENTS FOR GUARDING SCAFFOLDS

RULE: ***Guardrails and toeboards shall be installed on all open sides and ends of platforms more than 10 feet above the ground or floor, except needle beam scaffolds (See paragraphs (p) and (w) of this section). Scaffolds 4 feet to 10 feet in height, having a minimum horizontal dimensions in either direction of less than 45 Inches, shall have standard guardrails installed on all open sides and ends of the platform.***

INTENT:

This standard specifies when guardrail systems and toeboards are required for all types of scaffolds (General Scaffold Requirements) that are not covered by a specific standard. The requirements for guardrails at specific heights is similar to 1926.451(d)(10). Tubular Welded Frame Scaffolds (See #6 "Most Cited Physical Standards Sheet"), except for scaffolds which are 4' to 10' in height which are not covered by a specific standard. For further explanation see **OSHA CLARIFICATION LETTER** date 8/7/92, below. Guardrail and toeboard construction specifications are contained in 1926.445 (a)(5) & (6). This rule contains an exemption for needle beam scaffolds and floats (suspended scaffolds) and directs compliance with those type scaffolds be in accordance with Paragraphs (p) & (w), respectively. Guardrail systems are not required on these type scaffolds, OSHA requires only safety-belts and lifelines in accordance with 1926.104 for needle beam and float scaffolds.

HAZARDS:

- Fall from elevation. Probable injuries range -from death to severe sprains/strains.
- Struck by falling objects from scaffold platform due to lack of/insufficient material containment system, i.e., wire mesh screen or toeboards. Probable injuries include death, lost-time injuries due to head concussion, broken bones in the upper body, etc.

(AMONG OTHER) SUGGESTED ABATEMENTS:

- Whenever an employee must work at any elevated location ask the questions: 1) Are they protected from a fall? and 2) What measures must be taken to protect the employee at the elevated work location?
- Fall prevention systems such as standard guardrail systems provide more positive means of protection than fall protection systems such as a bodybelt/harness-lanyard-lifeline combination, except when workers are suspended, i.e., from suspended scaffolds, work platforms, etc.
- Construct/maintain all guardrail system according to OSHA requirements.

SELECTED CASE HISTORIES:

An employee was installing overhead boards from a scaffold platform consisting of two 2"x10" boards with no guardrails. He lost his balance and fell 7'6" to the floor sustaining fatal injuries.

COMMENTS:

1. Many scaffolding guardrail violations are issued because no railings were provided on the ends of the scaffolds. The fall prevention system is not complete until it is completely enclosed. Additionally, because the is a specification standard it is more essay identified and substantiated as a violation when guarding is not provided.
2. This standard was cited in 56 fatality investigations over a five year period.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:

[1] Section 451(a) & (d), [17]

OSHA CLARIFICATION LETTER

Date 3/11/83; From Acting Regional Administrator Region III to Area Director; Synopsis - 1926.451(a)(4) - General Scaffold Requirements, guarding in particular - If a specific type scaffold is covered by a individual standard, such as tubular welded frame, Guarding doesn't need to be provided as per 451(a)(4) from the 4' –10' level unless adjacent to dangerous equipment.

OSHA CLARIFICATION LETTER

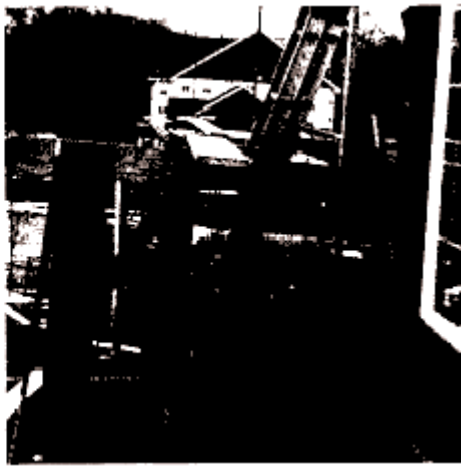
Date 8/7/92; From - Acting Assistant Secretary to individual company; Synopsis - The interpretation listed above is correct and still in effect. General requirements for scaffolds, 451(a), apply to all scaffolds unless specifically exempted or when the issue is specifically addressed in a specific section for a particular type of scaffold. The requirements for guardrails on scaffolds was specified at a height of 10' (less than 10' in height was omitted) for paragraph .451(b) through .451(y) (standards for particular type scaffolds). Therefore, the .451(a)(4) standard does not apply to any, 451(h) through 451(y), such as proprietary or make shift type scaffolds. Also, clarification of "10' above the ground or floor" was given - it is the falling distance, not the vertical dimension of the scaffold that is the controlling factor.

OSHA CLARIFICATION LETTER

Date 12/88; From Director of Compliance Programs to Regional Administrator; Synopsis - Guardrails not required -for Ladder Jack Scaffolds because they may pose additional hazards and increase risk. The OSHA proposed rule requires the use of a body harness/belt and lanyard for fall protection on these scaffolds.

☑ **VIOLATION** ☐ IN-COMPLIANCE

An employee using a makeshift single plank scaffold to apply stucco approximatetly 7'-8' above the ground with no fall protection.



☑ **VIOLATION** ☐ IN-COMPLIANCE

Front and side view (above) of a make shift scaffold 4'-6' above the ground. No fall protection is provided. NOTE: The opening between the scaffold platforms and the unsecured portable ladder.

RANK IN FREQUENCY CITED	1926.	
#16	651(j)(2)	SPOIL PILE PROTECTION

RULE: ***Employee shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations. Protection shall be provided by placing and keeping such materials or equipment at least 2 feet (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.***

INTENT:

The intent of this standard is two-fold, by requiring excavated material (spoils) and equipment to be set back 2 feet it accomplishes the following: 1) decreases the risk of spoils or equipment from rolling back into the excavation on top of employees; and 2) reduces superimposed loads on the face of the excavation which possibly could contribute to a cave-in. If the superimposed load of the spoils has been considered in the design of the protection system the spoils may be placed at the face of the excavation if they are retained by a sufficient (strength, i.e. can resist any reasonably anticipated forces applied to it, and/or height) device/operation such as barricading or wire mesh.

HAZARDS:

- Cave-in caused by superimposed load on face of excavation. Probable injury is death.
- Ro1ling/falling spoils or equipment; Probable injuries could be expected to range from head concussion to bruises. Extreme cases could result in death due to suffocation.

(AMONG OTHER) SUGGESTED ABATEMENTS:

- Conduct a pre-job survey of site to insure the location is large enough to accommodate 2 foot set back for the spoil pile. If not, materials must be obtained to provide an alternate retaining device.
- In some cases contractor may need to haul spoils to a temporary site until excavation is ready to back fill.

SELECTED CASE HISTORIES:

A spoil pile had been placed on top of a curb which formed the west face of a trench. A backhoe was spotted on top of the spoil pile. The west face of the trench collapsed on two employees who were installing sewer pipe. One employee was killed; the other received back injuries. The trench was 8 feet deep with vertical walls. No other protection was provided. In fact, the superimposed loads of the spoil pile and backhoe may have initiated the collapse.

COMMENTS:

1. Many excavations/trenches dug for utility line are located in narrow right-of-ways. Often spoil piles are placed at the edge with no retaining device. This situation can be avoided with a sound pre-job survey and plan.
2. The fatality rate for trenching/excavation work was 112% higher than the rate for construction in general [14].
3. This standard was cited in 37 fatality inspections since it became effective in March 1990.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:

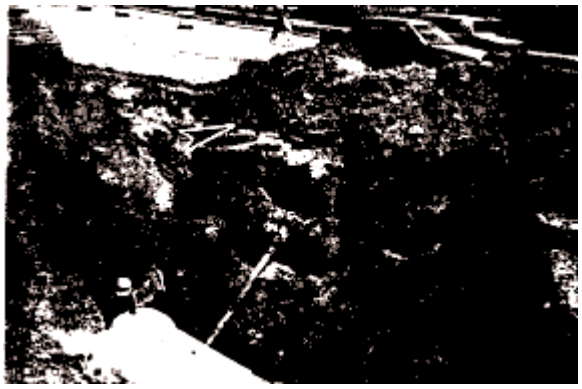
[1] Section 651(j); [14]; [20]; GUIDE FOR THE DAILY INSPECTION OF TRENCHES AND EXCAVATIONS (See pg.53)

☐VIOLATION ☑**IN-COMPLIANCE**

Proper spoil pile set back (above & right).
Arrows show spoil piles.

☑ **VIOLATION** ☐ IN-COMPLIANCE

Two employees along pipe are exposed to the spoil pile (arrow) which is located on the edge of the trench.
NOTE: Sloping does not meet OSHA requirements.



☑ **VIOLATION** ☐ IN-COMPLIANCE

Employee at end of pipe is exposed to the spoil pile at the edge of the trench.

RANK IN FREQUENCY CITED	1926.	
#17	350(a)(9)	SECURING OF COMPRESSED GAS CYLINDERS

RULE: Compressed gas cylinders shall be secured in an upright position at all times except, if necessary, for short periods of time while cylinders are actually being hoisted or carried.

INTENT:

This standard specifiesy the following: l) gas cylinders must be secured to prevent them from falling against people equipment and other cylinders; if a cylinder strikes a person it can cause an impact type injury, if it strikes nearby equipment the consequences will vary depending on the type of equipment if the first cylinder strikes other unsecured cylinders a domino effect may occur; an unsecured cylinder with its valve protection cap off could fall and strike the valve, rupturing it, causing the compressed gas cylinder to take-off like a rocket; and 2) the cylinders must be stored upright since adverse effects can result if cylinders containing some welding gases are stored/used in a horizontal position. This standard exempts hoisting or carrying cylinders that are only intended to be moved during short periods of time.

HAZARDS:

- Struck by facing or rocketing cylinders. injuries can range from death to contusions.

(AMONG OTHER) SUGGESTED ABATEMENTS:

- Supervisors should note all cylinders in their work area and identify if they are in use or storage. If they are in storage, are they upright, secured and labeled? Is the valve protection cap in place? Are incompatible materials (oxygen and fuel gas) separated properly? If the cylinders are in use, are all appropriate safeguards in place to protect the welder and other personnel in the area?

SELECTED CASE HISTORIES:

OSHA IMIS did not maintain any fatal/catastrophe inspections citing conditions related to this standard as a direct/indirect cause(s) of an accident.

COMMENTS:

1. Welding cylinders placed in welding carts are considered to be secured.
2. Unsecured cylinders on construction sites are common. This is a specification standard which is easily identified and substantiated as a violation as evident of its high ranking on the 100 **Most Cited Physical List**. Therefore, the contractor must continually audit the site to ensure compliance.
3. This standard was cited in 29 OSHA fatality inspections in 5 years.

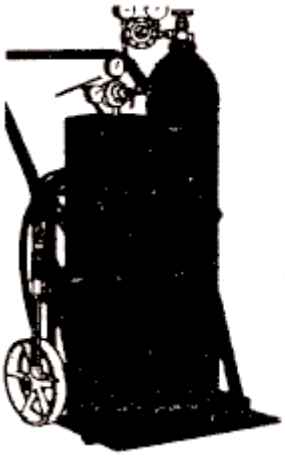
ADDITIONAL DOCUMENTS TO AIDIN COMPLIANCE:

[1] Section 350; [22]; [23]*; [24]

*- Referenced in 29 CFR 1926 - Construction Standards

OSHA INSTRUCTION STD 3-8.2

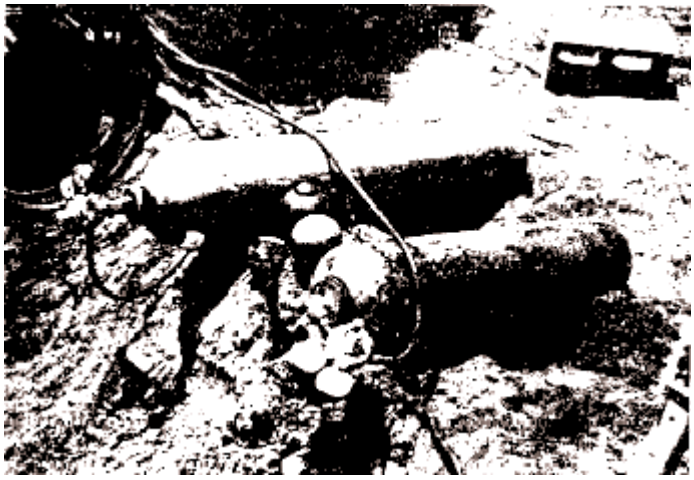
Dated 3/11/81 - Synopsis - Clarifies that the standard does not apply to welding gas supply manufacturers or distributors prior to delivery at construction sites. The intent of the standard is for it to apply to welding or cutting operations <u>on</u> construction sites.



CYLINDERS ARE BEST SECURED IN A CART

☐VIOLATION ☑**IN-COMPLIANCE**

The cylinders (above & right) are secured properly in an upright position. NOTE: Cylinders are not required to be secured to a cart as shown above. This method is only a recommendation.



☑ **VIOLATION** ☐ IN-COMPLIANCE

The cylinders are not secured (left) and are not secured in an upright position (above).
NOTE: Improper storage of oxygen and fuel gas cylinders in photo on left.

RANK IN FREQUENCY CITED	1926.	
#18	350(j)	ADDITIONAL RULES FOR WELDING/CUTTING AS PER ANSI Z49.1 - 1967

RULE: **Additional rules. For additional detail not covered in this subpart, applicable technical portions of American National Standards Institute, Z49.1 – 1967, Safety In Welding and Cutting, shall apply.**

INTENT:

This ANSI standard was incorporated by reference into the original OSHA construction standards and remains today. Its intent is to supplement the safety, requirement for gas welding. Additional requirements cover the following: 1) installation and operation of oxygen-fuel gas systems for welding and cutting; 2) fire prevention and protection; 3) protection of personnel; 4) health protection and ventilation; and 5) industrial applications. Construction industry applications are further subdivided by operation, those operations include: A) general; B) general maintenance welding and cutting operations; C) earth moving and grading equipment; D) fire protection and prevention; E) demolition; F) concrete construction and masonry; G) tunnels, shafts and caissons; H) marine piling and marine construction; I) batch plant and road paving; J) steel erection; K) transmission pipeline; and L) mechanical piping systems.

HARZARDS:

- Fire/explosion. Probable injuries range from death to minor burns.

(AMONG OTHER) SUGGESTED ABATEMENTS:

- A pre-job survey to identify all potential hazards and affected areas around the operation is critical.
- All fire prevention and protection rules absolutely must be followed.

SELECTED CASE HISTORIES:

- A welder was cutting braces on a catwalk of a conveyor when the catwalk collapsed falling approximately 30' to the ground killing the welder.
- Three employees were cutting (burning) a catwalk from the top of a 20,000 gallon ethanol storage tank which had been drained of liquid but the vapors were not purged. Vapors emanating from a gage hatch which was not sealed were ignited and the tank exploded. The three employees were fatally injured. The area (not designed for cutting purposes) was not properly inspected and authorized prior to the start of the operation.

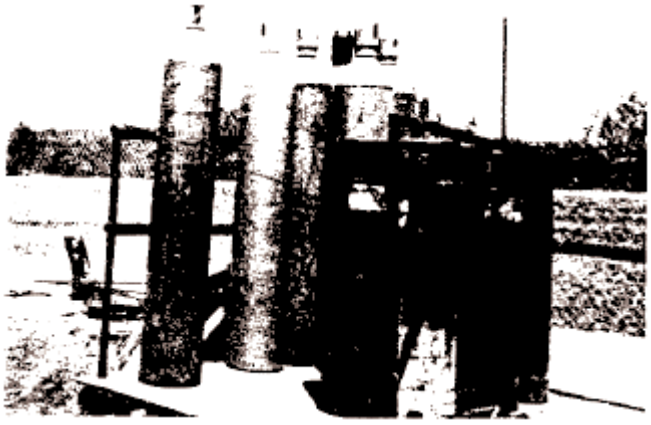
COMMENTS:

1. The most common standard cited from ANSI 249.1-1967 is 3.2.4.3, which specifies a 20 foot minimum spacing or ½ hour minimum fire rated wall 5 feet high separating oxygen cylinders from fuel gas cylinders in storage. Other commonly cited standards include: using acetylene at a pressure greater than 15 psig (3.1.2) and failure to inspect and authorize an operation when welding or cutting must be done in a location not designed for such purposes (6.2.5).
2. This rule only applies to gas welding. It does not apply to arc welding, resistance welding or other non-gas welding procedures

ADDTTIONAL DOCUMENTS TO AID IN COMPLIANCE:

[1] Subpart J; [24]; [281*

*- Referenced in 29 CFR 1926- Construction Standards



☑ **VIOLATION** ☐ IN-COMPLIANCE

Oxygen and fuel gas cylinders stored together without proper separation or barriers.

NOTE: The missing valve protection cap on the front of the cylinder bottle.

☐VIOLATION ☑**IN-COMPLIANCE**

Oxygen cylinders in storage separated from fuel gas cylinders by a 5' tall properly constructed and rated fire wall (arrow).

RANK IN FREQUENCY CITED	1926.	
#19	102(a)(1)	EYE/FACE PROTECTION FOR OPERATIONS WHICH CREATE EXPOSURE

RULE: Employees shall be provided with eye and face protection equipment when machines or operations present potential eye or face injury from physical, chemical, or radiation agents.

INTENT:

There were about 22,000 lost-time accidents in the construction industry in 10 states from 1985-1989 due to eye injuries [6]. Metal items (34.5%) and wood items (10.7%) were the most frequent sources of eye injuries. The purpose of the standard is obvious - to reduce the number of eye injuries. The rule requires employers to provide eye/face protection when there are potential hazards to the eye/face related to physical, chemical, or radiation agents. The key word is potential. On very few construction sites would potential for falling, flying, moving, etc. objects not be present. Sometimes pieces of debris break off, spring, eject, etc. from objects which are usually intact. Once airborne, potential exist to cause an eye/face injury (example - prying on a wooden box, when a splinter breaks due to the force (energy) of the prying operation, the splinter might be thrown in the direction of the employees face). Although these types of events are not normal, they can and should be expected because of the nature of construction work. Therefore, protection must be provided. Other standards in this Part include 1926.102(a)(2) which specifies that eye/face PPE will meet requirements of ANSI Z87.1-1968, UT [15] and 1926.102(a)(5), which specifies that Table E-1 [I] shall be used as guidance for selecting appropriate protection for listed operations. This is a very useful and user friendly table. All spectacle type glasses listed in TABLE E-1 require sideshields. A footnote in the table states spectacles without sideshields are available when only frontal exposure is possible. Most construction operations would require sideshields.

HAZARDS:

- Struck by flying objects, particles, and chemicals. Probable eye injuries can range from blindness to minor irritation caused by foreign matter in the eye. Probable injuries to the face range from chemical burns caused by splashes to lacerations caused by flying objects.
- Radiant energy exposure from welding and laser operations. Probable injuries range from blindness to temporary eye irritation.

(AMONG OTHER) SUGGESTED ABATEMENTS:

- Instruct fast-line supervisors to continually audit employees to insure eye/face protection is worn.
- Institute a formal discipline program in workplaces where a problem exist relating to employees not wearing PPE when required.
- Make the wearing of PPE in accordance with company rules a specific condition of employment. This has proven to be an effective tool for safety managers (Conversations with safety managers).

SELECTED CASE HISTORIES:

IMIS data did not show violations of this standard contributing to the direct cause of a fatality/catastrophe. However, numerous severe lost-time injuries are related.

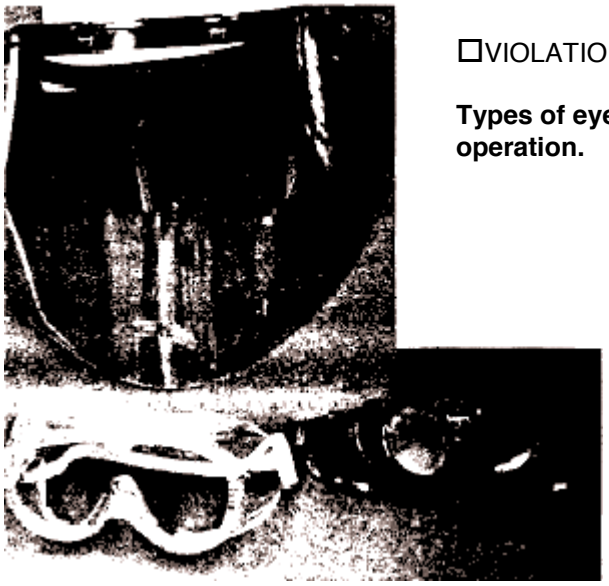
COMMENTS:

1. This rule requires employers to actually provide the eye/face protection to the employees.
2. This standard was cited in 17 fatality inspections conducted by OSHA in five years.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:

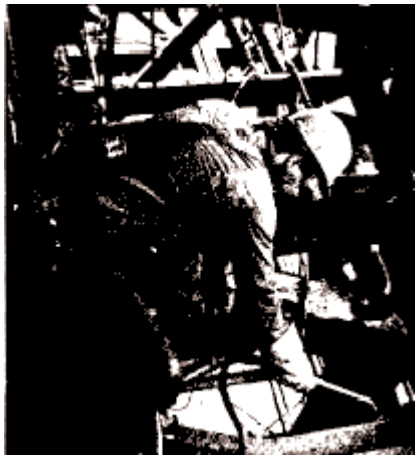
[1] Section 102, TABLES E-1, E-2 & E-3; [15]*; [25]

*- Referenced in 29 CFR 1926- Construction Standards



☐VIOLATION ☑**IN-COMPLIANCE**

Types of eye and face protection that are required depending on the operation.



☑ **VIOLATION** ☐ IN-COMPLIANCE

Employee is wearing the proper goggles while cutting steel for stairway.

RANK IN FREQUENCY CITED	1926.	
#20	500(b)(1)	GUARDING OF FLOOR OPENINGS

RULE: Floor openings shall be guarded by a standard railing and toeboards or cover, as specified in paragraph (f) of this section. In general, the railing shall be provided on all exposed sides, except at entrances to stairways.

INTENT:

OSHA defines a floor opening as "An opening measuring 12 inches or more in its least dimension in any floor, roof, or platform through which persons may fall." This rule is to specifies that holes will be protected with guardrails and toeboards or covers. It also specifies the requirements of construction for the guardrails, toeboards and covers (1926.500(f)). An exemption is given guarding the exposed side of an entrance to a stairway. Table 5.2-1 and Table 5.2-2 give details for constructing standard guardrails and toeboards. Floor hole coverings must meet the construction specifications listed in 1926.500(f) (5). Regular floor hole covers must be capable of supporting the maximum intended load and must be installed to prevent accidental displacement and covers and their supports when located in roadways and vehicle aisleways for conduits, and manholes must be designed to carry a rear axle load of two times the maximum intended load.

HAZARDS:

- Fall from elevation. Probable injuries range from death to sprains/strains.
- Struck by falling objects through floor hole. Probable Injuries range from death to head concussion.

(AMONG OTHER) SUGGESTED ABATEMENTS:

- For new construction identify floor holes as they are created and take immediate action.
- For existing structures, survey the site prior to starting work and continue audit as renovation, repair, etc. proceeds for floor opening and holes.
- Insure all covers are constructed properly and will support the maximum intended load.

SELECTED CASE HISTORIES:

- An employee fell 16 feet to his death through an improperly guarded roof opening 36"x30" while attempting to stay clear of an overhead crane load. The improper guarding system consisted of four 2"x4" posts supported using only one nail per post and high visibility barrier tape strung between the posts.
- An employee fell through an uncovered 36" diameter hole in the top of a slurry tank and fell 32 feet to his death.

COMMENTS:

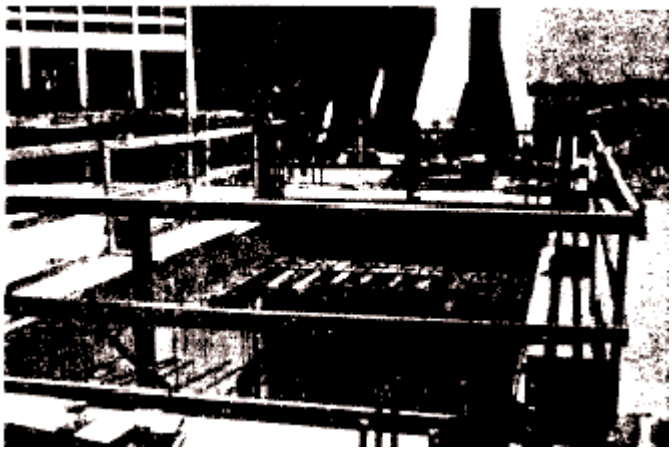
1. Many deaths occur each year when floor hole covers were removed and were not replaced or when they were constructed of materials that could not support the person/equipment load. (OSHA 1st Report of Death or Serious Injuries).
2. Toeboards are required to prevent materials from falling through the opening and striking persons below.
3. A floor hole is an opening measuring less than 12" but more than 1" in its least dimension. Floor hole protection is intended to prevent materials from falling to the level(s) below.
4. This standard was cited in 67 OSHA fatality cases in 5 years.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:

[1] sections 500(b) & (f); [19]

OSHA CLARIFICATION LETTER

Date 8/31/89; From Director of Construction Compliance Programs to Regional Administrator; Synopsis - A floor hole 60' x 40' x 12" deep in the middle of a large finished floor is not a floor opening or hole under this standard. Additionally, a uniform enforcement policy on floor openings is not possible because of the many variables that exist, i.e. the depth of the hole, workers exposure, etc.; therefore, each particular situation must be evaluated by the CSHO to determine if a hazard exists.



☐VIOLATION ☑**IN-COMPLIANCE**

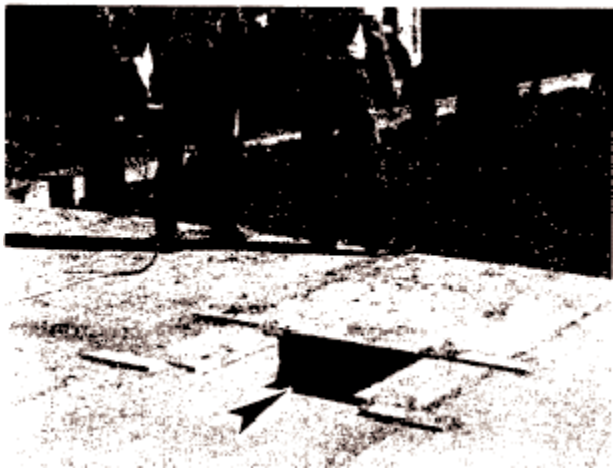
Properly erected standard guardrail system for floor opening.

☐VIOLATION ☑**IN-COMPLIANCE**

Employee is wearing the proper goggles while cutting steel for stairway.

☑ **VIOLATION** ☐ IN-COMPLIANCE

Unguarded floor opening (arrow) which exposes workers to a 9' fall into basement.



RANK IN FREQUENCY CITED	1926.	
#21	1053(b)(1)	LADDER EXTENDED 3' ABOVE LANDINGS

RULE: **When portable ladders are used for access to an upper landing surface, the ladder side rails shall extend at least 3 feet (.9 m) above the landing surface to which the ladder is used to gain access; or, when such an extension is not possible because of the ladder's length, then the ladder shall be secured at its top to a rigid support that will not deflect, and a grasping device, such as a grabrail, shall be provided to assist employees in mounting and dismounting the ladder. In no case shall the extension be such that ladder defection under a load would, by itself, cause the ladder to slip off its support.**

INTENT:
The purpose of this rule is to provide protection for employees during two critical phases of ladder climbing: 1) when employees are on the ladder and their movement may cause forces to be transferred to the ladder and it's support points which night tend to make it slip or fall; and 2) when the employee is either getting on or off the ladder - if nothing is available to grab and provide support the employee will be in a bent over position and his/her center of gravity may be outside the vertical line of normal body position in an attempt to correct this and straighten up and get onto the ladder the employee is vulnerable to a fall. The rule specifies: 1) that the side rails must extend three feet above the landing; 2) side rails must be secured at the top to a rigid support when the 3 foot extension is not provided (this can be done by tieing with rope boxing in with lumber, etc.); 3) a grab device must be provided when the ladder's side rails do not extend 3 feet above the landing (the grasping device can be constructed of materials such as metal, lumber, etc., it can be a part of the structure providing it's location does not create a hazard in itself and it's easy grasped); and 4) when employees are on the ladder its deflection cannot cause it to slip off its support; therefore, when selecting/spotting a ladder, consider the amount it will deflect during use to assure that the proper length is used.

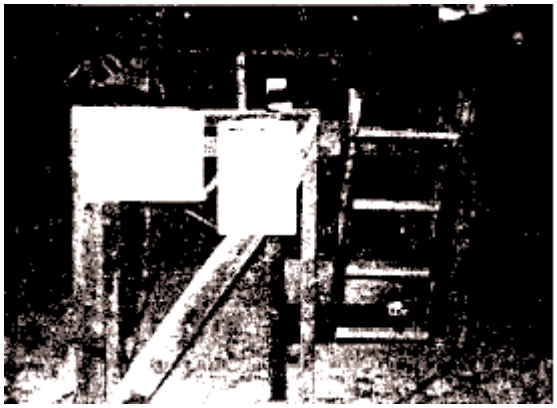
HAZARDS:
Fall from elevation. Probable injuries range from death to sprain/strains.

(AMONG OTHER) SUGGESTED ABATEMENTS:
- Abatement is obvious - construct/use ladders according to specification requirement.
- Instruct first-line supervisors to inspect ladders during each shift in their work area.

SELECTED CASE HISTORIES:
An employee was climbing a 10 foot ladder to access a landing which was 9 feet above the adjacent floor. The ladder slid down and the employee fell to the floor, sustaining fatal injuries. Although the ladder had slip-resistant feet, it was not secured, and the railings did not extend 3 feet above the landing.

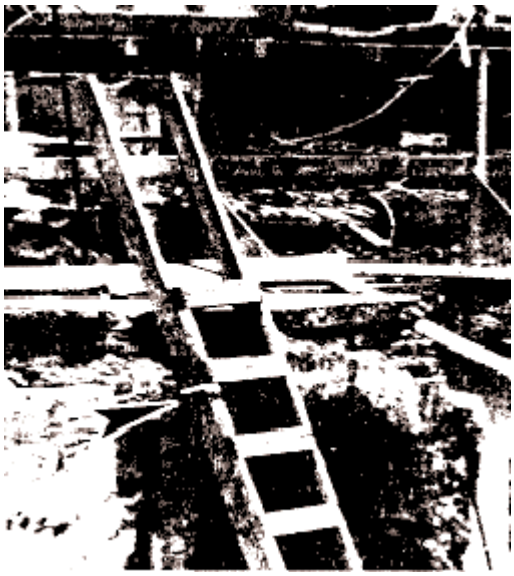
COMMENTS:
1. This standard covers only portable ladders. A similar requirement for fixed ladders is 1926.1053(a)(24).
2. This is a specification standard which is easily identified and substantiated as a violation as evident by it's high ranking on the 100 **Most Cited Physical List**. Therefore, the contractor must continually audit the site to remain in compliance with this item.
3. The standard was cited in 6 fatality/catastrophe inspections since January, 1991.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Subpart X; [18]



☐VIOLATION ☑**IN-COMPLIANCE**

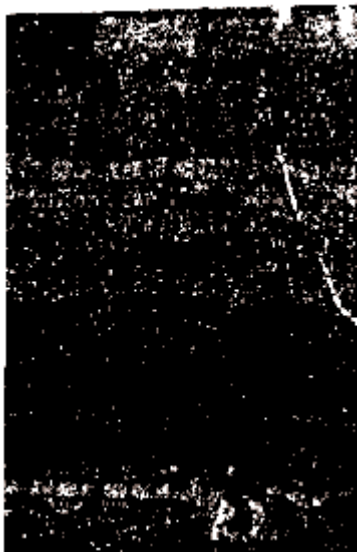
The portable ladder extends 3' above the opening (landing) of the confined space.
NOTE: The guarding of the floor hole except at the entrance for the ladder is acceptable.



☐VIOLATION ☑**IN-COMPLIANCE**

The job made ladder is secured (arrow) and extended 3' above the landing.

NOTE: The exposure to the open-sided floor when employees are on the landing would be a violation of 1926.500(d)(1)



☑ **VIOLATION** ☐ IN-COMPLIANCE

The job made ladder does not extend at least 3' above landing, nor is it secured against tipping.

RANK IN FREQUENCY CITED	1926.	
#22	651(c)(2)	EGRESS FROM TRENCH/EXCAVATION

RULE: **Means of egress from trench excavations. A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employee.**

INTENT:
When conditions begin to deteriorate in a trench, such as soil beginning to slug off the face of the trench, the risk of a cave-in increases and emergency egress may be required. This standard requires a means of egress. The intent of the rule is to specify the following: 1) maximum lateral distances an employee can travel (25 feet) to egress a trench; 2) maximum depth of the trench (4 feet) when egress must be provided; and 3) means in which egress from the trench can be accomplished, i.e. stairway, ladder, ramp, or other safe means. Note: It is not intended that this rule apply to large excavations ([14], pg. 45918). However, a safe means of access/egress from large excavations must be provided as per 29 CFR 1926.1051(a). That standard requires a stairway or ladder be provided at personnel points of access where there is a break in elevation of 19 inches or more, and no ramp runway, sloped embankment or personnel hoist is provided.

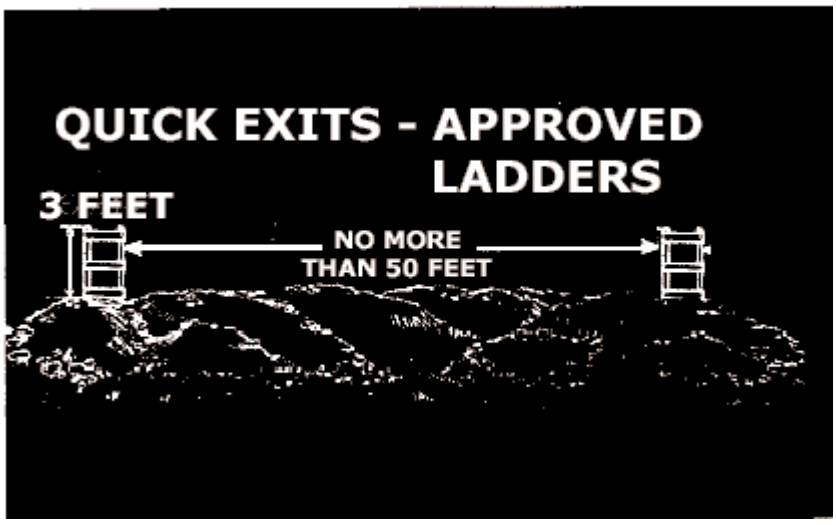
HAZARDS:
• Cave-in. Probable injury is death.
• Hazardous atmospheres caused by broken utility lines, toxic materials entrained in soil, etc. Large range of injuries from death due to inhalation of toxic material to first aid.

(AMONG OTHER) SUGGESTED ABATEMENTS:
• Provide properly constructed /maintained means of egress at predetermined points.

SELECTED CASE HISTORIES:
• Two employees were in a 12 foot deep trench laying pipe when one of the employees saw the bottom face of the trench move and jumped out of the way along the length of the trench as the wall caved-in fatally injuring the other employee. The walls of the trench were vertical and no means of emergency egress was provided.
• Two employees laying sewer pipe were in a 15 foot deep trench, which was not shored or sloped properly. The employees had to egress the trench by climbing the backfill. While exiting the trench the first worker was trapped by a small cave-in. The second employee tried to extricate him but a second cave-in occurred trapping the second employee at the waist. The second cave-in actually caused the death of the first employee; the second employee sustained a hip injury.

COMMENTS:
1. Only one means of egress is required in the middle of a trench 50' long to meet the requirements of this standard.
2. Earthen ramps may be used as a suitable means of egress only if employees can walk the ramp in an upright position when entering and exiting. The earthen ramp must be evaluated as acceptable by the competent person.
3. This standard was cited in 24 fatality inspections conducted by OSHA since January 1991.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:
[1] Subpart P; [14]; [20]



☐VIOLATION ☑**IN-COMPLIANCE**

Required for trench/excavations ≥ 4 feet deep.

☑ **VIOLATION** ☐ IN-COMPLIANCE

No means of egress provided. Employee is riding backhoe bucket out of trench.

RANK IN FREQUENCY CITED	1926.	LISTED, LABELED OR CERTIFIED EQUIPMENT USED IN MANNER PRESCRIBED
#23	403(b)(2)	

RULE: Listed, labeled, or certified equipment shall be installed and used in accordance with instructions included in the listing, labeling, or certification.

INTENT:

At times electrical equipment is installed or used in a manner for which it was not designed. This is one of the electrical standards which a used as a "catch all" for hazardous situations which are not covered by specific electrical standards. While the application of this standard may be broad, the intent is to ensure that all electrical equipment is used/installed as designed. The most common specific application of this standard as used by OSHA in construction is to address the situation when a multiple-receptacle box designed to be mounted is fitted with a power cord and placed on the floor to provide power for various tools. This would not be a prescribed use for the receptacle box. OSHA also cites this standard for the use of ROMEX® wire for making up extension cords; using equipment outdoors which is only listed and labeled for in indoor dry locations (this can even apply to double insulated tools which are listed and labeled for dry indoor locations only); short two-prong adapter plugs with pig tail equipment grounding connections to facilitate the attachment of cords and tools to electrical systems; and the use of the wrong size circuit breakers or fuses for overcurrent protection. The situations listed above would not be in accordance with the equipment's prescribed use.

HAZARDS:

- Electrical shock. Probable injuries can vary from death to minor burns.
- Fire. Probable injuries can vary from third degree to minor burns.

(AMONG OTHER) SUGGESTED ABATEMENTS:

- Since most violations rated to this standard are the result of original equipment being shop fabricated, altered, modified, etc. instruct first-line supervisors to watch for such equipment and determine if it is in compliance with OSHA/NEC. If not, take equipment out of service immediately.

SELECTED CASE HISTORIES:

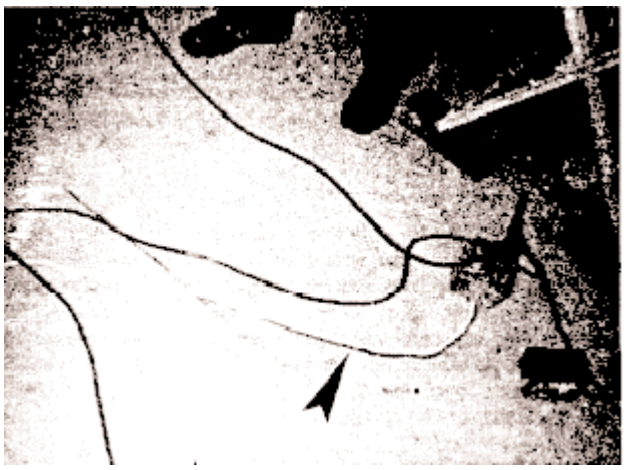
An employee was texturing a wall using an air compressor. The plug of the compressor and an extension cord had been modified to fit a wall outlet for a common household dryer (220 V). While attempting to unplug the compressor from the extension cord, the employee was fatally shocked. The modification to the plugs was not an intended use or prescribed by the manufacturer.

COMMENTS:

1. The shop-fabricated multi-receptacle box laying on the floor is quite common in the industry. After, OSHA CSHO's become familiar with this problem it becomes as easy a violation to identify and substantiate as many of the specification standards.
2. If an installation is made in accord with the 1984 National Electric Code, it will be considered to be in compliance with Section 1926.403 thru 1926.408, except 1926.404(b)(1), 1926.405(a)(2)(ii)(E), 1926.405(a)(2)(ii)(F), 1926.405(a)(2)(ii)(G), & 1926.405(a)(2)(ii)(J).
3. This standard was cited in seven fatality inspections conducted by OSHA in 5 years.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:

[1] Subpart K; [2]; [3]



☑ **VIOLATION** ☐ IN-COMPLIANCE

Multi-receptacle outlet box on the floor providing power to 3 extension cords. The supply power to the outlet box is provided by non-metallic sheath (NM) cable (arrow).
The manner in which the outlet box and NM cable is used is not a prescribed use.

☑ **VIOLATION**
☐ IN-COMPLIANCE

NM cable is being run across a field (above) to provide power to an outlet laying on ground (blow-up). It is being utilized as an extension cord. The use of the NM cable and outlet in this manner is not a prescribed use. NOTE: The NM cable is run on ground is not protected from damage (this particular cable was run across a subdivision street). When NM cable is used on a construction site it must be used in a manner prescribed such as wiring for feeders, branch lines and temporary lighting. Additionally, it must be installed properly and must be protected from physical damage.

RANK IN FREQUENCY CITED	1926.	FLEXIBLE CORDS DESIGNATED FOR HARD OR EXTRA HARD USAGE
#24	405(a)(2)(ii)(j)	

RULE: Extension cord sets used with portable electric tools and appliances shall be three-wire type and shall be designed for hard or extra-hard usage. Flexible cords used with temporary and portable lights shall be designed for hard or extra hard usage.

INTENT:

Extension cords when exposed to even "normal" construction use can experience rapid deterioration. When this happens, conductors with energized bare wires can be exposed. Conductors can break or come loose from their terminal screws, specifically the equipment grounding conductor. If that should occur the equipment grounding for the tool in use is lost. Since deterioration occurs more rapidly in cords which are not rugged enough for construction conditions, the National Electric Code [5] and OSHA have specified the types of cords to use in a construction environment. This rule designates the types of cords that must be used for various applications including portable tools, appliances, temporary and portable lights. The cords are designated **HARD and EXTRA HARD SERVICE** Examples of **HARD SERVICE** designation types include **S, ST, SO, STO, SJ, SJO, SJT & SJTO** Extension cords must be durably marked as per 1926.405(g)(2)(ii) with one of the HARD or EXTRA HARD SERVICE designation letters, size and number of conductors.

HAZARDS:

Electrical shock. Probable injuries range from death to minor burns.

(AMONG OTHER) SUGGESTED ABATEMENTS:

Continually audit cords on-site. Any cords found not to be HARD or EXTRA HARD SERVICE must be taken out of service immediately.

SELECTED CASE HISTORIES:

An employee received a fatal shock when he was cutting drywall with a metal casing router. The router's 3-wire power cord had been spliced to a 2-wire cord and plug. A fault occurred and with no grounding and the absence of GFCI protection, the employee was electrocuted. The cord was not a 3-wire HARD SERVICE variety.

COMMENTS:

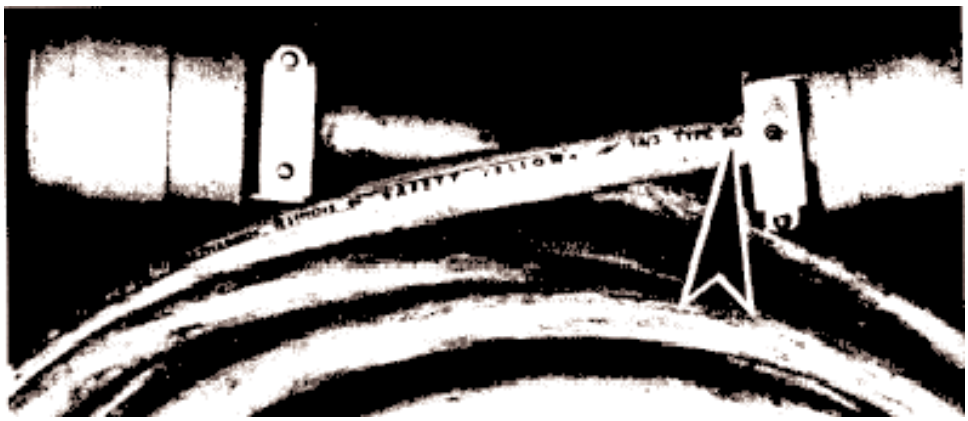
1. The durable marking required to be on the cord can be found as an indelible marking by the manufacturer approximately every foot along the length of the cord.
2. Because the use of extension cords is so numerous at construction sites and this is a specification standard, the number of related violations is quite high. For the OSHA CSHO this situation is relatively easy to identify and substantiate as a violation.
3. Because of the constant movement of contractors and equipment, specifically extension cords, on/off-site and the fact that sometimes several contractors draw power utilizing the same extension cord, identifying improper service cords may be difficult.
4. This standard was cited in 20 fatality inspections in last 5 years.

ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:

[1] Sections 405(b) & (g); [2], [3]

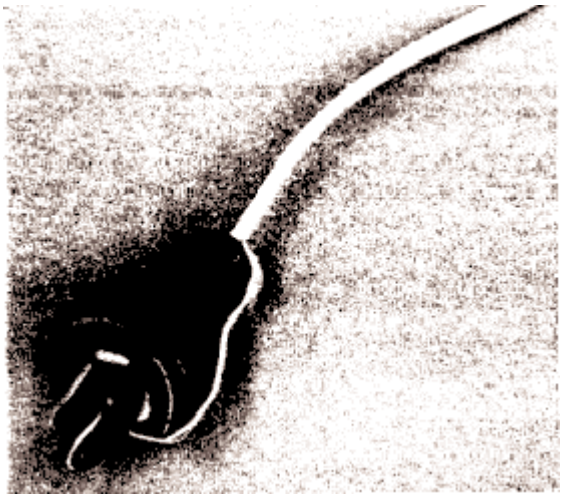
OSHA CLARIFICATION LETTER

Date 3/3/92;From Director of Compliance Programs to Director of Office of Construction and Engineering; Synopsis – Contractor shop-made extension cords are acceptable if they meet the following criteria; 1) all individual components of the cord set must be approved by a nationally recognized testing laboratory; 2) the cord sets must meet all applicable requirements such as strain relief, correct polarity of conductors, proper marking, etc.; 3) cords must be assembled by a qualified person; and 4) the cord set must be checked prior to its first use, for example, the following tests should be performed a) all equipment grounding conductors shall be tested for continuity and shall be electrically continuous and b) each receptacle and attachment plug must be tested to insure proper connection of the equipment grounding conductor to its appropriate terminal.



☐ VIOLATION ☑ **IN-COMPLIANCE**

Hard service cord TYPE SO (arrow).
NOTE: The strain relief devices for ends of the attachment plugs.



☑ **VIOLATION** ☐ IN-COMPLIANCE

2 wire ribbon type cord is not designed for HARD USAGE.

NOTE: The 2 wire cord does not provide equipment grounding. Additionally, there are exposed terminal screws and conductors on the end of the cord which create a shock hazard.

RANK IN FREQUENCY CITED	1926.	
#25	405(g)(2)(iv)	STRAIN RELIEF FOR CORDS

RULE: **Flexible cords shall be connected to devices and fittings so that strain relief is provided which will prevent pull from being directly transmitted to joints or terminal screws.**

INTENT:

The deterioration of electrical cords on construction sites is a common occurrence. If a cord deteriorates to a point where conductors have effectively worn through their insulation or equipment grounding conductors are no longer attached to their terminal screws, an electric shock hazard is created. Many times deterioration of the cord is due to the strain, both normal and abnormal, it experiences on the site. One of the weak points of a cord assembly is the area in which attachments are made (plug cap and connector body). When devices or fittings designed to relieve cord strain are not used, insulation will tend to pull back and expose conductors or the conductors will loosen from their terminal screws. Therefore, this standard requires hardware to prevent tension from being transmitted to joints and terminal screws. Manufactured molded plug caps and associated connections usually do not pose this problem under normal use. However, site-fabricated cords or cords that have been repaired in the field frequently do not have sufficient strain relief. Loose wires in a plug cap caused by improper connection or tension due to no strain relief can cause conductors to make contact where not intended causing short-circuit, fires, arching type explosion, etc.

HAZARDS:

Electrocution and fire. Probable injuries can range from death to first degree burns.

(AMONG OTHER) SUGGESTED ABATEMENTS:

- Use approved cords for HARD or EXTRA HARD USAGE (Designated S, ST, SO, STO, SJ, SJO, SJT or SJTO).
- Use only cords which are equipped or designed with strain relief.
- Use factory-assembled cord sets as much as possible.
- Reinforce the simple work practice that everyone learned when they were children -remove cords from receptacles by pulling on the plugs, not the cords.

SELECTED CASE HISTORIES:

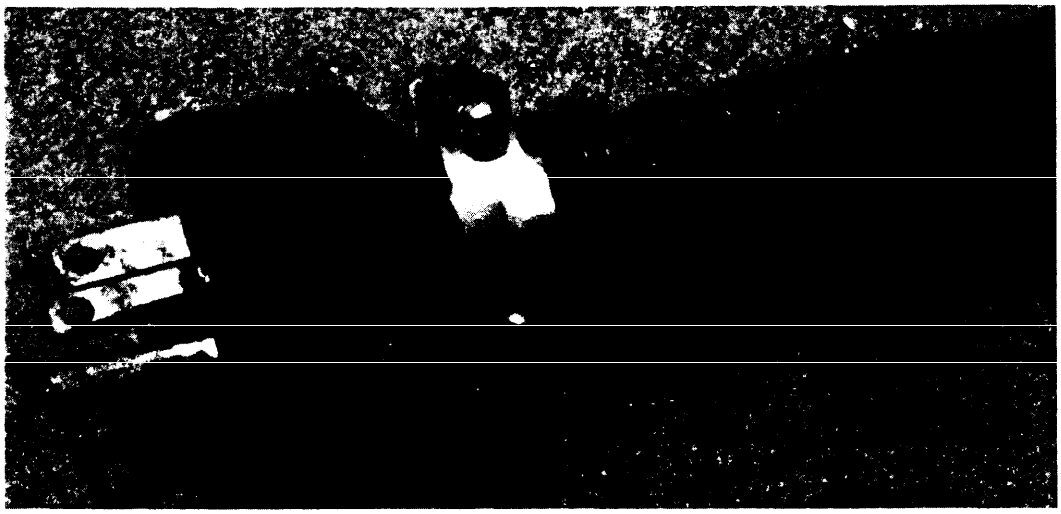
An employee operating a 3/4" electric chisel was electrocuted. An electrical fault occurred in the casing of the tool. An inspection revealed that the original power cord had been replaced with a flat cord (not designed for HARD service), the ground prong was missing and strain relief was not provided for the cord at the point it entered the tool. Additionally, no GFCI protection was provided.

COMMENTS:

1. There is no prohibition against fixing a cord or reattaching it to a plug. However, care must be taken to assure the original electrical and mechanical integrity of the cord is maintained.
2. Splices to flexible cords and cables are prohibited under 1926.405(g)(2)(iii) if their service rating is less than Hard Service No. 12. If the service rating is greater than No. 12 splices may be made provided they meet other mechanical requirements.
3. This standard was cited in 20 fatality inspections conducted in five years.

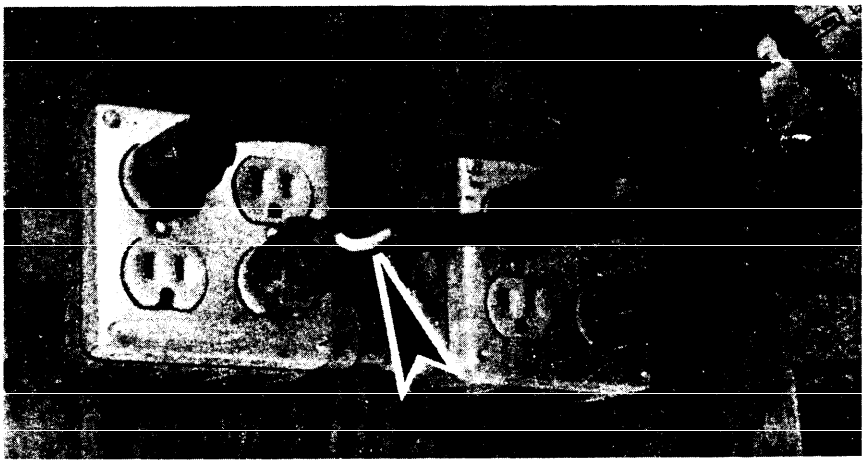
ADDITIONAL DOCUMENTS TO AID IN COMPLIANCE:

[1] Section 405; [2]; [3]; [21] Fact Sheet #5; Pull at Joints & Terminals Must Be Prevented



☐ VIOLATION ☑ **IN-COMPLIANCE**

Strain relief provided for plug on cord.



☑ **VIOLATION**
☐ IN-COMPLIANCE

The insulation of the cord (arrow) is pulling away from plug. The plug had earlier been repaired and it's original molded plug strain relief was compromised. Additionally, strain relief was not provided at the time of repair resulting in condition shown above.

5.2 CONSTRUCTION SPECIFICATIONS FOR GUARDRAILS AND TOEBOARDS

The following section presents construction specifications for guardrails and toeboards. These specifications relate to **GUIDE** Sheets #1, #6, # 12, # 15 and #20 listed above in Section 5.1. These tables compile the requirements for "standard guardrails and toeboards or their equivalent". Table 5.2-1 lists construction specifications for guardrails and Table 5.2-2 lists construction specifications for toeboards.

TABLE 5.2-1

MINIMUM SPECIFICATIONS FOR GUARDRAIL SYSTEMS

TYPE OF MATERIAL	SIZE OF TOP/MID RAIL[IN]	HEIGHT [IN] TOP RAIL(1)	POST SIZE/SPACING(2)	STRENGTH(3) [LBS.]
WOOD	2x4/1x6	42	2"x4"/8'	200
PIPE	1-½ nominal OD	42	1-½ nom./8'	200
STEEL	2x2x3/8 angle	42	2"x2"x3/8" angle/8'	200 or equiv. bend. strength
WIRE ROPE	3/8(4)	42	equivalent to one of above	200
OTHER EQUIVALENT	equivalent to one of above	42	equivalent to one of above	200

(1) Acceptable heights range from 39" to 45" (42"± 3"). Mid rail height should be about ½ height of top rail.
(2) Spacing is horizontal distance measured center post to center post
(3) Railing must have minimum deflection in any direction 200 1b. force is applied. Minimum deflection is not defined although 3" of deflection for wire rope after force is applied is a guideline. Strength criteria also applies to all structural members of system including post anchorages
(4) There is no present OSHA National Office guidance at this time for size of wire rope guard rails. 3/8" is a recommended size, however, any wire rope size ¼" or larger (as per NPRM for Subpart M) would be acceptable. OSHA requires a ½" wire rope or equivalent for periphery of floors during steel erection.
Note - Lumber sizes listed above can be nominal size.

TABLE 5.2-2

MINIMUM SPECIFICATIONS FOR TOEBOARDS

HEIGHT OF PROTECTION[1]	MATERIAL	CONSTRUCTION	SIZE
Standard Toeboard Does Provide Protection	Substantial	1) Solid 2) Opening < 1” 3) ¼ “ max. clear. from floor	4” min. (vertical dimension)
Standard Toeboard Does Not Provide Protection	Substantial	Paneling or Screening	Floor to Mid or Top Rail

(1) The size of the material containment, i.e. toeboard is dictated by the size of the material or the way it is piled. A standard toeboard may not be sufficient to contain items near the edge of an open-sided floor/platform. In that case the height of the containment must be increased accordingly.

ATTACHMENT

FIVE

Safety Poster

Attachment follows this cover sheet.

Do Not Enter an Unprotected Trench!

For your safety:

- Slope or bench trench walls, or
- Shore trench walls with supports, or
- Shield trench walls with trench boxes.
- Provide safe access through the use of ladders, ramps or stairways.
- Keep heavy equipment away from trench edges.
- Know where underground utilities are prior to digging.
- Keep excavated or other materials at least 2 feet back from the edge of trench.

OSHA's role is to assure the safety and health of workers by setting and enforcing standards; providing training, outreach and education; establishing partnerships; and encouraging continual improvement in workplace safety and health.

OSHA Occupational Safety and Health Administration

U.S. Department of Labor

To get more information, report an emergency or contact your local office:

www.osha.gov · (800) 321-OSHA · TTY (877) 889-5627

OSHA 3215-04N-05

ATTACHMENT

SIX

Owner-Controlled Insurance Programs

Attachment follows this cover sheet.

OWNER-CONTROLLED INSURANCE PROGRAMS

BY DAVID L. GRENIER

This is the first of a two-part feature focusing on OCIPs. Read this article in order to gain an understanding of the fundamentals of this increasingly popular insurance product.

What's inside…

- **Defining an OCIP**
- **Who & What Is Included & Excluded**
- **How an OCIP Manages Risk**
- **The Advantages & Disadvantages for Owners & Contractors**
- **Potential Savings**
- **Coverage Considerations**

In our next issue, we'll explore the assessment and implementation phases of an OCIP, and you'll get the answers to some FAQs.

Owner-controlled insurance programs (OCIPs) are a type of wrap-up, an increasingly popular insurance procurement option that allows coverages for multiple insureds to be bundled (or wrapped up) into one consolidated program.

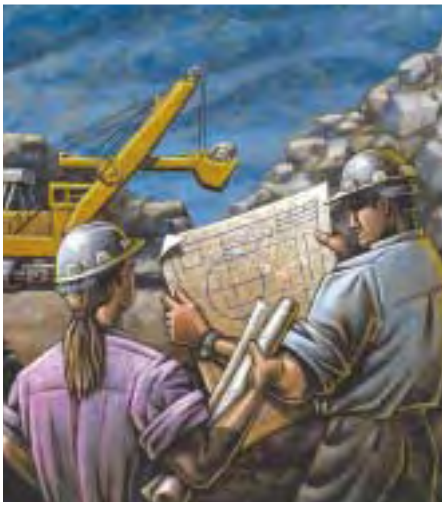
OCIPs are typically used on very large construction projects involving many contractors and subcontractors. They provide an owner with certain cost savings; as well, they offer some advantages for the contractors and subcontractors working on the project.

Construction financial managers should familiarize themselves with these programs in order to ensure that their companies are adequately protected when they choose to bid on and/or participate in an OCIP.

> OCIPs can potentially reduce an owner's project costs by approximately 1-2%, compared to traditional, fragmented insurance programs.

An OCIP is a wrap-up under which a project owner provides various insurance coverages to contractors and subcontractors. OCIPs comprise about 90% of the wrap-up programs currently being performed in the U.S. Another type of wrap-up is a contractor-controlled insurance program (CCIP), under which the general contractor is the sponsor. (For more information on CCIPs, see "How to Put a CCIP to Work for You" by Richard C. Livermore in our September/October 1997 issue.)

The two programs are basically the same. The main difference is sponsorship (owner vs. contractor) and the main question concerns control: *Who is responsible for what?* The issue of control can pose potential problems if the wrap-up is not structured with partnering and collaboration in mind. Having the proper scope definition, delineation of responsibilities, and program structure, as well as communication and cooperation, are critical to the success of any wrap-up. That said, let's now turn to the specifics of the OCIP.



Why OCIPs Now?

OCIPs have been around for more than 40 years; however, within the last decade, we've seen a proliferation of this type of insurance program on construction projects throughout the U.S. and abroad.

The use of OCIPs continues to grow as a result of several factors:

- The increase in the number of large capital improvement projects undertaken to repair the nation's deteriorating infrastructure.
- The booming economy, fueled by the growth and expansion of high-tech businesses.
- The implementation of less-stringent insurance regulations.
- A highly competitive construction insurance market.

Defining OCIPs

As stated at the outset, an OCIP is a wrap-up under which a project owner provides various insurance coverages to contractors and subcontractors. OCIPs can potentially reduce an owner's project costs by approximately 1-2%, compared to traditional, fragmented insurance programs.

Who & What Is Included

An OCIP can be site-specific or it can be for multiple jobsites. Most OCIPs are multi-year programs with a fixed duration. For large construction projects, the most common duration is two to five years. And, the OCIP normally applies to all contractors and subcontractors performing work at the project jobsite. This jobsite is defined to include the construction site, all on-site fabrication shops, and associated material storage and laydown yards.

The insurance coverages most commonly included in an OCIP are workers' compensation (workers' comp), employers liability, commercial general liability (CGL), and excess/umbrella liability. In addition (but not always), an OCIP can include builder's risk, professional liability for design professionals, and environmental liability insurance coverages.

In the last few years, design liability and environmental liability insurance have been bundled by some insurance carriers to provide professional and pollution coverage. In addition, some insurers have introduced subcontractor default liability policies into the OCIP mix as an alternative to surety bonds.

Who & What Is Excluded

If the majority of a contractor's work is performed away from the project site, the contractor may be excluded from the OCIP. The reason is simple: Limited jobsite exposure in the contractor's contract means limited exposure to jobsite injuries/claims. An OCIP should also exclude contractors with a contract amount below a certain threshold. (Depending on the total construction costs, $25,000-$50,000 in contract value is a good rule of thumb.)

Commercial auto liability coverage is usually excluded due to the difficulty of controlling/verifying losses. If included, such coverage could negatively impact OCIP savings.

Traditional vs. OCIP Approaches

In order to gain a better understanding of the OCIP, let's first examine how an owner would traditionally mitigate risk on a construction project.

Traditionally, an owner and a contractor execute a construction contract which includes an indemnification clause with exculpatory language expressly stating that the contractor shall hold the owner harmless for any loss arising out of the execution of the contract. This type of indemnification clause usually protects the owner from any vicarious liability and mitigates the owner's contributory negligence exposure.

In addition to this contractual provision, the project owner would require that the contractor purchase and maintain adequate insurance coverage with specified minimum limits of liability. At the very least, owners normally require contractors to provide workers' comp, employers liability, and CGL coverages. The owner will usually require that the contractor name the owner as an additional insured on the contractor's liability policies; this ensures that the contractor will defend the owner in the event of any third-party action-over claims.

Under traditional insurance programs, one alternative to being named as an additional insured is for the owner to require the contractor to purchase an owners' and contractors' protective liability policy. This project-specific policy is purchased and maintained by the contractor; however, the cost for this policy is reimbursed by the owner when required by the owner.

By comparison, under an OCIP, insurance coverage (usually the workers' comp and CGL) is provided by the owner to the contractor, subcontractors, and subsubcontractors. The indemnification provision still exists, but the standard contractor insurance requirements are removed.

Advantages & Disadvantages for Owners

OCIPs hold advantages and disadvantages for both the owner and the contractors performing the work. Advantages to owners include:

- The ability to obtain broader insurance coverage with higher dedicated limits for contractors, which ultimately provides better protection for an owner.
- Potentially lower construction costs resulting from volume discounts on insurance purchases and reduced losses from more effective, comprehensive, safety and loss-control programs.
- Improved quality of risk management services (e.g., claim handling, loss control).
- Substantial reduction in the amount of time required for obtaining certificates of insurance from contractors.
- Insurance requirements no longer an obstacle for contractors bidding work.

However, an OCIP is not the perfect risk management tool by any means. Here are several owner disadvantages:

- The additional administrative burden can require a substantial level of effort if not managed competently by the owner's OCIP administrator.
- If the insurance market hardens, there is a potential financial risk inherent in loss-sensitive programs, resulting in premium cost increases and/or coverage reductions.

- An additional accounting effort may be required for extracting insurance costs from contractor and subcontractor bids and change orders.
- An additional monitoring effort is required by the OCIP administrator to ensure that claims from a contractor's employees injured on other projects are not charged to the OCIP.
- Owner responsibility is increased for the implementation of safety and loss-control programs.

The Time Factor

In many cases, the additional administrative burden associated with the OCIP may be outsourced to an insurance agent or broker, risk management consultant, or a third-party administrator. However, there is still an administrative impact on an owner's operations because a number of departmental resources (e.g., legal, human resources, accounting, finance, purchasing, facilities and construction, safety and risk management) are affected throughout OCIP implementation and administration.

With the exception of risk management, the time burden placed on these other departmental resources is minimal, usually requiring only a few hours during the design and implementation phases. Post-implementation, an owner's day-today involvement should only be periodic, and will probably be limited to premium payment, claims reviews, and administrator coordination.

Other Owner Considerations

Owners should be cognizant of the financial risk inherent with a loss-sensitive OCIP, and understand how this differs from guaranteed-cost insurance.

With a traditional insurance program, the owner transfers all risk of loss to the contractor and subcontractors, and pays a fixed premium to the insurer for guaranteed-cost insurance. When an owner changes from a fixed-price, guaranteed-cost program to a loss-sensitive OCIP, an owner is trading off some financial certainty for the potential to lower the cost of risk.

The total cost of risk is limited by the application of per-occurrence and aggregate retentions, and by implementing an aggressive safety and loss-control program to mitigate losses. However, owners cannot completely protect themselves from risk unless they purchase a guaranteed-cost insurance program, which usually comes with higher fixed costs, particularly in a hardening insurance market.

Pros for Contractors

Just as there are advantages for owners, an OCIP offers a number of pluses to participating contractors, including:

- The ability to obtain broader coverage with higher liability limits.
- More effective safety, loss control, and risk management programs.
- Coordinated claims handling/adjusting procedures and claims management services.
- Elimination of coverage disputes and subrogation between contractor and insurers.
- OCIP claims not counted as part of the contractor's own aggregate limit.

But, OCIPs present a downside for contractors, just as they do for owners. Here are several disadvantages for contractors:

- Since bids must be provided with and without insurance, a more complicated bidding process is required in order to delineate bid credits.
- In a close bidding situation, a contractor with a good safety record may lose out when competing against a less safety-conscious contractor. (This could occur if the workers' comp experience modifier is not taken into consideration as part of the bid process.)
- Documentation and reporting requirements impose an additional administrative burden.
- Since OCIP costs must be segregated from other project costs, additional bookkeeping is required to maintain duplicate payroll records.
- OCIP coverage may not be as broad as, or may have lower limits than, the coverage provided by the contractor's own insurance policies. In this case, the contractor will have to negotiate with its own insurer to obtain excess limits or difference-in-conditions (DIC) liability coverage.
- An OCIP usually includes completed operations coverage for losses in a specified period of time (e.g., a two to five year "tail" after project completion). However, a contractor's exposure continues for a longer period of time. Therefore, whenever possible, a contractor should endorse its own general liability policy to include any exposures beyond the OCIP period.
- Due to the decrease in payroll volume, the contractor's own insurance company may reduce its premium credits; also, dividends for workers' comp may go to the owner, not the contractor.
- Auto liability coverage is usually excluded from an OCIP. This can make it more difficult to separate general liability and auto liability claims if these coverages are with different insurers.
- Some OCIP administrators do not report workers' comp loss data to rating bureaus in a timely manner, thereby affecting the contractor's experience calculation.

Other Contractor Considerations

As previously mentioned, contractors have additional administrative burdens associated with an OCIP, as do the subcontractors enrolled in the program. First, the contractor must expand its bid package to define the OCIP for subcontractors and identify the subcontractors' insurance deductions. The

project pre-bid and pre-mobilization meetings must be expanded to educate all subcontractors about the implementation and administration of the OCIP. The contractor must also work with the owner's insurance representative, and/or designated OCIP administrator, to validate insurance deductions and enroll all subcontractors who will be working on the project.

The Time Factor

Contractors should expect the incorporation of the OCIP documentation to add more time to the preparation of each bid package. (This would include the OCIP manual and associated pre-bid and bid clarification meetings with subcontractors bidding work on the project.) However, under a traditional insurance program, the contractor would probably have expended an equal amount of time tracking its subcontractors' certificates of insurance. Under an OCIP, this burdensome task is not required.

In addition, the contractor's and subcontractors' insurances must be modified to dovetail with the OCIP coverages. Subcontractors must complete wrap-up enrollment forms and monthly payroll reports, and must report claims to an OCIP administrator and insurer in lieu of their own insurers. Additional time should be budgeted for participating in OCIP orientation meetings, completing enrollment forms, and preparing periodic payroll reports.

Potential Savings to the Owner

It's extremely difficult to determine the total savings an owner can realize from an OCIP because the potential savings can vary significantly based on a number of factors.

Savings are derived when contractors and subcontractors remove insurance costs from their bids because these bid reductions lower the contract price. The owner's cost for providing workers' comp, CGL, and excess liability coverage on behalf of contractors and subcontractors will likely be substantially less than the deduction received from the contractors and subcontractors. The potential savings is the difference between the bid reductions and the owner's cost of contractor and subcontractor-provided insurance coverages.

Contractor and subcontractor bid deductions can vary between 2-5% of construction costs. However, the amount contractors and subcontractors spend on OCIP-provided coverages will vary by geographic area, contractor size, and type of project.

Some Numbers to Crunch

A study conducted by the Risk and Insurance Management Society provided statistical data from 30 contractors on the cost of risk (COR) based on annual revenue. This is a small sample from a much larger total population of contractors, but it will serve our purposes here.

The largest contractors in this study indicated a COR of approximately $25 per $1,000 of revenue. If you subtract the cost of the insurance coverages an OCIP would not normally include and then subtract a contractor's average risk-management administration costs, the OCIP-provided insurance cost would be less than $20 per $1,000 or 2% of revenue.

Assuming a total bid reduction of 2%, total owner savings would be 2% of construction costs less what the owner expends to purchase the OCIP-provided insurance coverages or an estimated savings in the range of 0.5-1% of construction costs.

Cost Comparisons

Most construction estimators use one of several techniques when preparing their bids. When bidding fixed-price work, they may use either a unit rate (cost per square foot for an office building or cost per floor, room, etc., for a hotel) or they may use labor and material estimates provided by the owner or owner's design professional. When bidding cost-plus work, estimators may use the prevailing wage rates for the geographical area and then gross-up this rate to include G&A expenses. Regardless of what method is used, each contractor's bid will contain insurance costs.

The costs on fixed-price bids are usually embedded in the wage rate, which can be directly factored into the estimate or indirectly included in the unit rate. The contractor's bid includes wage rates that are comprised of its employees' base wages and overheads, and are usually expressed as a percentage of

> Contractor and subcontractor bid deductions can vary between 2-5% of construction costs.

the base wage. Some of the overheads that are factored into the gross billing rate include profit, G&A, benefits, taxes, and insurance.

Contractors typically include state workers' comp rates (adjusted by their own experience modification rates) and company-specific general liability rates in their insurance overhead calculations. The insurance overhead assumes first-dollar (i.e., no retrospective rating plan or deductible fixed-cost) coverage. This is usually in the range of 8-14% of payroll, depending on the specific geographic location under consideration.

Many large contractors will include a standard premium figure in their billing rates because their actual insurance cost is undetermined at the time they are bidding on a proposed project. If these contractors were willing to gamble on the unknown, they could ultimately pay less by purchasing first-dollar, guaranteed-cost coverage.

OCIP Costs/Benefits

On an OCIP, the bid packages issued to contractors and subcontractors will contain an "Instructions to Bidders" section specifically stating that bids are to be submitted with and without insurance. However, the cost of insurance is to be included with their bids, as either an alternate/add or an alternate/deduct.

By combining the cost for all of the contractors' and subcontractors' owner-furnished insurance coverages into an OCIP, an owner creates substantial leverage in the insurance market. That's why owners are able to purchase insurance at a lower rate than individual contractors. An owner can realize cost savings of as much as 10-15% due to the volume purchasing of the OCIP coverages.

Owners can also significantly reduce project insurance costs through risk retention. This is achieved by assuming a higher deductible (e.g., $100K-$250K) per loss. Additional savings can be realized if project loss experience is better than the actuarial loss experience factors contained in the insurer's guaranteed-cost rates. It should be noted that loss experience on a significant number of OCIPs has historically averaged less than 40% of standard insurance rates.

A Hypothetical Example

Let's look at a hypothetical example of how an OCIP works in practice. An owner is considering building a $500 million luxury hotel and entertainment complex. The estimated payroll for this proposed project is equal to 25% of the hard construction cost, and the average contractor and subcontractor insurance rate is $10.75 per $100 of payroll (a composite rate, which includes workers' comp and general liability). Using a traditional insurance approach, the insurance cost on this project would be approximately $13.5 million.

[($500M x .25)/100] x $10.75 = $13,437,500

Based on empirical data collected over the past several years on various types of projects, we can expect to reduce this insurance cost by approximately 5% through the use of an OCIP – spending $12.8 million over a 24-month period, instead of the $13.5 million in the above example. The cost of owner-provided insurance contains two components: fixed expenses and retained losses. Fixed expenses include overhead expenses, claim reporting, commissions (if fixed), and premium taxes and assessments. Retained losses are the contractor's and subcontractors' losses that are paid by the owner under the owner's established deductible threshold. If the loss experience on this project is average, the total OCIP insurance cost would be approximately $8.75 million, and the owner's savings would be $4.05 million.

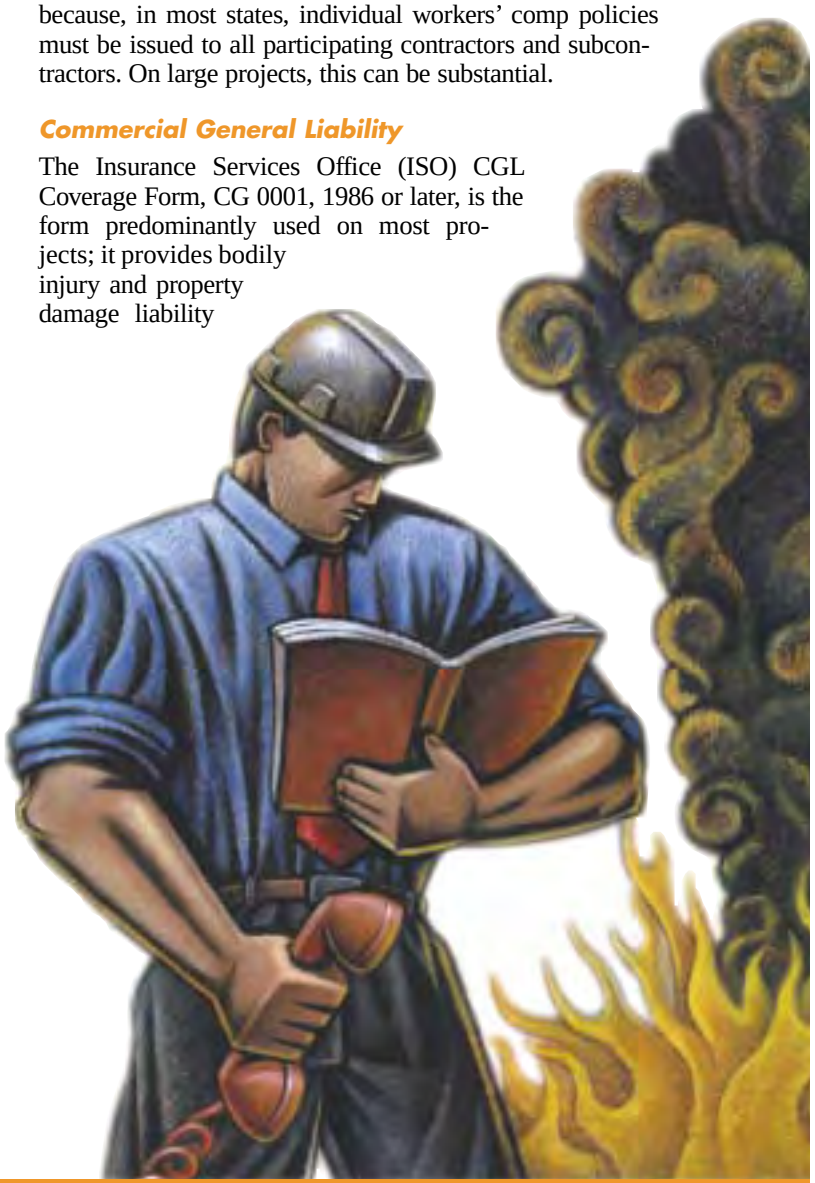
Insurance Coverage Considerations

Workers' Compensation & Employers Liability

Workers' comp and employers liability insurance are statutory, and the limits of liability coverage are regulated by each state's Department of Insurance. Workers' comp coverage is a major component of most OCIPs. This is due to the large premiums that are required, the level of claims handling, and the degree of control needed over the safety, loss control, and risk management aspects of the project. The majority of an OCIP's administrative burden is associated with workers' comp because, in most states, individual workers' comp policies must be issued to all participating contractors and subcontractors. On large projects, this can be substantial.

Commercial General Liability

The Insurance Services Office (ISO) CGL Coverage Form, CG 0001, 1986 or later, is the form predominantly used on most projects; it provides bodily injury and property damage liability



coverage. Regardless of the specific form used, general liability coverage for an OCIP should include (but not be limited to) several key provisions to safeguard the owner's interest: contractual liability; broad-form property damage; OCP liability (usually written on a separate project-specific policy); explosion, collapse, and underground coverages; personal injury liability; and employees-as-insureds. In addition, there are a number of endorsements that can be used with the CGL form to broaden coverage or reduce coverage.

It is highly recommended that contractors remove any wrap-up exclusion endorsement from their own individual CGL policy. Contractors should also attach a DIC endorsement to their CGL policy. This is required so that their CGL policy will apply as excess insurance coverage over the OCIP-provided CGL policy. (Note: The limits of these master policies may be less than the contractor would normally provide for its own non-OCIP projects.) This also provides the contractor with coverage at least as broad as that provided under its own policy. Other considerations relative to the contractor's CGL policy include:

Liability limits. Under an OCIP, aggregate and per-occurrence limits apply to all contractors and subcontractors for the term of the project. Aggregate limits are usually two to three times the per-occurrence limit for any given year on the project. OCIP per-occurrence limits allow the full limit of the policy for each named insured. The coverage provided under the OCIP is extended separately to each entity, which can result in pyramiding limits. Limits can usually start at $25 million and may be $100 million or more, depending on the project's exposures and owner's requirements.

Guaranteed-cost vs. loss-sensitive programs. Most OCIPs are written using large deductibles, large retentions, or retrospective rating plans. Under these programs, the total OCIP cost depends on the actual losses incurred. One disadvantage to this is the continuation of premium adjustments years after the project is actually completed. OCIPs can also be written at fixed rates for the project term, but these plans are more expensive due to the risk associated with the uncertainty of large losses.

Completed-operations coverage. Completed-operations coverage should extend for at least three years after final project completion or acceptance. This does not mean the completion of the contractor's or subcontractors' specific portion of the project, but the completion of the total project as delineated in the contract.

Contractors may negotiate "tail coverage" (which can be endorsed on their own CGL policy) with their own insurance carrier to extend permanent completed-operations coverage beyond the expiration of the OCIP-provided project insurance. Contractors are advised to negotiate this coverage before work begins so as not to lose their ability to obtain this coverage once the work actually starts.

Excess/Umbrella Liability

An excess/umbrella liability policy may be purchased in the excess and surplus insurance markets or as an umbrella policy form. This type of policy provides a buffer layer over the underlying CGL policy.

Note: Many umbrella policies contain a contractor's limitation endorsement which may include a blanket exclusion for wrap-up projects. For the reasons previously noted, these policies need to be modified.

Builder's Risk

The builder's risk insurance policy should cover project exposures associated with earthquakes and floods, damage to existing/adjoining property, boilers and machinery, project delays, the transit and storage of materials off-site, and explosion and collapse. Contractors are required to retain some portion of each property loss. The deductible should be at least $2,500 in order to provide an incentive for contractors to mitigate losses.

Professional Liability

Owners may purchase a professional liability insurance policy to provide coverage for all of the design professionals (e.g., architects, engineers, etc.) on the OCIP project. Ideally, the design professionals would subtract the cost of their own individual professional liability (or practice) insurance from their fees on the OCIP. This may not always be possible, however, because the insurer providing the practice policy may not provide a premium reduction to the owner.

Regardless of obtaining a premium cost savings, an owner may want to obtain a professional liability policy on the OCIP project to provide coverage for design professionals who may not have this coverage or whose coverage does not satisfy the owner's requirements. Also, an owner can purchase broader and more uniform coverage for the OCIP than each design professional could purchase individually in a stand-alone policy.

Environmental Liability

An OCIP can include pollution liability coverage. Policies can be written on an occurrence or claims-made form, can include completed operations coverage, and can be written for the total duration of the project.

Most policies provide coverage for environmental hazards arising from three sources: known pollutants existing on the jobsite which are accidentally released

during construction (pollutants collected by a remediation contractor); unknown pollutants existing on the jobsite that are uncovered by excavation operations (buried fuel oil tanks or barrels of toxic waste); and pollutants brought to the jobsite by a contractor or subcontractor (fuel, hydraulic fluids, paint, etc.).

Owners should seriously consider obtaining coverage for these types of exposures and should require environmental consultants to obtain environmental liability coverage.

Surety Bonds & OCIPs

Surety bonds (typically payment and performance bonds) are procured by the contractor at the request of the owner as a requirement of the contract. The surety guarantees the contractor's performance to the project owner and does whatever is necessary to get the project completed, should the contractor default.

So, surety bonds should not be included as part of an OCIP. Contractor-surety relationships are based on mutual trust, confidentiality, and the contractor's performance and financial solvency. However, the contractor is solely responsible for its own income statement and balance sheet. The owner should not attempt to gain any additional control over the contractor's bonding arrangement, over and above requiring such bonding.

Something New Has Been Added

Subcontractor default insurance provides an alternative to surety bonds. This type of coverage directly indemnifies owners for the costs resulting from contractor or subcontractor performance default.

Coverage applies to reimbursement of both direct and indirect costs incurred to complete unfulfilled contractor obligations, including costs related to job acceleration, extended overhead expenses, and liquidated damages. This approach allows an owner to retain control of the project if there is a default without jeopardizing any of the contractor-surety relationship issues, as mentioned above. There may also be a potential cost savings compared to the traditional surety-bond approach.

These types of policies usually include a deductible, a co-payment percentage, and an aggregate limit. The insurer underwrites the coverage by evaluating the owner's method of prequalifying, managing, and controlling the performance of the contractors and subcontractors (i.e., by reviewing the owner's project management and contract administration procedures). Pricing is determined by project size, geographical location, and the number of contracts.

Conclusion

Now you have a better understanding of an OCIP's features, benefits, and drawbacks. Next time, we'll review the assessment and implementation processes: how to determine if this program is right for the project and how to go about putting an OCIP in place. **BP**

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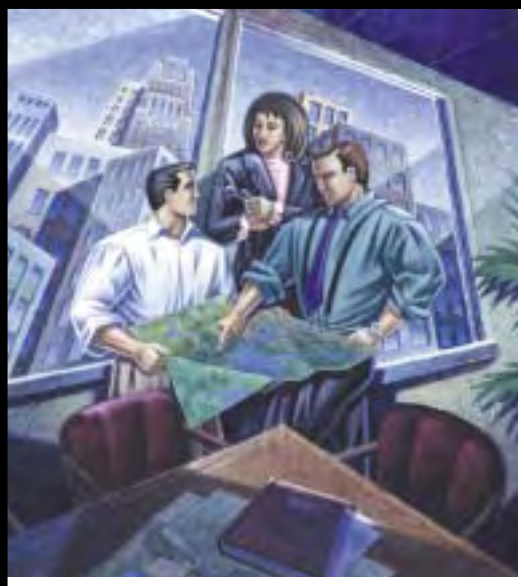
OWNER-CONTROLLED *INSURANCE PROGRAMS*

BY DAVID L. GRENIER

Insurance coverage is a major component of any large construction project. An Owner-Controlled Insurance Program (OCIP) allows project owners to maximize coverages across a project's many contractors and subs, while at the same time affording opportunities for significant savings on premiums.

Part I of this article (September/October, 2000) introduced this increasingly popular program, and examined the pros and cons for both owners and contractors, along with coverage considerations, potential savings, and other major issues.

Now, Part II will help determine whether or not an OCIP is right for your company's next project, and then will guide you through the implementation process.



Illustrations by Brad Goodell

Part Two

Why Owners Like OCIPs

Compared to conventional insurance programs, there are a number of compelling reasons why owners consider OCIPs appealing as an insurance/risk management approach. Some of these reasons include:

• **Coverage Quality.** While owners can mandate minimum insurance requirements, it can be very difficult to ensure that these requirements are actually met. Certificates of Insurance, the typical method of verifying coverage, only provide summary information. By comparison, an OCIP *guarantees* that the owner's requirements will be met. Also, OCIPs allow owners to secure broader coverage by leveraging premium volume with the insurer.

• **Insurance Limits.** Many contractors, especially smaller firms, carry only $500,000 to $1,000,000 of CGL coverage. These policies respond to liability arising from work on all of the contractor's projects; however, a contractor's aggregate limits may be eroded by claims on other projects. Also, individual contractor coverage may be inadequate, given today's multi-million dollar settlements and jury awards. Under an OCIP, an owner can provide $100 million or more of *dedicated* liability coverage, if required.

• **Insurer Stability.** On a large OCIP, there can be over 100 contractor and subcontractor firms; so, theoretically, there could be as many as 100 different insurers covering these contractors and subcontractors. This poses two concerns: Not all of these insurers may be financially stable and their financial stability at the start of a project does not guarantee financial stability throughout! Under an OCIP, an owner has *direct control* over the selection of the insurer and can monitor that insurer's performance and financial solvency. Typically, only one insurer is selected for the primary workers' comp and CGL lines of coverage.

• **Program Innovation.** Over the past few years, owners of construction projects have expressed a growing interest in using integrated risk management and risk financing methods to augment the benefits of design-build project delivery. This type of innovative risk-transfer methodology is best utilized on large, multi-discipline, multi-year OCIPs because it requires a strong project management team to administer.

Some of these programs can integrate insurance coverage for professional design, environmental remediation, *force majeure* perils, and builder's risk. Capitalizing on the leverage created under an OCIP approach, an owner can buy broader coverage at more reasonable prices, realizing volume discounts from economies of scale.

However, these cost savings can be offset by increased administrative costs. Additionally, combining P&C policies (typically written on an occurrence basis) with professional and/or environmental policies (typically written on a claims-made basis) can create difficulties from a claims standpoint.

Why Contractors Should Like OCIPs

When an owner assumes the risk burden under an OCIP, two important benefits are realized: **1)** improved loss control and **2)** improved claims management. Both minimize the cost of retained losses.

"OCIPs are usually implemented on projects to improve safety, reduce losses, and achieve specific financial results."

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• **Loss Control.** By complementing the existing safety programs of participating contractors, an OCIP can help standardize safety procedures on the whole jobsite. Also, an owner can add additional safety staffing, implement a financial safety-incentive program, expand periodic audits, or some combination of these options, by using the money from contractor and subcontractor bid credits and insurance deductions.

• **Claims Management.** Over the past few years, workers' comp reform in several states has greatly improved employer's control over injured-employee claims management. Cost control techniques (such as directing employees to Preferred Provider Networks, return-to-work and modified-duty programs, and medical bill reviews) can potentially reduce an employer's workers' comp costs by as much as 30%.

Owners can offer these program features to all contractors and subcontractors on the OCIP – a real advantage to smaller contractors, since many would not normally benefit from these features through their individual insurance programs.

Another claims-related benefit is the streamlining of GL claims management. Under the conventional approach to project insurance, the owner, contractor, and/or subcontractor involved in a claim are all likely to be represented by different insurers and attorneys. An OCIP helps to mitigate and lower the cost of claims because, typically, only one insurer provides the insurance for all enrolled parties.

The Necessary Groundwork

Owners who are considering implementing an OCIP on an upcoming project should proceed through the following steps prior to implementation:

• **Conduct a Feasibility Study.** This critical first step evaluates the advantages and disadvantages, statutory and regulatory impediments, cost savings, timing, and other key issues.

• **Issue the Request for Proposal (RFP).** Assuming an OCIP is feasible, proposals should be obtained from brokers and/or OCIP administrators. In many cases, the broker is the OCIP administrator; however, an owner's representative or risk management consultant may also be considered.

The RFP should describe the scope of the construction project, anticipated coverages, and requested services, and should be used to obtain information from the respondents about their:

- Background
- OCIP administrative services
- Experience and location of the project team
- Approach to structuring insurance programs
- Available safety and loss control services
- Available claims management services
- Computerized risk management information systems (RMIS)
- Fees for all other required service components

• **Initiate the Interview Process.** Firms that submit the best proposals should be interviewed (or "invited to the beauty contest," as they say in the business). This gives the owner an opportunity to compare and contrast different firms so that the one offering the best OCIP structure, services, innovative approaches, and fees for that particular project can be selected.

Note: Services and fees can vary widely between firms, so evaluate fees carefully. Request sample service contracts, and negotiate changes to meet your specific requirements.

• **Work Together for Insurance Placement.** The selected firm should work with the owner and the GC (if selected at this time) to compile underwriting information and negotiate insurance terms.

• **Prepare All Documentation.** This includes creating the OCIP administration manual, drafting the bid document clauses, and producing enrollment forms and similar administrative materials.

Successfully Implementing an OCIP

Owners who decide to go with an OCIP should remember these words of wisdom: OCIP administration is the critical component of a successful OCIP implementation.

Once an owner commits to an OCIP approach, there are several things that will influence its ultimate success, which include:

• **Owner-Contractor Partnership.** At the onset of a construction project, it is essential that the GC understand and accept responsibility for his or her role in the OCIP program management. The GC typically has authority over, and responsibility for, the two most important elements of an OCIP's financial success: **1)** negotiating insurance credits with subcontractors, as part of the procurement process, and **2)** project site safety.

• **Program Design.** To maximize owner and GC support, OCIP procedures must be compatible with the owner's and GC's existing practices. Therefore, the person providing design and implementation consulting should consider *mapping* the owner's and GC's procurement, accounting, safety, and risk management procedures in order to minimize any changes imposed by OCIP implementation.

• **Information Management.** If the program is to be a success, every contractor and subcontractor must understand and comply with all OCIP procedures.

There are three steps an owner should take to accomplish this:

- Bid instructions and expectations must be clearly described and communicated to all contractors in order to maximize the insurance deduct process.
- Timely and accurate claims reporting is necessary to ensure that all injured employees receive immediate medical treatment and are assigned to back-to-work programs.
- Timely and accurate payroll reporting is necessary to measure program financial performance and to ensure compliance with insurance statutory, regulatory, and audit requirements.

• **Documentation and Procedures.** Understanding the requirements and expectations of an OCIP can be achieved by using these tools:

- A bid deduct form that is easy-to-read and understand
- A user-friendly procedures manual
- A comprehensive safety and loss control manual
- Clear and concise claims reporting forms and procedures
- Pre-bid and pre-mobilization meetings and associated documentation packages

• **Safety Program.** To minimize OCIP losses, it is essential that the GC create and continually reinforce a proactive safety culture. A good safety program has many of the following characteristics:

- A formal, structured program with a written safety manual
- Contractor and subcontractor safety prequalification procedures
- Safety training, monitoring, and periodic "toolbox" talks
- Independent, scheduled and unscheduled safety audits
- A full-time safety representative and onsite safety staffing
- Pre-mobilization safety orientation and certification process
- Drug and alcohol testing programs

• **Program Monitoring.** An OCIP monitoring program provides for the timely measurement and recording of trends and events so that financial results, the effectiveness of administrative procedures, and individual contractor safety performance can be evaluated.

These reports should be produced monthly, be easy to read and interpret, and be written in terms that are consistent with the owner's and GC's procedures and expectations.

Here are some key implementation and administrative tasks:

- Prepare a manual providing contractors and subcontractors with information about implementation procedures, insurance coverages and limits, safety programs, claims reporting, record keeping, and other OCIP requirements.
- Prepare insurance clauses for bid documents and contract administration.
- Provide contractor and subcontractor orientation notices and meetings.
- Obtain evidence of any insurance not provided by the OCIP that is purchased for contractors and subcontractors (such as commercial auto liability and general liability DIC coverage for accidents that occur away from the project site).
- Enroll all contractors and subcontractors in the OCIP.
- Prepare claims administration procedures for insurers and/or claims administrators.
- Review contractor and subcontractor bid deducts for all OCIP-provided coverages.
- Review initial bids and change orders to ensure proper insurance deductions.
- Collect payroll and other required reports from contractors and subcontractors.

OCIP administration is the critical component of a successful OCIP implementation.

- Prepare cost reports that show both the cost of the OCIP and contractor/subcontractor insurance bid deductions. (This gives the owner the ability to monitor OCIP savings.)
- Provide periodic cost reports to the owner or other owner-designated recipients.
- Ensure that statutory workers' comp reports are filed with the appropriate rating bureaus.
- Ensure that contractor and OCIP insurers accurately complete payroll audits.
- Following a contractor's or subcontractor's completion of work, review performance and quality, then calculate final insurance deductions for each contract prior to final payment.

Note: It is highly recommended that you review the capabilities of the RMIS used by administrators to track contractor and subcontractor bid deductions and fixed OCIP costs. Some of these systems do not track losses and variable costs. If an OCIP premium is loss-sensitive, the total OCIP costs may require a manual calculation. Carefully consider this when selecting your agent, broker, and/or OCIP administrator.

The Importance of Audits

OCIPs are usually implemented on projects to improve safety, reduce losses, and achieve specific financial results. To accomplish all of these goals, the OCIP administrator needs to complete the specified implementation and administrative tasks. Periodic audits can help ensure that the quality of OCIP administration is maintained and that potential OCIP savings are being achieved.

Audits should be done annually, preferably at the same time each year prior to the anniversary date of the OCIP, and also at the completion of the project. The practices and procedures related to the following should be reviewed:

- Binding insurance coverage, issuing certificates of insurance, and issuing insurance policies to contractors and subcontractors.
- Contractor and subcontractor enrollment.
- Collection of contractor and subcontractor exposure data (such as EMRs) and other information required to calculate bid and change-order deductions for OCIP-provided insurance coverages.
- Verification of completeness and accuracy of all contractor- and subcontractor-required OCIP forms and documentation; verification of proper filing and maintenance of these documents by the OCIP administrator.
- Workers' comp and GL claims reporting; the quality of claims handling and administrative services provided to enrolled contractors and subcontractors.
- Compliance with all state and federal laws; the policies related to safety and loss control, accident prevention, and drug and alcohol abuse testing.
- Quality of status reports, delineating all OCIP costs incurred and credits obtained from contractor/subcontractor bids and change orders.
- Verification of insurance bills and OCIP premium adjustments.

To be effective, these audits require interviews with representatives of the owner, GC, contractors and subcontractors, agent or broker, OCIP administrator, and the insurer(s).

Frequently Asked Questions (FAQs)

Owners thinking about implementing an OCIP may receive questions from their own internal management. Questions can also come from the GC (who may be responsible for a significant portion of the OCIP administration) and other contractors/subcontractors. There may also be queries from regulatory agencies, union officials, and local trade associations. Here are some common FAQs:

What's the difference between an OCIP and a wrap-up?

The terms "OCIP" and "wrap-up" are frequently used interchangeably because the underlying premise is relatively the same. Both have the same primary insurance coverages (usually workers' comp, GL, and an umbrella policy).

However, there is one major difference. The wrap-up originated as a type of consolidated insurance program that could be viewed as a Contractor-Controlled Insurance Program (CCIP). On a CCIP, responsibility for providing project insurance coverage for all subs resides with the GC.

On an OCIP, the owner is the sponsor who provides insurance for all parties. And, the owner takes total responsibility for the insurance procurement, including direct payment of premiums, along with the management and administration of the entire program.

How does an OCIP benefit an owner?

The primary advantage of an OCIP is increased control (hence, the name

Owner-Controlled Insurance Program). But, an owner benefits in many other ways:

- Cost savings
- More efficient project management and administration
- More effective safety and loss control programs
- More opportunities to hire MBE/WBE/DBE/SBE contractors and subs
- Direct control of insurance coverage exclusions
- Ability to obtain higher insurance limits and mitigate claims disputes

Other benefits include a lower cost of risk (resulting from cost reductions) and protection from catastrophic loss by obtaining higher limits of liability insurance coverage.

How much additional time will an OCIP require from an owner's management staff?

On a typical OCIP, the estimated time expenditure will be more significant in the initial stages of design and implementation. However, once the OCIP is up and running, the time required for administration will be minimal, consisting mostly of responding to coordination questions and reviewing periodic OCIP status reports with the broker, OCIP administrator, and insurer.

If an owner commits to an OCIP, can it revert back to a conventional insurance program?

There are several reasons why an owner may want to dissolve an OCIP, but the main one is usually driven by economic factors resulting from changes in insurance market conditions. For example: If an OCIP is implemented in a hard market and the market softens, the OCIP will cost less than projected. However, if an OCIP is implemented in a soft insurance market and then the market hardens, costs will increase, coverage may be reduced, and limits will be lowered.

Therefore, economic-cycle volatility can make it extremely difficult for an owner to provide the necessary insurance coverage, which is a contractually stipulated requirement on all construction projects.

In the event that happens, the OCIP may need to be dissolved. This entails the negotiation of contract cost adjustments, including change order increases with enrolled contractors and subcontractors.

Unfortunately, the magnitude of the increased construction costs would have a negative financial impact on the project's profitability.

Do all contractors and subcontractors who perform work on the project have to be enrolled in the OCIP?

Contractors or subs who perform the majority of their work away from the project site may be excluded from an OCIP. The primary reason for this exclusion is that their limited project site exposure results in limited risk and exposure to jobsite injuries, claims and liability.

In addition, contractors and subs should also be excluded if their contract value is less than a certain amount due to considerations of practicality from an administrative standpoint. Depending on the total construction cost of the project, a good rule of thumb is to exclude contractors and subcontractors with contract values less than $25,000-$50,000, but these figures are relative.

Do OCIPs provide an unfair advantage to contractors with poor loss experience when bidding on work against a contractor with a good safety record?

Logically, it would appear that contractors with poor loss experience usually expend a greater percentage of revenue on the cost of insurance than do contractors with good safety performance and low loss experience. Therefore, contractors with poor loss experience should have higher insurance costs, higher total costs and higher construction bids than a contractor with favorable loss experience.

So, by removing insurance costs from construction bids, contractors with favorable loss experience may lose a cost advantage. However, the difference in

Other benefits include obtaining a lower cost of risk . . . and protection from catastrophic loss . . .

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contractors' bids created by differences in loss experience is likely to be small when measured as a percentage of construction bids. Also, by making insurance costs a neutral factor, the bid competition is focused on more substantive issues, like performance, quality of workmanship, and safety.

In addition, a contractor develops the lowest bid because of lower labor, material, or other costs and not because of lower insurance costs. This should be an advantage to the owner. To eliminate any advantage to contractors or subs with poor loss experience, some owners will not accept bids when workers' comp EMRs exceed a set level (for example, 125%).

Are contractors' and/or subs' loss-sensitive insurance programs impaired by an OCIP? Specifically, would it cause them to have less leverage with their own insurance carriers?

Loss-sensitive insurance programs, such as dividend plans and retrospective rating plans, have two components: a fixed charge and a variable charge. The variable charge is based on the frequency and severity of losses.

When a contractor's or sub's projected payroll (the predominant rating base used for determining premium) is moved from its own insurance program to an OCIP, the fixed charge may increase as a percentage of premium because of this reduction in payroll.

If a substantial portion of the premium is moved to the OCIP, the effect on a contractor's or sub's own insurance premium may ultimately result in a higher fixed – but, a lower variable – cost.

Wrapping Up the OCIP

As we noted at the outset of this two-part series, OCIPs are an increasingly popular insurance procurement option, typically used on very large single-site construction projects with many contractors and subs, and total construction values in excess of $100 million. They can also be used effectively with portfolios of smaller projects that aggregate to at least $50 million annually.

Note: Over the last several years, many states have lowered the minimum threshold for the use of wrap-ups. Consult your state insurance laws for specifics.

An OCIP can provide owners with some definite advantages over a traditional insurance program:

- Substantial savings potential
- Broader insurance coverage
- Higher policy limits
- More efficient claims management
- Better safety and loss control procedures.

In addition, OCIPs offer many of these same benefits to contractors and subs who choose to participate on the project.

However, an OCIP may not always be the best choice for a risk management program on all projects. That's why owners contemplating this type of program for an upcoming project should initiate a formal assessment process, including a feasibility study.

After the feasibility has been determined, owners should structure the OCIP carefully, with the help of a competent risk management professional. Because, like everything else in the construction industry, careful planning and administration are key components of any successful OCIP. Good luck! **BP**

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ATTACHMENT

SEVEN

Construction Risk Brochure

Attachment follows this cover sheet.

AIG Risk Management

Construction Risk Management

AIG Risk Management
AIG Construction Risk Management Group

For more than a decade, the AIG Construction Risk Management Group has been known as the leading provider of construction risk management solutions for large contractors and wrap-up projects. From manufacturing plants to high-rise buildings, from airports to mass transit systems, and from highways to educational institutions, the AIG Construction Risk Management Group builds innovative insurance programs that help brokers and clients manage their construction risks.

No matter how complex the construction risk exposures, AIG Construction Risk Management Group's flexible underwriting allows our construction-dedicated, regional underwriting specialists to construct comprehensive insurance programs that address even the most challenging construction risks. We offer wrap-up and rolling wrap-up programs designed to reduce costs versus traditional insurance programs and a comprehensive array of core casualty coverages to protect against most types of construction risks.

The AIG Construction Risk Management Group also draws upon the vast resources of the AIG Companies® to offer a spectrum of integrated solutions. For your specialized construction risks, we can access specialty coverages, such as Excess/Umbrella, Environmental, Property/Builder's Risk, Professional Liability/A&E, Accident & Health, Surety, Defense Base Act, Foreign Voluntary Workers' Compensation, and Infrastructure Funding to create a seamless risk management program for our clients.

Diverse Solutions for Diverse Needs

The AIG Construction Risk Management Group looks for *total risk management solutions* for our customers.

Target Contractors Accounts
- Large Contractors With Significant Self-performed Payroll
- Large Specialty Trade Contractors

Wrap Up Specialty Areas
- Single & Multi Site
- Infrastructure
- Civil
- Public Buildings
- Commercial Buildings
- Entertainment Complexes
- Power Facilities

Coverages
- Workers' Compensation
- Commercial General Liability
- Automobile Liability
- OCP's/RRP's in support of main casualty program
- And Others

Program Structures
- Guaranteed Cost
- Retrospective Plans
- Incurred & Paid Loss
- Retention Plans
- Self-insured Retention

Client Specialized Services

Through our integrated services approach, the AIG Construction Risk Management Group offers clients a complete risk management program serviced by a team of professionals who are construction-dedicated underwriting, loss control, and claims specialists.

- *Construction Account Service Team* – Led by the Account Services Manager, the Account Service Team is a single point of contact for the broker and the client to orchestrate the day-to-day services and special arrangements that serve your complex risk management needs. These dedicated construction service personnel are responsible for coordinating stewardship meetings, claims reviews, safety and loss control, managed care programs, risk management information system, and crisis management – ensuring that each client's programs run seamlessly.
- *Construction-Dedicated Loss Control Services* – Our construction safety and loss control specialists offer comprehensive services that can include pre-job evaluations, job site audits, qualified OSHA construction safety training, motor vehicle fleet loss control programs, and accident investigations among other services. Working with the broker and client, we can create a customized program that can lower your cost of risk and increase safety in the workplace. In 2004, in recognition of our work on the Boston Central Artery Tunnel Project, we were awarded, along with Bechtel Parsons Brinckerhoff, the Arthur Quern Quality Award by the Risk and Insurance Management Society, Inc.
- *Construction-Dedicated Claims Services* – Construction claims require timely, accurate claims management that helps clients minimize claims-related exposures. With our nationwide network of workers' compensation offices, we can help clients control their workers compensation costs through a proactive and fair multi-faceted approach that includes disability management and early-return-to-work strategies. For liability claims, we offer in-house construction claims counsel and external counsel to help keep your expenses low by avoiding unnecessary litigation and resolving cases quickly and cost effectively.

The AIG Risk Management Advantage

As a division of the Domestic Brokerage Group of American International Group, Inc. (AIG), AIG Risk Management provides clients with comprehensive risk management programs that are backed by the financial strength and underwriting of the world's leading international insurance and financial services organization, with operations in more than 130 countries and jurisdictions.

AIG member companies serve commercial, institutional and individual customers through the most extensive worldwide property-casualty network of any insurer. In the United States, AIG member companies are the largest underwriters of commercial and industrial insurance.

Financial strength and long-term stability are important factors when selecting an insurance carrier. With more than $800 billion in assets and more than $80 billion in shareholders' equity, AIG is one of the strongest and most stable insurance and financial services organizations in the world. Our strong financial resources and more than 85 years experience help ensure that clients' claims are successfully and satisfactorily handled – today and well into the future.

To learn more, please contact your insurance broker or call your local AIG Companies® representative.

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AIG Risk Management

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ATTACHMENT

EIGHT

Fundamentals Test Specifications

Attachment follows this cover sheet.

NATIONAL COUNCIL OF EXAMINERS FOR ENGINEERING AND SURVEYING

Fundamentals of Engineering (FE) Examination

Effective October 2005

- The FE examination is an 8-hour supplied-reference examination: 120 questions in the 4-hour morning session and 60 questions in the 4-hour afternoon session.
- The afternoon session is administered in the following seven modules—Chemical, Civil, Electrical, Environmental, Industrial, Mechanical, and Other/General engineering.
- Examinees work all questions in the morning session and all questions in the afternoon module they have chosen.

MORNING SESSION (120 questions in 12 topic areas)

Topic Area	Approximate Percentage of Test Content
I. Mathematics A. Analytic geometry B. Integral calculus C. Matrix operations D. Roots of equations E. Vector analysis F. Differential equations G. Differential calculus	**15%**
II. Engineering Probability and Statistics A. Measures of central tendencies and dispersions (e.g., mean, mode, standard deviation) B. Probability distributions (e.g., discrete, continuous, normal, binomial) C. Conditional probabilities D. Estimation (e.g., point, confidence intervals) for a single mean E. Regression and curve fitting F. Expected value (weighted average) in decision-making G. Hypothesis testing	**7%**
III. Chemistry A. Nomenclature B. Oxidation and reduction C. Periodic table D. States of matter E. Acids and bases F. Equations (e.g., stoichiometry) G. Equilibrium H. Metals and nonmetals	**9%**
IV. Computers A. Terminology (e.g., memory types, CPU, baud rates, Internet) B. Spreadsheets (e.g., addresses, interpretation, “what if,” copying formulas) C. Structured programming (e.g., assignment statements, loops and branches, function calls)	**7%**
V. Ethics and Business Practices A. Code of ethics (professional and technical societies) B. Agreements and contracts C. Ethical versus legal D. Professional liability E. Public protection issues (e.g., licensing boards)	**7%**

VI. Engineering Economics **8%**

A. Discounted cash flow (e.g., equivalence, PW, equivalent annual FW, rate of return)
B. Cost (e.g., incremental, average, sunk, estimating)
C. Analyses (e.g., breakeven, benefit-cost)
D. Uncertainty (e.g., expected value and risk)

VII. Engineering Mechanics (Statics and Dynamics) **10%**

A. Resultants of force systems
B. Centroid of area
C. Concurrent force systems
D. Equilibrium of rigid bodies
E. Frames and trusses
F. Area moments of inertia
G. Linear motion (e.g., force, mass, acceleration, momentum)
H. Angular motion (e.g., torque, inertia, acceleration, momentum)
I. Friction
J. Mass moments of inertia
K. Impulse and momentum applied to:
    1. particles
    2. rigid bodies
L. Work, energy, and power as applied to:
    1. particles
    2. rigid bodies

VIII. Strength of Materials **7%**

A. Shear and moment diagrams
B. Stress types (e.g., normal, shear, bending, torsion)
C. Stress strain caused by:
    1. axial loads
    2. bending loads
    3. torsion
    4. shear
D. Deformations (e.g., axial, bending, torsion)
E. Combined stresses
F. Columns
G. Indeterminant analysis
H. Plastic versus elastic deformation

IX. Material Properties **7%**

A. Properties
    1. chemical
    2. electrical
    3. mechanical
    4. physical
B. Corrosion mechanisms and control
C. Materials
    1. engineered materials
    2. ferrous metals
    3. nonferrous metals

X. Fluid Mechanics **7%**

A. Flow measurement
B. Fluid properties
C. Fluid statics
D. Energy, impulse, and momentum equations
E. Pipe and other internal flow

XI. Electricity and Magnetism **9%**

A. Charge, energy, current, voltage, power
B. Work done in moving a charge in an electric field (relationship between voltage and work)
C. Force between charges
D. Current and voltage laws (Kirchhoff, Ohm)
E. Equivalent circuits (series, parallel)
F. Capacitance and inductance
G. Reactance and impedance, susceptance and admittance
H. AC circuits
I. Basic complex algebra

XII. Thermodynamics **7%**

A. Thermodynamic laws (e.g., 1st Law, 2nd Law)
B. Energy, heat, and work
C. Availability and reversibility
D. Cycles
E. Ideal gases
F. Mixture of gases
G. Phase changes
H. Heat transfer
I. Properties of:
    1. enthalpy
    2. entropy

AFTERNOON SESSION IN CHEMICAL ENGINEERING (60 questions in 11 topic areas)

Topic Area		Approximate Percentage of Test Content
I.	**Chemistry** A. Inorganic chemistry (e.g., molarity, normality, molality, acids, bases, redox, valence, solubility product, pH, pK, electrochemistry) B. Organic chemistry (e.g., nomenclature, structure, qualitative and quantitative analyses, balanced equations, reactions, synthesis)	**10%**
II.	**Material/Energy Balances** A. Mass balance B. Energy balance C. Control boundary concept (e.g., black box concept) D. Steady-state process E. Unsteady-state process F. Recycle process G. Bypass process H. Combustion	**15%**
III.	**Chemical Engineering Thermodynamics** A. Thermodynamic laws (e.g., 1st Law, 2nd Law) B. Thermodynamic properties (e.g., internal thermal energy, enthalpy, entropy, free energy) C. Thermodynamic processes (e.g., isothermal, adiabatic, isentropic) D. Property and phase diagrams (e.g., T-s, h-P, x-y, T-x-y) E. Equations of state (e.g., van der Waals, Soave-Redlich-Kwong) F. Steam tables G. Phase equilibrium and phase change H. Chemical equilibrium I. Heats of reaction J. Cyclic processes and efficiency (e.g., power, refrigeration, heat pump) K. Heats of mixing	**10%**
IV.	**Fluid Dynamics** A. Bernoulli equation and mechanical energy balance B. Hydrostatic pressure C. Dimensionless numbers (e.g., Reynolds number) D. Laminar and turbulent flow E. Velocity head F. Friction losses (e.g., pipe, valves, fittings) G. Pipe networks H. Compressible and incompressible flow I. Flow measurement (e.g., orifices, Venturi meters) J. Pumps, turbines, and compressors K. Non-Newtonian flow L. Flow through packed beds	**10%**

V. Heat Transfer **10%**

A. Conductive heat transfer
B. Convective heat transfer
C. Radiation heat transfer
D. Heat transfer coefficients
E. Heat exchanger types (e.g., plate and frame, spiral)
F. Flow configuration (e.g., cocurrent/countercurrent)
G. Log mean temperature difference (LMTD) and NTU
H. Fouling
I. Shell-and-tube heat exchanger design (e.g., area, number of passes)

VI. Mass Transfer **10%**

A. Diffusion (e.g., Fick's 1st and 2nd laws)
B. Mass transfer coefficient
C. Equilibrium stage method (efficiency)
D. Graphical methods (e.g., McCabe-Thiele)
E. Differential method (e.g., NTU, HETP, HTU, NTP)
F. Separation systems (e.g., distillation, absorption, extraction, membrane processes)
G. Humidification and drying

VII. Chemical Reaction Engineering **10%**

A. Reaction rates and order
B. Rate constant (e.g., Arrhenius function)
C. Conversion, yield, and selectivity
D. Series and parallel reactions
E. Forward and reverse reactions
F. Energy/material balance around a reactor
G. Reactions with volume change
H. Reactor types (e.g., plug flow, batch, semi-batch, CSTR)
I. Homogeneous and heterogeneous reactions
J. Catalysis

VIII. Process Design and Economic Optimization **10%**

A. Process flow diagrams (PFD)
B. Piping and instrumentation diagrams (P&ID)
C. Scale-up
D. Comparison of economic alternatives (e.g., net present value, discounted cash flow, rate of return)
E. Cost estimation

IX. Computer Usage in Chemical Engineering **5%**

A. Numerical methods and concepts (e.g., convergence, tolerance)
B. Spreadsheets for chemical engineering calculations
C. Statistical data analysis

X. Process Control **5%**

A. Sensors and control valves (e.g., temperature, pressure)
B. Dynamics (e.g., time constants, 2nd order, underdamped)
C. Feedback and feedforward control
D. Proportional, integral, and derivative (PID) controller concepts
E. Cascade control
F. Control loop design (e.g., matching measured and manipulated variables)
G. Tuning PID controllers and stability (e.g., Method of Ziegler-Nichols, Routh Test)
H. Open-loop and closed-loop transfer functions

XI. Safety, Health, and Environmental **5%**

A. Hazardous properties of materials (e.g., corrosive, flammable, toxic), including MSDS
B. Industrial hygiene (e.g., noise, PPE, ergonomics)
C. Process hazard analysis (e.g., using fault-tree analysis or event tree)
D. Overpressure and underpressure protection (e.g., relief, redundant control, intrinsically safe)
E. Storage and handling (e.g., inerting, spill containment)
F. Waste minimization
G. Waste treatment (e.g., air, water, solids)

AFTERNOON SESSION IN CIVIL ENGINEERING (60 questions in 9 topic areas)

Topic Area	Approximate Percentage of Test Content
I. Surveying	**11%**
A. Angles, distances, and trigonometry	
B. Area computations	
C. Closure	
D. Coordinate systems (e.g., GPS, state plane)	
E. Curves (vertical and horizontal)	
F. Earthwork and volume computations	
G. Leveling (e.g., differential, elevations, percent grades)	
II. Hydraulics and Hydrologic Systems	**12%**
A. Basic hydrology (e.g., infiltration, rainfall, runoff, detention, flood flows, watersheds)	
B. Basic hydraulics (e.g., Manning equation, Bernoulli theorem, open-channel flow, pipe flow)	
C. Pumping systems (water and wastewater)	
D. Municipal water distribution systems	
E. Reservoirs (e.g., dams, routing, spillways)	
F. Groundwater (e.g., flow, wells, drawdown)	
G. Sewer collection systems (storm and sanitary)	
III. Soil Mechanics and Foundations	**15%**
A. Index properties and soil classifications	
B. Phase relations (air-water-solid)	
C. Laboratory and field tests	
D. Effective stress (buoyancy)	
E. Retaining walls (e.g., active pressure/passive pressure)	
F. Shear strength	
G. Bearing capacity (cohesive and noncohesive)	
H. Foundation types (e.g., spread footings, piles, wall footings, mats)	
I. Consolidation and differential settlement	
J. Seepage	
K. Slope stability (e.g., fills, embankments, cuts, dams)	
L. Soil stabilization (e.g., chemical additives, geosynthetics)	
IV. Environmental Engineering	**12%**
A. Water quality (ground and surface)	
B. Air quality	
C. Solid/hazardous waste	
D. Sanitary sewer system loads	
E. Basic tests (e.g., water, wastewater, air)	
F. Environmental regulations	
G. Water treatment and wastewater treatment (e.g., primary, secondary, tertiary)	

V. Transportation **12%**

A. Streets and highways
   1. geometric design
   2. pavement design
   3. intersection design

B. Traffic analysis and control
   1. safety
   2. capacity
   3. traffic flow
   4. traffic control devices

VI. Structural Analysis **10%**

A. Force analysis of statically determinant beams, trusses and frames
B. Deflection analysis of statically determinant beams, trusses and frames
C. Stability analysis of beams, trusses and frames
D. Column analysis (e.g., buckling, boundary conditions)
E. Loads and load paths (e.g., dead, live, moving)
F. Elementary statically indeterminate structures

VII. Structural Design **10%**

A. Codes (e.g., AISC, ACI, NDS, AISI)
B. Design procedures for steel components (e.g., beams, columns, beam-columns, tension members, connections)
C. Design procedures for concrete components (e.g., beams, slabs, columns, walls, footings)

VIII. Construction Management **10%**

A. Procurement methods (e.g., design-build, design-bid-build, qualifications based)
B. Allocation of resources (e.g., labor, equipment, materials, money, time)
C. Contracts/contract law
D. Project scheduling (e.g., CPM, PERT)
E. Engineering economics
F. Project management (e.g., owner/contractor/client relations, safety)
G. Construction estimating

IX. Materials **8%**

A. Concrete mix design
B. Asphalt mix design
C. Test methods (e.g., steel, concrete, aggregates, asphalt)
D. Properties of aggregates
E. Engineering properties of metals

AFTERNOON SESSION IN ELECTRICAL ENGINEERING (60 questions in 9 topic areas)

Topic Area		Approximate Percentage of Test Content
I.	**Circuits** A. KCL, KVL B. Series/parallel equivalent circuits C. Node and loop analysis D. Thevenin/Norton theorems E. Impedance F. Transfer functions G. Frequency/transient response H. Resonance I. Laplace transforms J. 2-port theory K. Filters (simple passive)	**16%**
II.	**Power** A. 3-phase B. Transmission lines C. Voltage regulation D. Delta and wye E. Phasors F. Motors G. Power electronics H. Power factor (pf) I. Transformers	**13%**
III.	**Electromagnetics** A. Electrostatics/magnetostatics (e.g., measurement of spatial relationships, vector analysis) B. Wave propagation C. Transmission lines (high frequency)	**7%**
IV.	**Control Systems** A. Block diagrams (feed forward, feedback) B. Bode plots C. Controller performance (gain, PID), steady-state errors D. Root locus E. Stability	**10%**
V.	**Communications** A. Basic modulation/demodulation concepts (e.g., AM, FM, PCM) B. Fourier transforms/Fourier series C. Sampling theorem D. Computer networks, including OSI model E. Multiplexing	**9%**
VI.	**Signal Processing** A. Analog/digital conversion B. Convolution (continuous and discrete) C. Difference equations D. Z-transforms	**8%**

VII. Electronics **15%**

A. Solid-state fundamentals (tunneling, diffusion/drift current, energy bands, doping bands, p-n theory)
B. Bias circuits
C. Differential amplifiers
D. Discrete devices (diodes, transistors, BJT, CMOS) and models and their performance
E. Operational amplifiers
F. Filters (active)
G. Instrumentation (measurements, data acquisition, transducers)

VIII. Digital Systems **12%**

A. Numbering systems
B. Data path/control system design
C. Boolean logic
D. Counters
E. Flip-flops
F. Programmable logic devices and gate arrays
G. Logic gates and circuits
H. Logic minimization (SOP, POS, Karnaugh maps)
I. State tables/diagrams
J. Timing diagrams

IX. Computer Systems **10%**

A. Architecture (e.g., pipelining, cache memory)
B. Interfacing
C. Microprocessors
D. Memory technology and systems
E. Software design methods (structured, top-down bottom-up, object-oriented design)
F. Software implementation (structured programming, algorithms, data structures)

AFTERNOON SESSION IN ENVIRONMENTAL ENGINEERING (60 questions in 5 topic areas)

Topic Area	Approximate Percentage of Test Content
I. Water Resources	**25%**
A. Water distribution and wastewater collection	
B. Water resources planning	
C. Hydrology and watershed processes	
D. Fluid mechanics and hydraulics	
II. Water and Wastewater Engineering	**30%**
A. Water and wastewater	
B. Environmental microbiology/ecology	
C. Environmental chemistry	
III. Air Quality Engineering	**15%**
A. Air quality standards and control technologies	
B. Atmospheric sciences	
IV. Solid and Hazardous Waste Engineering	**15%**
A. Solid waste engineering	
B. Hazardous waste engineering	
C. Site remediation	
D. Geohydrology	
E. Geotechnology	
V. Environmental Science and Management	**15%**
A. Industrial and occupational health and safety	
B. Radiological health and safety	
C. Radioactive waste management	
D. Environmental monitoring and sampling	
E. Pollutant fate and transport (air/water/soil)	
F. Pollution prevention and waste minimization	
G. Environmental management systems	

AFTERNOON SESSION IN INDUSTRIAL ENGINEERING (60 questions in 8 topic areas)

Topic Area		Approximate Percentage of Test Content
I.	**Engineering Economics** A. Discounted cash flows (equivalence, PW, EAC, FW, IRR, loan amortization) B. Types and breakdown of costs (e.g., fixed, variable, direct and indirect labor, material, capitalized) C. Analyses (e.g., benefit-cost, breakeven, minimum cost, overhead, risk, incremental, life cycle) D. Accounting (financial statements and overhead cost allocation) E. Cost estimating F. Depreciation and taxes G. Capital budgeting	**15%**
II.	**Probability and Statistics** A. Combinatorics (e.g., combinations, permutations) B. Probability distributions (e.g., normal, binomial, empirical) C. Conditional probabilities D. Sampling distributions, sample sizes, and statistics (e.g., central tendency, dispersion) E. Estimation (point estimates, confidence intervals) F. Hypothesis testing G. Regression (linear, multiple) H. System reliability (single components, parallel and series systems) I. Design of experiments (e.g., ANOVA, factorial designs)	**15%**
III.	**Modeling and Computation** A. Algorithm and logic development (e.g., flow charts, pseudo-code) B. Spreadsheets C. Databases (e.g., types, information content, relational) D. Decision theory (e.g., uncertainty, risk, utility, decision trees) E. Optimization modeling (decision variables, objective functions, and constraints) F. Linear programming (e.g., formulation, primal, dual, graphical solution) G. Math programming (network, integer, dynamic, transportation, assignment) H. Stochastic models (e.g., queuing, Markov, reliability) I. Simulation (e.g., event, process, Monte Carlo sampling, random number generation, steady-state vs. transient)	**12%**
IV.	**Industrial Management** A. Principles (e.g., planning, organizing) and tools of management (e.g., MBO, re-engineering) B. Organizational structure (e.g., functional, matrix, line/staff) C. Motivation theories (e.g., Maslow, Theory X, Theory Y) D. Job evaluation and compensation E. Project management (scheduling, PERT, CPM)	**10%**

V. Manufacturing and Production Systems **13%**

A. Manufacturing systems (e.g., cellular, group technology, flexible, lean)
B. Process design (e.g., number of machines/people, equipment selection, and line balancing)
C. Inventory analysis (e.g., EOQ, safety stock)
D. Forecasting
E. Scheduling (e.g., sequencing, cycle time, material control)
F. Aggregate planning (e.g., JIT, MRP, MRPII, ERP)
G. Concurrent engineering and design for manufacturing
H. Automation concepts (e.g., robotics, CIM)
I. Economics (e.g., profits and costs under various demand rates, machine selection)

VI. Facilities and Logistics **12%**

A. Flow measurements and analysis (e.g., from/to charts, flow planning)
B. Layouts (e.g., types, distance metrics, planning, evaluation)
C. Location analysis (e.g., single facility location, multiple facility location, storage location within a facility)
D. Process capacity analysis (e.g., number of machines/people, trade-offs)
E. Material handling capacity analysis (storage & transport)
F. Supply chain design (e.g., warehousing, transportation, inventories)

VII. Human Factors, Productivity, Ergonomics, and Work Design **12%**

A. Methods analysis (e.g., improvement, charting) and task analysis (e.g., MTM, MOST)
B. Time study (e.g., time standards, allowances)
C. Workstation design
D. Work sampling
E. Learning curves
F. Productivity measures
G. Risk factor identification, safety, toxicology, material safety data sheets (MSDS)
H. Environmental stress assessment (e.g., noise, vibrations, heat, computer-related)
I. Design of tasks, tools, displays, controls, user interfaces, etc.
J. Anthropometry, biomechanics, and lifting

VIII. Quality **11%**

A. Total quality management theory (e.g., Deming, Juran) and application
B. Management and planning tools (e.g., fishbone, Pareto, quality function deployment, scatter diagrams)
C. Control charts
D. Process capability and specifications
E. Sampling plans
F. Design of experiments for quality improvement
G. Auditing, ISO certification, and the Baldridge award

AFTERNOON SESSION IN MECHANICAL ENGINEERING (60 questions in 8 topic areas)

Topic Area		Approximate Percentage of Test Content
I.	**Mechanical Design and Analysis** A. Stress analysis (e.g., combined stresses, torsion, normal, shear) B. Failure theories (e.g., static, dynamic, buckling) C. Failure analysis (e.g., creep, fatigue, fracture, buckling) D. Deformation and stiffness E. Components (e.g., springs, pressure vessels, beams, piping, bearings, columns, power screws) F. Power transmission (e.g., belts, chains, clutches, gears, shafts, brakes, axles) G. Joining (e.g., threaded fasteners, rivets, welds, adhesives) H. Manufacturability (e.g., fits, tolerances, process capability) I. Quality and reliability J. Mechanical systems (e.g., hydraulic, pneumatic, electro-hybrid)	**15%**
II.	**Kinematics, Dynamics, and Vibrations** A. Kinematics of mechanisms B. Dynamics of mechanisms C. Rigid body dynamics D. Natural frequency and resonance E. Balancing of rotating and reciprocating equipment F. Forced vibrations (e.g., isolation, force transmission, support motion)	**15%**
III.	**Materials and Processing** A. Mechanical and thermal properties (e.g., stress/strain relationships, ductility, endurance, conductivity, thermal expansion) B. Manufacturing processes (e.g., forming, machining, bending, casting, joining, heat treating) C. Thermal processing (e.g., phase transformations, equilibria) D. Materials selection (e.g., metals, composites, ceramics, plastics, bio-materials) E. Surface conditions (e.g., corrosion, degradation, coatings, finishes) F. Testing (e.g., tensile, compression, hardness)	**10%**
IV.	**Measurements, Instrumentation, and Controls** A. Mathematical fundamentals (e.g., Laplace transforms, differential equations) B. System descriptions (e.g., block diagrams, ladder logic, transfer functions) C. Sensors and signal conditioning (e.g., strain, pressure, flow, force, velocity, displacement, temperature) D. Data collection and processing (e.g., sampling theory, uncertainty, digital/analog, data transmission rates) E. Dynamic responses (e.g., overshoot/time constant, poles and zeros, stability)	**10%**
V.	**Thermodynamics and Energy Conversion Processes** A. Ideal and real gases B. Reversibility/irreversibility C. Thermodynamic equilibrium D. Psychrometrics E. Performance of components F. Cycles and processes (e.g., Otto, Diesel, Brayton, Rankine) G. Combustion and combustion products H. Energy storage I. Cogeneration and regeneration/reheat	**15%**

VI. Fluid Mechanics and Fluid Machinery **15%**

A. Fluid statics
B. Incompressible flow
C. Fluid transport systems (e.g., pipes, ducts, series/parallel operations)
D. Fluid machines: incompressible (e.g., turbines, pumps, hydraulic motors)
E. Compressible flow
F. Fluid machines: compressible (e.g., turbines, compressors, fans)
G. Operating characteristics (e.g., fan laws, performance curves, efficiencies, work/power equations)
H. Lift/drag
I. Impulse/momentum

VII. Heat Transfer **10%**

A. Conduction
B. Convection
C. Radiation
D. Composite walls and insulation
E. Transient and periodic processes
F. Heat exchangers
G. Boiling and condensation heat transfer

VIII. Refrigeration and HVAC **10%**

A. Cycles
B. Heating and cooling loads (e.g., degree day data, sensible heat, latent heat)
C. Psychrometric charts
D. Coefficient of performance
E. Components (e.g., compressors, condensers, evaporators, expansion valve)

AFTERNOON SESSION IN OTHER/GENERAL ENGINEERING (60 questions in 9 topic areas)

Topic Area	Approximate Percentage of Test Content
I. Advanced Engineering Mathematics A. Differential equations B. Partial differential calculus C. Numerical solutions (e.g., differential equations, algebraic equations) D. Linear algebra E. Vector analysis	**10%**
II. Engineering Probability and Statistics A. Sample distributions and sizes B. Design of experiments C. Hypothesis testing D. Goodness of fit (coefficient of correlation, chi square) E. Estimation (e.g., point, confidence intervals) for two means	**9%**
III. Biology A. Cellular biology (e.g., structure, growth, cell organization) B. Toxicology (e.g., human, environmental) C. Industrial hygiene [e.g., personnel protection equipment (PPE), carcinogens] D. Bioprocessing (e.g., fermentation, waste treatment, digestion)	**5%**
IV. Engineering Economics A. Cost estimating B. Project selection C. Lease/buy/make D. Replacement analysis (e.g., optimal economic life)	**10%**
V. Application of Engineering Mechanics A. Stability analysis of beams, trusses, and frames B. Deflection analysis C. Failure theory (e.g., static and dynamic) D. Failure analysis (e.g., creep, fatigue, fracture, buckling)	**13%**
VI. Engineering of Materials A. Material properties of: 1. metals 2. plastics 3. composites 4. concrete	**11%**
VII. Fluids A. Basic hydraulics (e.g., Manning equation, Bernoulli theorem, open-channel flow, pipe flow) B. Laminar and turbulent flow C. Friction losses (e.g., pipes, valves, fittings) D. Flow measurement E. Dimensionless numbers (e.g., Reynolds number) F. Fluid transport systems (e.g., pipes, ducts, series/parallel operations) G. Pumps, turbines, and compressors H. Lift/drag	**15%**

VIII. Electricity and Magnetism **12%**

A. Equivalent circuits (Norton, Thevenin)
B. AC circuits (frequency domain)
C. Network analysis (Kirchhoff laws)
D. RLC circuits
E. Sensors and instrumentation
F. Electrical machines

IX. Thermodynamics and Heat Transfer **15%**

A. Thermodynamic properties (e.g., entropy, enthalpy, heat capacity)
B. Thermodynamic processes (e.g., isothermal, adiabatic, reversible, irreversible)
C. Equations of state (ideal and real gases)
D. Conduction, convection, and radiation heat transfer
E. Mass and energy balances
F. Property and phase diagrams (e.g., T-s, h-P)
G. Tables of thermodynamic properties
H. Cyclic processes and efficiency (e.g., refrigeration, power)
I. Phase equilibrium and phase change
J. Thermodynamic equilibrium
K. Combustion and combustion products (e.g., CO, CO_2, NOX, ash, particulates)
L. Psychrometrics (e.g., humidity)

ATTACHMENT

NINE

General Test Specifications

Attachment follows this cover sheet.

THE NATIONAL COUNCIL OF EXAMINERS FOR ENGINEERING AND SURVEYING
PRINCIPLES AND PRACTICE OF ENGINEERING EXAMINATION

CIVIL BREADTH (AM) EXAMINATION

EFFECTIVE OCTOBER 2000

The civil engineering examination is a breadth and depth examination. This means that **all** examinees work the breadth (AM) exam and **one** of the five depth (PM) exams. The five areas covered in the civil engineering examination are environmental, geotechnical, structural, transportation, and water resources. The breadth exam contains questions from all five areas of civil engineering. The depth exams focus more closely on a single area of practice in civil engineering.

	Approximate Percentage of Examination
I. ENVIRONMENTAL	**20%**
A. Wastewater Treatment – wastewater flow rates, unit processes.	
B. Biology – toxicity, algae, stream degradation, temperature, disinfection, water taste & odor, BOD.	
C. Solid/Hazardous Waste – collection, storage/transfer, treatment, disposal, quantity estimates, site & haul economics.	
D. Ground Water and Well Fields – groundwater flow, aquifers (e.g., characterization).	
II. GEOTECHNICAL	**20%**
A. Subsurface Exploration & Sampling – drilling and sampling, soil classification, boring log interpretation, soil profile development.	
B. Engineering Properties of Soils – index properties, phase relationships, permeability.	
C. Soil Mechanics Analysis – pressure distribution, lateral earth pressure, consolidation, compaction.	
D. Shallow Foundations – bearing capacity, settlement, allowable bearing pressure.	
E. Earth Retaining Structures – gravity walls, cantilever walls, earth pressure diagrams, stability analysis.	
III. STRUCTURAL	**20%**
A. Loadings – dead & live loads, wind loads.	
B. Analysis – determinate analysis, shear diagrams, moment diagrams.	
C. Mechanics of Materials – flexure, shear, tension & compression, deflection.	
D. Materials – reinforced concrete, structural steel, timber, concrete mix design, masonry.	
E. Member Design – beams, slabs, columns, reinforced concrete footings, retaining walls, trusses.	
IV. TRANSPORTATION	**20%**
A. Traffic Analysis – capacity analysis.	
B. Construction – excavation/embankment, material handling, optimization, scheduling.	
C. Geometric Design – horizontal curves, vertical curves, sight distance.	
V. WATER RESOURCES	**20%**
A. Hydraulics – energy dissipation, energy/continuity equation, pressure conduit, open channel flow, flow rates, friction/minor losses, flow equations, hydraulic jump, culvert design, velocity control.	
B. Hydrology – storm characterization, storm frequency, hydrographs, rainfall intensity & duration, runoff analysis.	
C. Water Treatment – demands, hydraulic loading, storages (raw & treated water).	
TOTAL	**100%**

NOTES:

1. The knowledge areas specified as A, B, C, ... etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.

2. The breadth (AM) exam contains 40 multiple-choice questions. Examinee works all questions.

ATTACHMENT

TEN

Specialization Test Specifications

Attachment follows this cover sheet.

THE NATIONAL COUNCIL OF EXAMINERS FOR ENGINEERING AND SURVEYING
PRINCIPLES & PRACTICE OF ENGINEERING EXAMINATION

CIVIL/ENVIRONMENTAL DEPTH (PM) EXAM

EFFECTIVE OCTOBER 2000

	Approximate Percentage of Examination
I. ENVIRONMENTAL	**65%**

A. Wastewater Treatment
Wastewater flow rates, primary clarification, biological treatment, secondary clarification, chemical precipitation, sludge systems, digesters, disinfection, nitrification/denitrification, effluent limits, wetlands, unit processes, operations.

B. Biology (including micro & aquatic)
Toxicity, algae, food chain, stream degradation, organic load, oxygenation/deoxygenation/oxygen sag curve, eutrophication, temperature, indicator organisms, disinfection, water taste & odor, most probable number (MPN), BOD, quality control.

C. Solid/Hazardous Waste
Collection, storage/transfer, treatment, disposal, quantity estimates, site & haul economics, energy recovery, hazardous waste systems , applicable standards.

D. Ground Water and Well Fields
Dewatering, well analysis, water quality analysis, subdrain systems, groundwater flow, groundwater contamination, recharge, aquifers (e.g., characterization).

II. GEOTECHNICAL	**10%**

A. Subsurface Exploration and Sampling
Drilling and sampling procedures, soil classification, boring log interpretation, soil profile development.

B. Engineering Properties of Soils
Permeability.

C. Soil Mechanics Analysis
Compaction, seepage and erosion.

III. WATER RESOURCES	**25%**

A. Hydraulics
Energy/continuity equation, pressure conduit, open channel flow, detention/retention ponds, pump application and analysis, pipe network analysis, flow rates (domestic, irrigation, fire), surface water profile, cavitation, friction/minor losses, flow measurement devices, flow equations, culvert design, velocity control.

B. Hydrology
Storm characterization, storm frequency, hydrograph (unit & others), transpiration, evaporation, permeation, rainfall intensity & duration, runoff analysis, gauging stations, flood plain/floodway, sedimentation.

C. Water Treatment
Demands, hydraulic loading, storages (raw & treated water), rapid mixing, flocculation, sedimentation, filtration, disinfection, applicable standards.

TOTAL	**100%**

NOTES :

1. The knowledge areas specified as A, B, C, ... etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.
2. Each depth (PM) exam contains 40 multiple-choice questions. Examinee chooses **one** depth exam and works all questions in the depth exam chosen.

THE NATIONAL COUNCIL OF EXAMINERS FOR ENGINEERING AND SURVEYING
PRINCIPLES & PRACTICE OF ENGINEERING EXAMINATION

CIVIL/GEOTECHNICAL DEPTH (PM) EXAM

EFFECTIVE OCTOBER 2000

	Approximate Percentage of Examination
I. GEOTECHNICAL	**65%**

A. Subsurface Exploration and Sampling
Drilling & sampling procedures, in-situ testing, soil classification, boring log interpretation, soil profile development.

B. Engineering Properties of Soils
Index properties, phase relationships, shear strength properties, permeability.

C. Soil Mechanics Analysis
Effective & total stresses, pore pressure, pressure distribution, lateral earth pressure, consolidation, compaction, slope stability, seepage and erosion.

D. Shallow Foundations
Bearing capacity, settlement, allowable bearing pressure, proportioning individual/combined footings, mat and raft foundations, pavement design.

E. Deep Foundations
Axial capacity (single pile/drilled shaft), lateral capacity (single pile/drilled shaft), settlement, lateral deflection, behavior of pile/drilled shaft groups, pile dynamics & pile load tests.

F. Earth Retaining Structures
Gravity walls, cantilever walls, mechanically stabilized earth wall, braced & anchored excavations, earth dams, earth pressure diagrams, stability analysis, serviceability requirements.

G. Seismic Engineering
Earthquake fundamentals, liquefaction potential evaluation.

II. ENVIRONMENTAL	**10%**

A. Ground Water and Well Fields
Dewatering, water quality analysis, groundwater contamination, aquifers (e.g., characterization).

III. STRUCTURAL	**20%**

A. Loadings
Dead & live loads, earthquake loads.

B. Materials
Concrete mix design.

C. Member Design
Reinforced concrete footings, pile foundations, retaining walls.

IV. TRANSPORTATION	**5%**

A. Construction
Excavation/embankment, pavement design.

TOTAL	**100%**

NOTES:

1. The knowledge areas specified as A, B, C, ... etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.
2. Each depth (PM) exam contains 40 multiple-choice questions. Examinee chooses **one** depth exam and works all questions in the depth exam chosen.

THE NATIONAL COUNCIL OF EXAMINERS FOR ENGINEERING AND SURVEYING
PRINCIPLES & PRACTICE OF ENGINEERING EXAMINATION

CIVIL/STRUCTURAL DEPTH (PM) EXAM

EFFECTIVE OCTOBER 2000

	Approximate Percentage of Examination
I. STRUCTURAL	**65%**

A. Loadings
Dead & live loads, moving loads, wind loads, earthquake loads, repeated loads.

B. Analysis
Determinate, indeterminate, shear diagrams, moment diagrams.

C. Mechanics of Materials
Flexure, shear, torsion, tension & compression, combined stresses, deflection.

D. Materials
Reinforced concrete, pre-stressed concrete, structural steel, timber, concrete mix design, masonry, composite construction.

E. Member Design
Beams, slabs, columns, reinforced concrete footings, pile foundations, retaining walls, trusses, braces & connections, shear and bearing walls.

F. Failure Analysis
Buckling, fatigue, failure modes.

G. Design Criteria
IBC, ACI, PCI, AISC, NDS, AASHTO, ASCE-7

II. GEOTECHNICAL **25%**

A. Subsurface Exploration and Sampling
Boring log interpretation.

B. Soil Mechanics Analysis
Pressure distribution, lateral earth pressure.

C. Shallow Foundations
Bearing capacity, settlement, proportioning individual/combined footings, mat & raft foundations

D. Deep Foundations
Axial capacity - Single pile/drilled shaft.
Lateral capacity - Single pile/drilled shaft.
Behavior of pile/drilled shaft groups.

E. Earth Retaining Structures
Gravity walls, cantilever walls, braced & anchored excavations, earth pressure diagrams, stability analysis.

III. TRANSPORTATION **10%**

A. Construction
Excavation/embankment, material handling, optimization, scheduling.

TOTAL **100%**

NOTES :

1. The knowledge areas specified as A, B, C, ... etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.

2. Each depth (PM) exam contains 40 multiple-choice questions. Examinee chooses **one** depth exam and works all questions in the depth exam chosen.