General Conditions

OVERVIEW

This chapter provides guidelines for preparing the general conditions portion of the construction specification. These guidelines address the responsibilities of the general contractor including:

- Guideline GC1: Sustainable Job-Site Operations Plan
- Guideline GC2: Construction and Demolition (C&D) Waste Management
- Guideline GC3: Indoor Air Quality During Construction
- Guideline GC4: Site Protection During Construction
- Guideline GC5: Contractor's Commissioning Responsibilities

The general conditions guidelines aim to ensure that the methods used to build the school and operate the construction site are environmentally sound. It is not only important to end up with a high performing school; the means to get there should be consistent with that end.

During construction, literally hundreds of opportunities exist to work toward fulfilling the environmental goals of a high performance school or, alternatively, to compromise them. To ensure the construction process is consistent with these goals, contractors should be made aware of these opportunities upfront, as part of the bidding process. Ideally, the selected contractor should have experience with some of the practices recommended in this Best Practices Manual. At a minimum, they should be aware of, and responsive to, the goals set for the project. The better contractors understand their role in achieving the high performance goals, the more likely the construction process will go smoothly.

Using Environmentally Preferable Methods during Construction

During construction, general and trade contractors have a significant role to play in making efficient use of materials, preventing future indoor air quality problems, and protecting the site from degradation. In practice, requiring that the contractor produce and implement a job-site operations plan has proven to be the most effective way to ensure that environmental goals will be given equal treatment along with other project goals.

Sustainable job-site operational costs are generally minimal, and benefits can be significant. Planning helps minimize costs and liabilities, including expensive delays, stoppages, and callbacks due to mistakes made during construction. Savings resulting from job-site waste reduction practices are well documented. Contractors familiar with sustainable job-site operations will know the benefits and understand that these are not complicated practices. Contractors unfamiliar with them, however, will assume they cost more and bid accordingly. Bid packages should contain references to existing resources to help uninitiated contractors familiarize themselves with high performance construction practices plans as well as provide tools to estimate costs and benefits more accurately.

A sustainable job-site operation will use a combination of contract language, signage, weekly job-site meetings, and incentives/rewards to educate and motivate field personnel to ensure everyone works towards the high performance goals. Brief presentations, signage that both informs and motivates by reporting progress on environmental goals, and contractor's field guides can be helpful communication aids. On most construction sites, signage and other printed instructions will need to be written so individuals for whom English is a second language can easily understand. For some construction trades, it may be beneficial to include both English and Spanish signage.

In addition, the most successful contractors identify an individual (often the safety officer) who can enforce the sustainable job-site operations plan on a day-to-day basis. With many recommended job-site practices and with a host of subcontractors, it is difficult to determine whether the recommended practices actually occur without regular in-the-field monitoring. Ideally, the same individual monitoring compliance would take an active role in training and other on-site educational efforts.

Achieving the Design Intent of a High Performance School

Perhaps the most important contribution the contractor can provide in achieving high performance goals for the school is in participating in the commissioning process. The entire point of this process is to demonstrate that the installed components of building systems meet the original design intent. (See the Best Practices Manual Volume V: Commissioning for more detailed discussions of the commissioning process.) Contractors can play a key role in effective commissioning by providing timely documentation, understanding the importance of thorough testing and tuning, paying attention to detail when correcting problems, and being responsive to the commissioning agent's recommendations and requests.

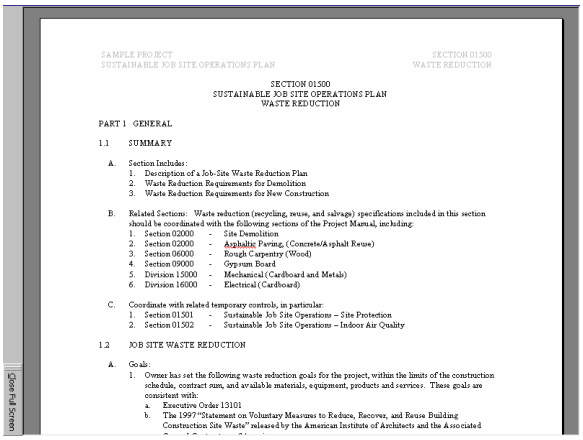
Installation schedules of a high performance school may be different from a conventional school. For example, the California Department of Health Services' "Reducing Occupant Exposure to Volatile Organic Compounds (VOCs) from Office Building Construction Materials Non-Binding Guidelines" recommends that "porous materials, such as carpets and fabric-covered office dividers…be installed last." This practice prevents the porous materials from acting as a "sink" for VOCs being emitted by wet products (paints and other finishes, for example). Proper sequencing can be spelled out in execution articles of pertinent specification sections, but may also be called out under general conditions. In addition, ventilation and flush-out requirements during and after installation will need to be specified in appropriate sections.

In addition, product substitutions (especially those made in the field due to last-minute availability problems) can contribute to losing sight of the original design intent. When substitutions in the field occur, submittals must show that these substitutions possess the environmentally preferable characteristics of the original product or material specified. A sustainable job-site operations plan should specify a method to providing documentation for substituted products, so that, in the event of replacement or repair, the information is available to the custodial staff. In addition, when dealing with non-conventional or innovative materials, it can be helpful to note information in a field log about how a product behaves during installation and pre-occupancy maintenance (such as during cleanup), as well as any other "lessons learned.

GUIDELINE GC1: SUSTAINABLE JOB-SITE OPERATIONS PLAN

Recommendation

Require a job-site operations plan that includes protocols for Job-Site Waste Reduction (Guideline GC2: Construction and Demolition (C&D) Waste Management), Indoor Air Quality (Guideline GC3: Indoor Air Quality During Construction), and Site Protection (Guideline GC4: Site Protection During Construction).



SAMPLE PROJECT
SUSTAINABLE JOB SITE OPERATIONS PLAN

SECTION 01500
WASTE REDUCTION

SECTION 01500
SUSTAINABLE JOB SITE OPERATIONS PLAN
WASTE REDUCTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Description of a Job-Site Waste Reduction Plan
2. Waste Reduction Requirements for Demolition
3. Waste Reduction Requirements for New Construction

B. Related Sections: Waste reduction (recycling, reuse, and salvage) specifications included in this section should be coordinated with the following sections of the Project Manual, including:
1. Section 02000 - Site Demolition
2. Section 02000 - Asphaltic Paving, (Concrete/Asphalt Reuse)
3. Section 06000 - Rough Carpentry (Wood)
4. Section 09000 - Gypsum Board
5. Division 15000 - Mechanical (Cardboard and Metals)
6. Division 16000 - Electrical (Cardboard)

C. Coordinate with related temporary controls, in particular:
1. Section 01501 - Sustainable Job Site Operations – Site Protection
2. Section 01502 - Sustainable Job Site Operations – Indoor Air Quality

1.2 JOB SITE WASTE REDUCTION

A. Goals:
1. Owner has set the following waste reduction goals for the project, within the limits of the construction schedule, contract sum, and available materials, equipment, products and services. These goals are consistent with:
a. Executive Order 13101
b. The 1997 "Statement on Voluntary Measures to Reduce, Recover, and Reuse Building Construction Site Waste" released by the American Institute of Architects and the Associated

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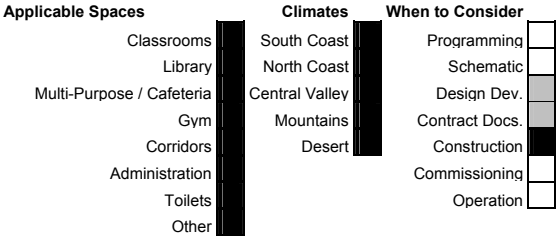
Figure 3—Sample Sustainable Job Site Operations Plan

Description

A sustainable job-site operations plan will describe goals, construction practices to achieve those goals, methods to train or otherwise communicate these goals to field personnel, and methods to track and assess progress towards those goals. For each component of the plan (waste reduction, IAQ, and site protection), these elements will be specified. In addition, the plan will specify the method of documenting compliance with these goals, including in the case of product substitutions.



Applicability

Job-site management is applicable to all spaces in schools and to all climates. While it is carried out in the construction phase, the contract documents must clearly specify the expectations of the general contractor.

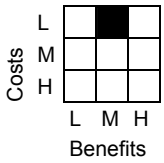
Applicable Codes

There are many jurisdictions in California (at the county and city level) that have developed, or are developing, ordinances that require job-site waste management planning. (See Guideline GC2: Construction and Demolition (C&D) Waste Management for more information.) In addition, local school districts are beginning to develop IAQ policies that incorporate some operational requirements for construction. (See Guideline GC3: Indoor Air Quality During Construction for more information.) The U.S. Green Building Council's LEED Green Building Rating System (Commercial, Version 2.1) includes

a provision for an IAQ construction plan as well. All jurisdictions include some requirements related to water quality protection, in particular stormwater management during construction. More communities are adopting "green building ordinances" that capture some elements of sustainable job-site operations.

Integrated Design Implications

A sustainable job-site operations plan protects the integrity of design goals to reduce waste, improve air quality, and protect the site and surrounding waterways from degradation.



Cost Effectiveness

Costs for implementing the plan will include labor for overseeing and documenting compliance, and should not be significant.

Benefits

Having a plan in place helps minimize costs and liabilities, including delays, stoppages, and residual problems in the completed school building. Proper planning is always more cost-effective than cleaning up after a mistake.

Design Tools

None.

Design Details

The requirement for a sustainable job-site operations plan would appear in the "Temporary Controls" section(s) of specifications. The more clearly a plan allocates responsibilities and expectations, the less likely the project will generate unpleasant surprises during and after construction. Ideally, the plan should specify a time requirement for when a plan must be submitted, such as within 14 days of Notice of Award and prior to applicable construction activities. In addition, it can include sample forms, references, or other resources for the contractor to help facilitate development of an effective plan. Sample specifications for the three plan components recommended in this guideline—job-site waste reduction, IAQ, and site protection—can be found in the electronic Appendix A.[3]

3 The electronic appendices are located on-line at www.chps.net/manual/index.htm or on the CD-ROM version of the Manual.

Operation and Maintenance Issues

The plan should specify a method of providing documentation for products substituted in the field, so that information is available to maintenance staff should a replacement or repair be required. In addition, when dealing with non-conventional or innovative materials, information about how a product behaves during installation and pre-occupancy maintenance (such as during cleanup), as well as other "lessons learned" noted in a field log can be helpful.

Commissioning

None.

References/Additional Information

Please see the References listed for individual components of the plan in the following guidelines: Guideline GC1: Sustainable Job-Site Operations Plan, Guideline GC2: Construction and Demolition (C&D) Waste Management, and Guideline GC3: Indoor Air Quality During Construction.

Also see electronic Appendix A for sample specifications language. This appendix includes a specification section 01500 that contains sample language that can be used in the contract documents.

GUIDELINE GC2: CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT

Recommendation

Require waste reduction planning and job-site practices. These guidelines recommend that a sustainable job-site operations plan (Guideline GC1: Sustainable Job-Site Operations Plan) be developed that incorporates a job-site waste reduction component. An alternative is to develop a stand-alone Construction and Demolition (C&D) Waste Management Plan.

Figure 4—Conducting a Construction Site Waste Audit (courtesy O'Brien & Company)

Description

Effective job-site waste management will reduce the amount of C&D waste generated, as well as divert materials generated through C&D processes from disposal through reuse (salvage) and recycling. This effort can be combined with a concerted use of salvaged or recycled-content building materials throughout the building project; specific materials would be called out in appropriate sections of project specifications.

Applicable Spaces		Climates		When to Consider	
Classrooms	■	South Coast	■	Programming	□
Library	■	North Coast	■	Schematic	□
Multi-Purpose / Cafeteria	■	Central Valley	■	Design Dev.	▒
Gym	■	Mountains	■	Contract Docs.	▒
Corridors	■	Desert	■	Construction	■
Administration	■			Commissioning	□
Toilets	■			Operation	□
Other	■				

C&D waste management will include the development of a waste reduction plan, identification of personnel responsible for implementing and monitoring the plan, and an outline of consequences for non-compliance. Waste management should reflect the prioritized hierarchy of "Reduce, Reuse, and Recycle, Buy Recycled" with recycling efforts occurring in concert with *source reduction* and applying only to materials that *cannot be reused*. The concept of source reduction eliminates or reduces potential waste prior to generation.

Applicability

C&D waste management is applicable in all climates and in all types of school spaces. While carried out during the C&D phase, the contract documents must clearly layout the responsibilities of the general contractor.

Applicable Codes

Because of state goals and possible sanctions, many jurisdictions at the county and city level have developed, or are developing, ordinances related to C&D waste management. In some cases, these ordinances apply only to municipally owned projects. Some ordinances exempt C&D projects below a specified dollar value or size.

Though not mandated, the CIWMB provides a model C&D waste management ordinance for cities and counties to consider adopting. The CIWMB Web site has the model ordinance at www.ciwmb.ca.gov/LGLibrary/CandDModel/.

These ordinances generally require a C&D waste management plan and implementation documentation for permitting, often providing a sample form for this purpose. In some cases, the ordinances require a minimum level of C&D materials diversion from landfills, or at the very least, a "good faith effort." In addition, at least two ordinances require deposits be held until proof of compliance with waste reduction requirements has been provided. Though schools are not required to go through the local building approval process, CHPS recommends that schools do comply and, through project specifications, require that contractors pay this deposit and/or follow any other local ordinance requirements.

For a sample of C&D-waste-related ordinances, see www.ciwmb.ca.gov/ConDemo/SampleDocs.

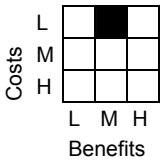
Integrated Design Implications

Some waste reduction can be designed into the building project, such as: standardized dimensioning, modular or panelized building units, and layout of openings. Specifying the use of mechanical fasteners (screws, Velcro) rather than chemical adhesives and solvents will allow components to be easily disassembled and reused.

It will be important that intent of these design details be made clear to avoid in-the-field decisions that waste materials. Contractors are excellent problem solvers, and should be encouraged to find cost-effective substitutes that they know will meet or exceed the environmental goals.

Improper handling of materials on the job site can add to construction waste. For example, materials contaminated by mildew and mold due to moisture exposure have to be discarded and replaced.

Cost Effectiveness



Costs include labor for overseeing and implementing the C&D waste reduction (or waste management) plan, rental for additional bins or other containers used for recycling or salvage, and transportation. Research indicates labor costs decrease significantly as contractors become more familiar with job-site waste reduction techniques. Some contractors keep costs down by utilizing temporary lay down areas with plywood barriers to hold recyclables, rather than renting bins or containers. Alternatively, planning ahead and ordering bins only when needed can keep down costs, since C&D materials are typically generated at predictable phases

of the project. And, using recycling bins can avoid disposal costs, saving contractors and districts money.

Waste disposal/management is generally budgeted as a very small portion of overall job costs. However, the cost of purchasing materials to replace materials that are wasted is rarely taken into account. The tendency is to assume that effective waste reduction takes more time and results in higher costs, but case studies show that, if labor crews are adequately trained and a good plan is in place, costs do not increase.

Benefits

In general, C&D waste reduction should also reduce overall construction costs, especially as the practice becomes a part of every job, and the C&D recycling/reuse infrastructure matures. If revenues from waste reduction, reuse/salvage, and recycling are allocated to the contractor, the responsibility (and the incentive) for waste reduction clearly lies in the contractor's domain. Most contractors report that having a good waste reduction program in place results in a cleaner, safer site, resulting in less lost time and delay.

Environmentally, less waste means better use of limited raw materials and of the energy required to produce, transport, and dispose of building products used in the project. Also, recycling provides "stock" for new materials to be manufactured.

Design Tools

See the Waste Management specification section and the C&D Waste Management Plan of the electronic Appendix A, for sample specification language. Also see the sample specifications included in Green Spec: The Environmental Building News Product Directory and Guideline Specifications.

Design Details

Scheduling should permit salvaging and deconstruction activities, as appropriate.

Waste reduction goals (as with all other sustainable building goals) should be outlined in the Instructions to Bidders section of the Project Summary. The California Integrated Waste Management Board (CIWMB) recommends a goal of 75% diversion of C&D materials by weight. In addition, waste reduction specifications should be included in the Temporary Controls sections of General Conditions. The CIWMB recommends a 13-step C&D site recycling process (see Table 2 at the end of this guideline).

As part of identifying those materials that should be targeted for recycling or reuse in a particular project, contact the local waste authority (www.ciwmb.ca.gov/OLA/Contacts.asp) for information about building materials that can be cost-effectively recycled or salvaged in the project area. These materials (an example being gypsum drywall) should be called out for recycling in the General Conditions specifications section pertaining to waste reduction and in other pertinent sections.

Waste reduction specifications should reflect local jurisdictional requirements, but should be organized using typical CSI convention. The specifications should describe what is included in the job-site waste reduction plan, outline submittal and documentation requirements; indicate ownership of revenues resulting from waste reduction efforts; and include performance goals like minimum levels of waste reduction. The specifications should also outline remedies in the event those levels cannot be met.

If the contractor is required by ordinance or specification to be responsible for achieving waste reduction, it is not necessary to detail methods by which the contractor can achieve it. However, it is informative to contractors to include a list of proven waste reduction strategies, such as:

- A pre-C&D-waste-management meeting to discuss procedures, schedules, coordination, and special requirements for materials.
- A waste reduction provision in supply agreements specifying a preference for reduced, U-turn, and/or recyclable packaging.
- Detailed take-offs that identify location and use in the structure to reduce risk of unplanned and potentially wasteful cuts.
- Proper storage for materials to avoid water or other damage as well as outdating. Materials that become wet or damp due to improper storage shall be replaced at contractor's expense.
- Safety meetings, signage, and subcontractor agreements that communicate the goals of the waste reduction plan. Signage should be clear and easy to understand for multiple languages, through the use of graphic symbols.
- On-site instruction regarding appropriate separation, handling, recycling, salvage, reuse, and return methods to be used to achieve waste reduction goals.
- Discussion of C&D waste management during regular job meetings and safety meetings.
- Contamination protection for materials to be recycled.

Tipping fees or hauling costs are sometimes quoted by weight and sometimes by volume. The conversion from volume to weight, or vice versa, depends on the density of the material. The volume to weight conversions for most common construction and demolition materials are given at the following website, www.ciwmb.ca.gov/LGLibrary/DSG/ICandD.htm.

Operation and Maintenance Issues

Contractors should be required to provide sufficient information on product substitutions to enable the operation and maintenance staff to properly maintain, repair, and replace all products.

Commissioning

None.

References/Additional Information

California Integrated Waste Management Board Web site. In particular, see "Job Site Source Separation," a fact sheet located at www.ciwmb.ca.gov/ConDemo/Materials/SourceSep.htm. Also see the Clean Washington Center's *Recycling Plus Manual* at www.ciwmb.ca.gov/ConDemo/Links.htm. Use this resource to produce a step-by-step construction waste management and recovery plan. *Designing with Vision: A Technical Manual for Material Choices in Sustainable Construction*. Chapter 9, Managing Job-Site Waste addresses C&D waste and is located at www.ciwmb.ca.gov/ConDemo/Pubs.htm.

California Integrated Waste Management Board, Conducting a Diversion Study: A Guide for Local Jurisdictions, www.ciwmb.ca.gov/LGLibrary/DSG.

U.S. Environmental Protection Agency, *Characterization of Building-Related Construction and Demolition Debris in the United States*, June 1998 at www.epa.gov/epaoswer/hazwaste/sqg/c&d-rpt.pdf. Provides national data that a builder may find helpful to estimate and characterize his own waste generation.

U.S. Green Building Council's *Reference Manual* for LEED Green Building Rating System (Commercial, Version 2.1) at www.usgbc.org.

For product substitutions, refer contractors to the CIWMB Web site. Also refer to Green Spec: The Environmental Building News Product Directory and Guideline Specifications (www.buildinggreen.com/), and the OIKOS Web site (www.data.oikos.com/products).

Table 2 – Steps to a Successful Construction and Demolition Waste Management Program

Excerpt from Designing With Vision, A Technical Manual for Material Choices in Sustainable Construction, Revised July 2000, California Integrated Waste Management Board, www.ciwmb.ca.gov/greenbuilding/pubs.htm

Step 1—Plan the project.	Each construction project and job site presents a different set of challenges. Develop a "solid resources management plan" for each project. An effective plan outlines job site waste reduction goals, identifies targeted materials, describes specific waste reduction actions to be implemented on a project, and identifies reuse, recycling, or disposal facilities to which materials will be taken. This is an extremely important part of the materials management plan. The plan should be outlined in the bid and contract specifications, as described in Step 2.
Step 2—Incorporate solid resources management in specifications.	One of the most important tools for assuring that contractors implement the goals and objectives of your waste management plan is to put it right up front in the bid package. The bid specification should outline the procedures and specifications required for salvage, reuse or recycling.
Step 3—Coordinate recycling by project phase.	Different materials are generated at different phases of the project. Use your construction schedule to coordinate recycling by project phase and by trade. A fast-paced job could decrease the amount of materials recycled, since many activities will be happening simultaneously and site recovery efforts may be placed on the back burner. Careful planning can help minimize this problem. A slow job could decrease the rate of materials collection below that which is cost-effective. This problem can be minimized if there is space to store the materials on site.
Step 4—Estimate amount of waste expected.	Estimate the types and quantities of waste that are expected from the project. See “Types of Materials Typically Recovered Successfully” on page 137 for a list of possible materials.
Step 5—Determine what is cost-effective to recycle.	Select several material types that are typically recycled, such as wood, cardboard, concrete, and metals. Though labor costs are often higher for recycling, the lower tipping fees at recycling facilities can often more than compensate. For example, concrete and asphalt recycling may cost $5 per ton, versus $35 per ton for landfilling. If the concrete recycler's location is not too much farther than the landfill, the project could save a significant amount of money. To determine the cost-effectiveness of recycling, calculate each material's cost per ton for recycling versus landfilling by estimating labor costs, transportation costs, and tipping fees. The “Economics Worksheet” in Appendix D is a convenient tool for this calculation. (Note: This worksheet is a draft and may require revisions over time. Please contact IWMB staff to suggest improvements, and/or obtain an updated version.)
Step 6—Consider hiring a recycling service.	Consider working with either (1) your hauler, (2) a professional full-service recycling contractor, or (3) a waste management consultant to help you identify what types of materials can be cost-effectively recycled from your project. See “Sample Provisions for a Full-Service Recycling Agreement With a Waste Hauler,” page 138, for information on contract language and sample provisions to use when hiring a full-service recycling contractor or hauler.
Step 7—Consider space constraints.	Most jobs have moderate to severe space constraints. Develop a plan to "stage" the job site for the most effective method for storing and collecting both recyclables and waste, and position recycling bins at the most convenient location for the various trades to use. See “Tips for Recycling Bin Use,” page 139.
Step 8—Work with haulers to plan collection.	Work with haulers to develop a plan for collecting materials. Identify "peak generation" times early in the process. Determine what types of containers are available to collect the materials. Different containers may be needed at different phases of the project in coordination with the various trades. For example, a large 40-yard (cubic yard) dumpster may be needed for wood, but only a 20-yard dumpster is needed for steel studs.
Step 9—Get “buy in” up front.	For the program to be successful, it is important to establish a high level of commitment from the contractor, subcontractors, cleanup personnel, and waste haulers up front. Some contractors have waste management training as part of their prebid, preconstruction, and safety training meetings. Hold your subcontractors accountable for implementing the solid resources management plan outlined in the bid package. Provide a package of information on the recycling program to each new subcontractor when they come on board.
Step 10—Expect a learning curve.	When dealing with contractors and subcontractors, who are inexperienced with waste reduction and recycling practices, expect some errors and inefficiencies because of the learning curve. Set recycling goals that are realistic for personnel who are learning new skills. It's better for morale to exceed the goals than to miss them.
Step 11—Reward participation.	It's important that field personnel know how their efforts are paying off. Communicate the success of the reuse/recycling program with subcontractors. One idea would be to put up a status graph to show on a monthly or weekly basis how much waste has been diverted from the landfill, and how much savings have accrued to the project because of their waste management efforts. Another idea would be to provide incentives such as t-shirts or mugs, when goals are met. Also, encourage everyone's ideas and suggestions.
Step 12—Monitor and track for quality control.	One contaminated box can really add costs to a successful recycling program. It is helpful to track on a monthly basis the type, amount and cost of all materials being recycled or landfilled from the job site. A simple tracking form is provided in the "Solid Resources Management" specification in Appendix C (Attachment B), called "Summary of Solid Waste Disposal and Diversion." This form can be used to develop a spreadsheet that gives you an up-to-date report that will identify how many clean dumpsters went off site for reuse and recycling and how many contaminated and costly dumpsters were taken to the landfill.
Step 13—Promote your success.	Put out press releases on the success of your project. Clearly identify the job site with signs that tell the public you are reducing, reusing, and recycling your waste. Let the public know you are committed to being resource efficient.

GUIDELINE GC3: INDOOR AIR QUALITY DURING CONSTRUCTION

Recommendation

Require indoor air quality (IAQ) planning and preventive job-site practices for the jobsite.

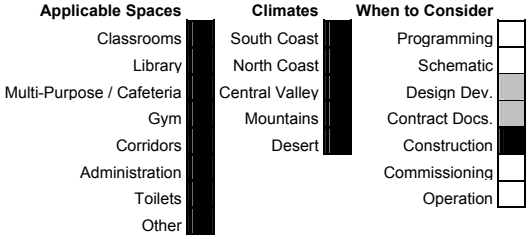
Description

Preventive job-site practices can eliminate undue health risks for workers and reduce residual problems with IAQ in the completed building and eliminate undue health risks for workers. "Healthy" job-site planning will adequately address problem substances, including construction dust, chemical fumes, off-gassing materials, and moisture. It will make sure these problems are not introduced during construction, or, if they must be, eliminates or reduces their impact. Areas of planning will include product substitutions and materials storage, safe installation, proper sequencing, regular monitoring, as well as safe and thorough cleanup.

Figure 5—Healthy Job Site Signage (courtesy of O'Brien & Company)

Applicability

Maintaining healthy job-site conditions is important for all spaces and all climates. The activity is carried out in the construction and renovation phases, but must be planned in the design development and documented in contracts, maintenance plans, and policies.



Applicable Codes and Guidelines

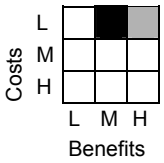
Local school districts are beginning to develop IAQ policies that incorporate construction/operational requirements. See for example, the Materials/Indoor Air Quality Policy for School District Buildings (Berkeley Unified School District, Berkeley, CA: 1994–1995). Check with your local jurisdiction to see if a

similar policy is in place. In addition, the U.S. Green Building Council's LEED Green Building Rating System (Commercial, Version 2.1) includes a provision for an IAQ construction plan. This provision requires that the project contractor "meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 1995."

Integrated Design Implications

When identifying "healthy" materials for use in buildings, the focus is generally on preventing problems during occupancy. This guideline implies some responsibility for air quality falls during installation, which may impact the choice of material and/or the method of installation. Also, since product substitutions may happen in the field, it is important to outline the approval process for these substitutions clearly. For materials with off-gassing potential, require specific ingredient information about the product itself (as well as any adhesives, solvents, or other products that might be used during installation or maintenance). Designing to use mechanical fasteners (screws, Velcro) rather than chemical adhesives and solvents can reduce potential problems with IAQ during construction.

Cost Effectiveness



Implementing this guideline should not necessarily add cost to the project. The one area where it might add cost is in the form of potential delays due to sequencing and ventilation requirements. However, this cost can be minimized by proper planning.

Risk managers may be reluctant to take on the added responsibility of requiring IAQ planning and preventive job-site practices. However, school districts and project architects across the country have experienced litigation related to poor IAQ resulting from improper construction activities. Addressing these issues before and during construction will reduce exposure of the school district and designers to potentially expensive litigation in the future.

Benefits

The costs of poor IAQ are difficult to quantify, but considerable. They include the sum of illness and decreased student productivity suffered by students and teachers, along with the district's cost of equipment replacement, workers' compensation claims, and in the most severe cases, litigation. Unfortunately, serious health complaints have resulted from careless acts during construction projects, such as failure to clean up spilled adhesives or neglecting to properly ventilate during and after applying sealants in an occupied building. These mistakes have led to school closures, unpleasant headlines, and costly lawsuits. Good IAQ strategies during construction will help eliminate these potential liabilities.

Design Tools

See electronic Appendix A for sample specification language.

Design Details

IAQ goals (as with all other sustainable building goals) should be outlined in the Instructions to Bidders as part of the Project Summary addition. IAQ specifications should be included in the Temporary Controls sections of General Conditions.

The specifications should describe what is included in an IAQ construction plan, outline submittal requirements, and reference the SMACNA IAQ Guidelines for Occupied Buildings Under Construction 1995, with the goals of:

- Protect the ventilation system components from contamination, or provide cleaning of the ventilation components that are accidentally exposed to contamination during construction prior to occupancy. Manufacturers and distributors of these components should have clear instructions for cleaning and sealing these components to remove any manufacturing residues and to avoid subsequent contamination by dust or fumes. Duct work and air handlers should be well-sealed until they are installed.
- Provide a minimum continuous ventilation rate of one air change per hour during construction, or conduct a building flush-out with new filtration media at 100% outside air after construction ends (following issuance of Occupancy Certificate) and prior to occupancy for seven days (one week). Systems designed to filter particulate matter must not be operated without a particulate filter in place during construction, though the filter used during construction does not need to be of the same rating as that used during occupancy (per ANSI/ASHRAE *Standard 62.1-2004*). Note that seven days is considered a minimum. IAQ specialists recommend flushing the building with 100% outside air for 30 days prior to substantial completion.

If the contractor is required by the specification to be responsible for protecting IAQ during construction, it is not necessary to detail methods by which the contractor can achieve it. However, it is informative for contractors to include a list of proven air quality protection strategies, such as:

- Use supplemental (temporary) ventilation during the installation of carpet, paints, furnishings, and other volatile organic compound (VOC)-emitting products, for at least 72 hours after work is completed. Preferred HVAC system operation uses supply air fans and ducts only, with windows providing exhaust. Use exhaust fans to pull air from deep interior locations. Stair towers and other paths to the exterior can be useful during this process. Portable floor fans are also recommended to improve pollutant removal from surface materials such as carpeting.
- Perform regular inspection and maintenance of IAQ measures, including ventilation system protection and ventilation rate. Spot check walls, duct work, and plenums before they are closed up, to ensure that debris, contamination, and mold are not present.
- Provide VOC-safe masks for workers installing VOC-emitting products (interior and exterior), which are defined as products that emit 150 grams per liter (gpl) or more. If local jurisdiction's requirements are stricter, the strictest requirement should be followed for use of VOC-safe masks.

- Provide low-toxicity cleaning supplies for surfaces, equipment, and worker's personal use. Options include several soybean-based solvents and cleaning options (SoySolv), and citrus-based cleaners.
- Wet sand gypsum board assemblies. Exceptions should be clearly defined and include full isolation of space undergoing finishing or closure of all air system devices and ductwork. Additional conditions can be set.
- Use safety meetings, signage, and subcontractor agreements to communicate the goals of the construction IAQ plan.

The IAQ construction plan is also a good opportunity to proscribe unacceptable behaviors that represent a potentially negative impact on long term IAQ, such as smoking, using chew tobacco, or wearing contaminated work clothes.

Operation and Maintenance Issues

Contractors should be required to provide information on product substitutions sufficient to enable operation and maintenance staff to properly maintain and repair low-emitting or otherwise "healthy" materials.

Commissioning

None.

References/Additional Information

U.S. Green Building Council's *Reference Manual* for LEED Green Building Rating System (Commercial, Version 2.1) at www.usgbc.org. Also see Carpet and Rug Institute (CRI) guidelines for carpet installation. The Painting Contractors Union (New York City local) has reportedly developed guidelines for ventilation during painting.

U.S. Environmental Protection Agency. www.epa.gov/iaq/schools/tfs/renovate.html. A checklist for IAQ issues at all stages of construction.

For product substitutions, refer contractors to the CIWMB Web site. Also refer to Green Spec: The Environmental Building News Product Directory and Guideline Specifications (www.buildinggreen.com/), and the OIKOS Web site (www.data.oikos.com/products).

GUIDELINE GC4: SITE PROTECTION DURING CONSTRUCTION

Recommendation

Require best management practices for site protection during construction.

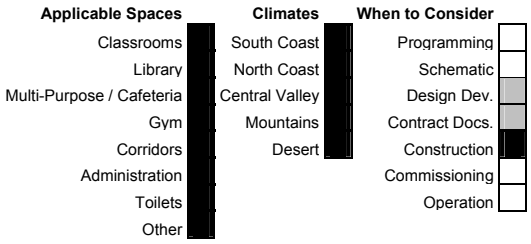
Figure 6—Silt Fencing for Sedimentation Control (courtesy of O'Brien & Company)

Description

An effective job-site protection plan will describe construction practices that eliminate unnecessary site disturbance, minimize impact on the site's natural (soil and water) functions, and eliminate water pollution and water quality degradation.

Primarily it will include protocols for:

- Construction equipment operation and parking.
- Topsoil and vegetation protection and reuse.
- Hazardous materials management.
- Installation and maintenance of erosion control and stormwater management measures.



Applicability

This guideline applies to all climates and spaces.

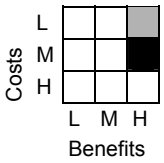
Applicable Codes

All jurisdictions include some requirements related to water quality protection, in particular stormwater management and erosion control during construction. Local policies may govern other construction activities covered in this guideline. Please check with the local jurisdiction.

Integrated Design Implications

The plan should be integrated with stormwater management and erosion control measures (see the Site Planning chapter). In addition, a requirement to submit ingredient information about in-field product substitutions to avoid degradation of water quality on the site is important.

Cost Effectiveness



This guideline recommends going beyond typical site practices. The project architect needs to evaluate the risk of erosion problems to determine whether redundant erosion control measures are cost effective. Least-toxic pest and weed control is quite cost effective, as it can provide savings and an increased level of safety for students who will be using the school grounds.

Benefits

Construction delays and work stoppages due to erosion control failure are avoided. Water quality in surrounding waterways and groundwater supplies are protected. Health risks to students due to residual toxicity on the site can be reduced.

Design Tools

See electronic Appendix A for sample specification language.

Design Details

Site protection (as with all other sustainable building goals) should be outlined in the Instructions to Bidders as part of the Project Summary. In addition, site protection specifications should be included in the Temporary Controls sections of General Conditions. The specifications should describe what is included in a site protection plan, outline submittal requirements, and recommend strategies, including:

- Regular inspection and maintenance of site protection measures. At a minimum, inspection of all erosion and sedimentation measures after a heavy rainfall, which is defined as 0.5 in. in less than 24 hours.
- Redundant mechanisms for site protection of any critical or sensitive areas, as identified in the site plan. Silt fencing fabric and other temporary site protection measures should be selected to last for the life of the project.
- Measures to ensure that detergent does not get into soil and sediment separators.
- Posted protocol for construction vehicles regarding parking and access on the site.
- Rocked heavy construction vehicle entrance and tire wash.

- Posted clean-up procedures for spills to prevent illicit discharges.
- Measures to minimize risk of the toxic release of hazardous wastes, including paints and other finish products, solvents, adhesives, and oils as follows:
- Avoid overstocking.
- Adopt a first-in, first-out policy.
- Label containers properly.
- Control access to storage areas and routinely inspect containers.
- Inspect all containers upon receipt. Reject leaking or damaged containers.
- Topsoil preparation, planting, and maintenance using Integrated Pest Management (least-toxic) protocol. Least-toxic products for controlling pests and insects in detention ponds and for soil prep. No chemical weed eradication.
- Safety meetings, signage, and subcontractor agreements that communicate the goals of the site protection plan.

Operation and Maintenance Issues

Operation and maintenance staff should be informed that least-toxic products have been used for soil preparation and for controlling pests and insects in detention ponds. Also, contractors should be required to provide information on product substitutions sufficient to enable operation and maintenance staff to properly maintain site protection measures.

Commissioning

None.

References/Additional Information

Ross Middle School. Ross School District, CA. Completed in 1999. For more information contact Dana Papke, DPapke@CIWMB.ca.gov.

U.S. Green Building Council's *Reference Manual* for LEED Green Building Rating System (Commercial, Version 2.1) at www.usgbc.org. Also see the Environmental Protection Agency (EPA) publication: Stormwater Management for Construction Activities, Chapter 3.

For product substitutions, refer contractors to the CIWMB Web site. Also refer to Green Spec: The Environmental Building News Product Directory and Guideline Specifications (www.buildinggreen.com/), and the OIKOS Web site (www.data.oikos.com/products).

GUIDELINE GC5: CONTRACTOR'S COMMISSIONING RESPONSIBILITIES

Recommendation

Require that the contractor and subcontractors provide the commissioning agent (CA) with information needed to facilitate the commissioning process and to coordinate activities with the CA as needed.

Description

Commissioning is a systematic, documented process including visual examination and functional performance testing to demonstrate that installed components or systems, as well as the building overall, meet the intent of the original design. A CA is someone qualified to provide an independent inspection of the building or site/landscape component or system being commissioned. This guideline recommends that the contractor be required to coordinate with the CA and provide information as needed to optimize commissioning results. Contractors will be involved in fine-tuning and correcting systems when commissioning indicates this is needed. See the CHPS Volume V on Commissioning for more information.

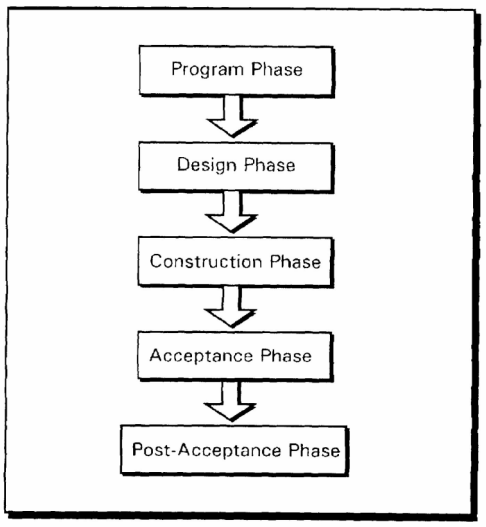
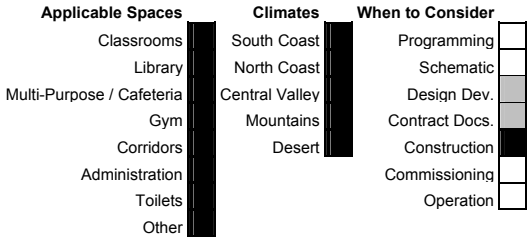


Figure 7—Commissioning Phases

(from Building Commissioning Guide; see References/Additional Information)



Applicability

This requirement is applicable to all climates and spaces. It is implemented in the construction phase, but needs to be considered in both the design development and contract documents phase.

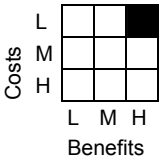
Applicable Codes

None.

Integrated Design Implications

None.

Cost Effectiveness



Costs for this aspect of commissioning are minimal. Overall, commissioning has the potential for producing savings in avoided delays and other startup problems.

Benefits

Requiring contractor coordination will facilitate effective commissioning. Commissioning can provide tremendous economic benefits as well as improve building performance.

Design Tools

None.

Design Details

Commissioning goals (in addition to all high performance building goals) should be outlined in the Instructions to Bidders as part of the Project Summary. A requirement that the contractor coordinate with the CA should be included in General Conditions. (A separate commissioning agreement will be drawn up between the district and the CA.) Other commissioning requirements for the contractor will appear in pertinent sections, including mechanical and electrical. (If the contractor is responsible for hiring the CA, a special section incorporating commissioning requirements should be written, and the "coordination" aspect of this guideline would be part of the agreement between the contractor and the CA.)

The contractor should be informed of the types of systems that will be commissioned, the types of information that may be required, and his responsibilities in terms of correcting problems that are identified. Types of systems to be commissioned may include:

- HVAC plant.
- Air and water delivery system.
- Energy management system.
- Electrical and lighting system.

- Fire/life safety system.
- Data networks/communications.
- Security system.
- Irrigation system.
- Kitchen equipment.
- Building envelope.
- Renewable energy system.
- Fume hoods.
- Science lab gas delivery system.
- Emergency power supply.
- Plumbing.

Frequently it is difficult to enforce the requirement that the contractor finish all commissioning tasks prior to Substantial Completion. A practical solution is to provide an incentive to complete the work, by applying a penalty if such tasks are not performed by "functional" completion. Exceptions would be seasonal or "approved deferred" testing and controls training. Functional and substantial completion should be defined in the general conditions of the construction contract.

During construction, building systems are installed, undergo pre-functional performance tests, and are placed into operation. Once construction is completed, all building systems should be operating as designed, both individually and collectively, and are ready for functional performance testing. The contractor assists in all aspects of the commissioning process, including documentation; pre-functional testing; start-up and initial checkout; initial controls checkout; testing; adjusting and balancing (TAB); functional testing for individual systems and integrated systems; verification; training of operation and maintenance personnel; and operation and maintenance manual development and review. In practice, some of the system checks included in full commissioning are performed, but rarely documented.

Operation and Maintenance Issues

The contractor will be required to provide documentation and information for the commissioning process that will be incorporated into an operation and maintenance plan or manual.

Commissioning

None.

References/Additional Information

U. S. Department of Energy's Federal Energy Management Program (FEMP), in cooperation with the General Services Administration (GSA), developed the *Building Commissioning Guide* as part of GSA's facility commissioning program to ensure that construction of new facilities meets the requirements. Chapter 10 of this document includes an extensive list of additional resources related to building commissioning. www.femp.gov/

A Web site dedicated to providing access to documents dealing with the Guidelines for Total Building Commissioning is being developed under the auspices of the National Institute of Building Sciences. The site is maintained by the Florida Design Initiative and is organized around the individual technical guidelines that will comprise the complete set of Guidelines for Total Building Commissioning. http://sustainable.state.fl.us/fdi/edesign/resource/totalbcx.