Department of Energy

Condition Assessment Survey **(CAS)** Program

Deficiency Standards & Inspections Methods Manual

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for
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CAS PROGRAM OVERVIEW

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INTRODUCTION

GENERAL

Welcome to the DOE Condition Assessment Survey (CAS) Program In the next few pages you will be Introduced to a new way of seeing familial things. As an introduction to CAS, this Program Overview will explain how the various parts of CAS have been developed and integrated to meet the needs of DOE sites, Field Offices, and Headquarters. Our discussion will center around three broad topics:

- WHY CAS?

  This section will discuss issues DOE has faced in previous inspection approaches and explain the CAS goals of providing creative "standardized" solutions.

- WHAT IS CAS?

  Here, key elements of the CAS Program and how they relate to each other will be examined

- HOW IS CAS IMPLEMENTED?

  Strategies for beginning to use CAS and the key roles facility managers and CAS inspectors play within the CAS process are detailed.

Again, welcome to the CAS Program. Your role in this program is essential to its overall success

INTRODUCTION

WHY CAS?

DOE NATIONWIDE INVENTORY:

- 10,000 BUILDINGS AND 15.000 STRUCTURES ON 52 SITES NATIONWIDE
- LACK OF DOE STANDARDS
- VARYING DEGREES OF INSPECTION
- INCONSISTENT RESULTS LEADING TO INEQUITIES AMONG SITES

INTRODUCTION

WHY CAS? - The State of DOE

The use of standards, from simple weights and measures to complex computer language has been a fundamental part of human development. Because of standards, we can be assured that a meter of length in one place is the same in another This question of standards has become increasingly important for DOE. Over the past 50 years, DOE and predecessor agencies have been at the forefront of the nation's technical advances. This investment has left the department a vast array of facilities under its care. With 10,000 facilities and 15,000 miscellaneous structures comprising over 100,000,000 square feet at 52 sites across the country, the problem of design, construction, and maintenance of all DOE physical plants is acute. Add aging facilities, revised missions, and changing technology, and condition assessment becomes a vital tool to use to ensure facilities will continue to meet DOE's and the nation's program goals

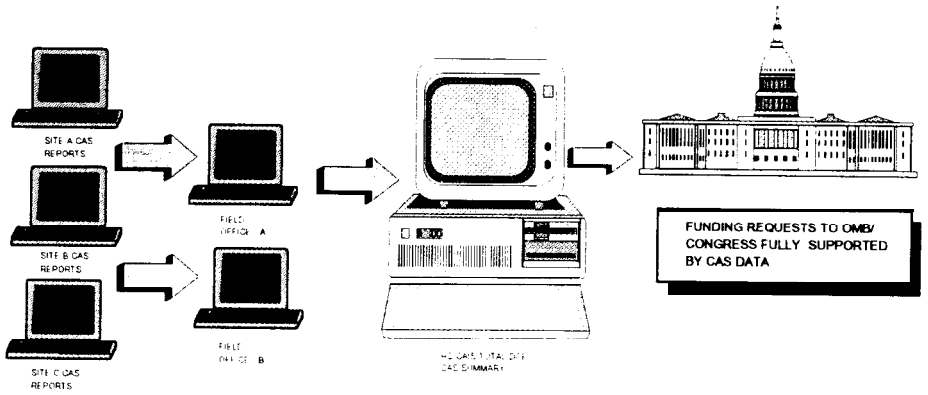
The current state of condition assessment across all DOE assets is mixed. While DOE regulations dictate facility assessments be made, no one methodology is mandated to conduct them. As a result, DOE surveys have varied from site to site, with some locations providing exhaustive in-depth analysis while others have used a more limited approach. Because of such different interpretations, it is difficult to judge the validity and comparability of data being provided This. in turn, has led to funding requests that cannot be fully substantiated to Congress.

This lack of standards for use in the facility assessment process and the resultant inconsistencies in developing program budgets have convinced DOE that a standardized, clearly defined methodology for condition assessment is essential to support DOE's program missions.

INTRODUCTION

WHY CAS?

- ASSESS PHYSICAL CONDITION OF EXTENSIVE AND VARIED DOE FACILITY AND EQUIPMENT INVENTORY
- STANDARDIZE INSPECTIONPROGRAM FOR ALL SITES
- IDENTIFY REPAIR/REPLACEMENT NEEDS TO FACILITATE KEY BUDGET DECISION MAKING
- DEVELOP SUPPORTABLE FUNDINGREQUESTS BASED ON "UNIVERSAL" STANDARDS



INTRODUCTION

WHY CAS? • Four Key Requirements

In today's economic environment, it is essential that the DOE knows with confidence the condition of its vast asset inventory. To accomplish this a method to review all DOE assets in a 'standardized" approach is required. In designing guidelines for such a program, DOE established four key requirements:

Assess Physical Condition of All Assets:

To be valid, all sites eventually must be included in the program. Universal participation will ensure that all DOE sites and installations will be using the same "score card."

Standardize Inspection Programs:

To remove the problem of inconsistent and misinterpreted facility inspection data, a "standard" evaluation method used by all DOE sites is required. Results from such a program will allow DOE to determine a "base condition" for all of its assets.

Identify Repair/Replacement Funding:

Using inspection data from all sites, a general picture across all DOE assets and programs can be used to direct limited resources to crucial areas Standardized reports form "a level playing field" to ensure that all programs and missions will receive a fair analysis

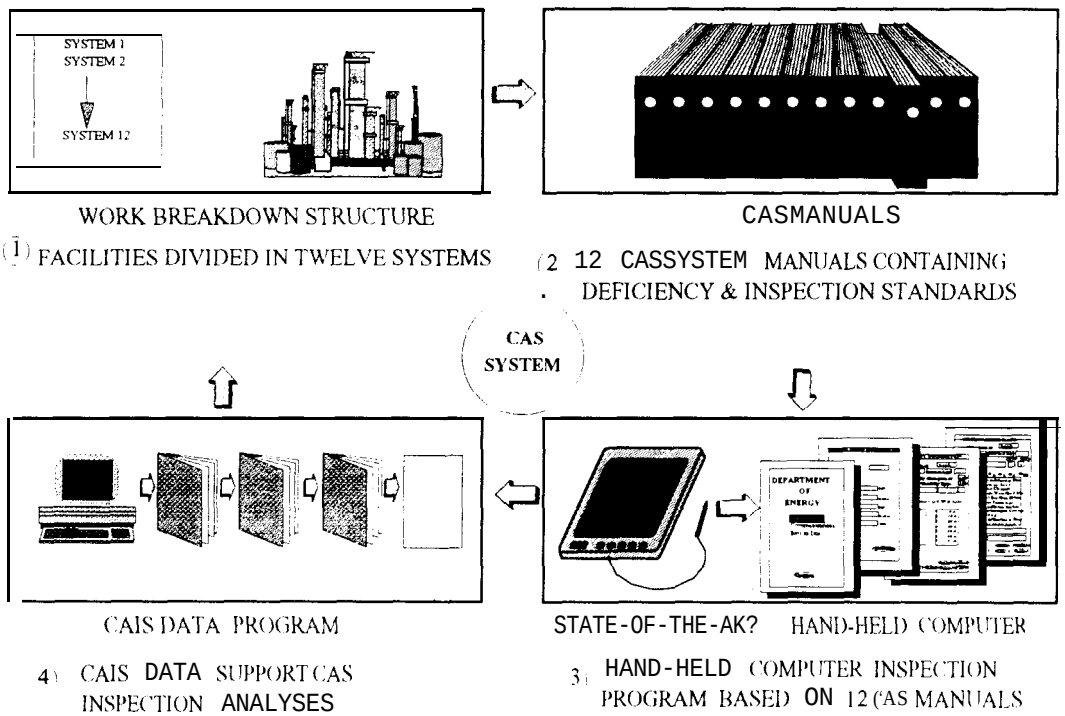
Develop Supportable Funding Requests:

In today's atmosphere of fiscal constraint, requests for funds from Congress require extensive justification, backed up by reliable, consistent field data, if such programs are to be successfully supported.

INTRODUCTION

WHAT IS CAS?

A SYSTEMATIC INSPECTION APPROACH INSTITUTED AT ALL SITES



WORK BREAKDOWN STRUCTURE

(1) FACILITIES DIVIDED IN TWELVE SYSTEMS

CASMANUALS

(2 12 CASSYSTEM MANUALS CONTAINING
. DEFICIENCY & INSPECTION STANDARDS

CAIS DATA PROGRAM

4) CAIS DATA SUPPORT CAS INSPECTION ANALYSES

STATE-OF-THE-AK? HAND-HELD COMPUTER

3) HAND-HELD COMPUTER INSPECTION PROGRAM BASED ON 12 CAS MANUALS

INTRODUCTION

WHAT IS CAS? - The Work Breakdown Structure (WBS)

The CAS system has been developed to answer the critical questions facing DOE. Using state-of-the-art hand-held computers and system software programs, the CAS process will establish a systemized, standard approach to facility and asset evaluations. This program will help DOE provide the necessary assets as it seeks to bring our nation's premierresearch and development agency into the year 2000 and beyond.

The condition assessment process involves evaluating separate building "systems" that comprise the entire facility. These systems traditionally fall under three broad professional disciplines architectural (including structural), mechanical, and electrical. Specialty assessments (e.g industrial hygiene, chemical engineering) are usually performed as adjuncts to these primary disciplines when required. The WBS employed under CAS is based on the 12 system assemblies that R.S. Means employs in its square foot cost analysis. Using this system as a foundation to define assemblies and components in the CAS Program will create a direct link to a broadly accepted industry-wide standard.

TABLE ONE

WORK BREAKDOWN STRUCTURE

SYSTEM (R.S. MEANS CAT.)	CONTROL NO.
FOUNDATIONS & FOOTINGS	0 01 SYSTEM
SUBSTRUCTURE	0 02 SYSTEM
SUPERSTRUCTURE	0 03 SYSTEM
EXTERIOR CLOSURE	0 04 SYSTEM
ROOFING	0 05 SYSTEM
INTERIOR FINISHES & CONSTRUCTION	0.06 SYSTEM
CONVEYING SYSTEMS	0 07 SYSTEM
MECHANICAL SYSTEMS	0 08 SYSTEM
ELECTRICAL SYSTEMS	0 09 SYSTEM
*PROD/LAB/OTHER EQUIPMENT	0 10 SYSTEM
SPECIALTY SYSTEMS	0 11 SYSTEM
SITEWORK ...	0 12 SYSTEM

CONSTRUCTION SPECIFICATIONS

DIVISION (MASTERFORMAT)	DESCRIPTION
01000	GENERAL REQUIREMENTS
02000	SITEWORK
03000	CONCRETE
04000	MASONRY
05000 ..	METALS
06000	WOOD & PLASTICS
07000	THERMAL&MOISTURE PROTECTION
08000	DOORS &WINDOWS
09000	FINISHES
10000	SPECIALTIES
11000	EQUIPMENT
12000	FURNISHINGS
13000	SPECIAL CONSTRUCTION
14000	CONVEYING SYSTEMS
15000	MECHANICAL
16000	ELECTRICAL

The WBS of the CAS Program will be linked to the MASTERFORMAT system developed by the Construction Specifications Institute (CSI) and used as the basis for the DOE Design Guide (DOE 6430.1A). These CSI numbers will be referenced after each system assembly and componentin the CAS Manuals as follows:

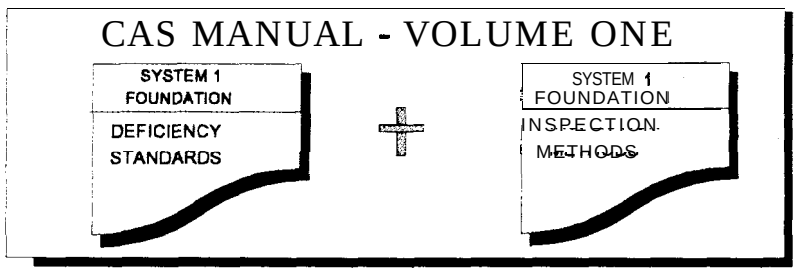
EXAMPLE: Roofing (CSI 07000)

*NOTE This section supersedes Means 0 10 category and Includes FIS 700 Series Asset Codes

WHAT IS CAS?

DEFICIENCY STANDARDS & INSPECTION METHODS MANUAL

- DEVELOPED SEPARATELY FOR EACH SYSTEM
- DEFICIENCY STANDARDS CONTAIN NARRATIVE AND GRAPHICS FOR DESCRIBING DEFICIENCIES AFFECTING SYSTEM ASSEMBLIES
- INSPECTION METHODS CONTAIN PROCEDURES TO IDENTIFY TYPE, SEVERITY, AND PERCENT COVERAGE OF EACH COMPONENT OK SYSTEM DEFICIENCY ILLUSTRATED



INTRODUCTION

WHAT IS CAS? • DOE CAS Manual Format

Using these 12 systems as the basic organizing principal, the DOE CAS Manual will contain Deficiency Standards and Inspection Methods It will be divided into 12 volumes corresponding to these established WBS systems The internal organization of manuals is outlined below

SECTION 1 • SYSTEM INFORMATION

1.1 Asset Determinant **Factor/CAS** Repair **Codes/CAS** Cost Factors Discusses the Asset Determinant Factor (ADF). a decision matrix used to provide a graded approach to inspections commensurate with the use and relative Importance of the asset Inspected Also addresses the CAS repair codes and a general overview of cost estimating techniques

1.2 Guide Sheet Tools 8 Materials Listing Contains tools and materials groups used in conjunction with the Inspection methods process for the system outlined in each volume

1.3 Testing Methods - Contains the specific requirements for testing methods applicable to the systems

1.4 Inspection Frequency Schedule of CAS inspection frequencies for systems/components

1.5 Standard System Design Life Tables - Standard design life tables for the system assemblies/components

1.6 System Work Breakdown Structure (WBS) - Complete listing of all assemblies/components

1.7 General System/Material Data General material data relevant to system deficiency problems (Optional. not included for all systems)

SECTION 2 • DEFICIENCY STANDARDS

Each major assembly/component is defrned by a brief narrative and accompanying graphic(s) that visually illustrate the general characteristics Major deficiencies affecting this assembly/component are described, including probable failure pornts A deficiency characteristics profile and graphic illustrations are provided with each deficiency defined

SECTION 3 • INSPECTION METHODS

This section contains discussions of methods and procedures involved in rnspectrng each of the WBS systems Each system contains an Inspection Method, including a narrative and a System/Component Inspection Guide Sheet Listing that provides a general overview for each defined major assembly/component type. This information will be developed for Standard and Non-Standard Inspections and testing methods that would be used in conjunction with Standard or Non-Standard Inspection Methods Also included is a simulated example, “walking” the inspector through the data collection process

SECTION 4 • REFERENCES

All major reference standards used and/or associated with the system are described, including government, Industry, and DOE references

APPENDICES

Appendix A Abbreviations All abbreviated terms contained in the CAS manuals

Appendix B Glossary - All technical terms directly related to the particular systems discussed will be defined in this subsection

Appendix C Technical Bulletins/Updates/Advisories - This subsection contains technical information issued by the government and/or private industry that may affect specific data as developed in the particular volume DOE guidelines may also be included in this subsection

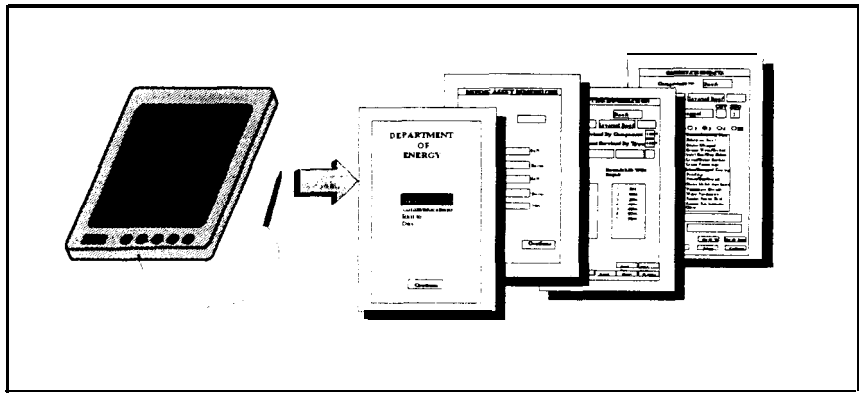
Appendix D Revisions Summary All revisions listed in chronological sequence The last revision listed will be the most current modification

INTRODUCTION

WHAT IS CAS?

STATE-OF-THE-ART TECHNOLOGY STREAMLINES FIELD CONDITION ASSESSMENT SURVEY PROCESS

- HAND-HELD COMPUTER "PROMPTS" INSPECTOR WITH PRELOADED SOFTWARE SYSTEM "MENUS"
- INSPECTOR SELECTS DEFICIENCIES, SEVERITY, PERCENTAGE OF COVERAGE, LOCATION, ETC. FROM "MENU" SYSTEM



INTRODUCTION

WHAT IS CAS? - State-Of-The-Art Technology

At the outset of this Introduction, we talked about a "new way" of seeing familiar things. The traditional methods of facility assessment inspection, using hard copy forms then entering data either by laptop or into a PC, have given way to a new, exciting technology. The Pen-Based Computer. This hardware, and the Condition Assessment Information System (CAIS) software developed to support it, form the heart of the DOE CAS data collection process. Using the CAS manuals as the basis to develop the inspection process, CAIS software will create pre-stocked survey "menus". These will be used to record defined deficiencies in terms of severity and **covet** age. With this user-friendly device, inspectors will simply use a pen-like device to record their observations directly on the prompted inspection screens developed for each system.

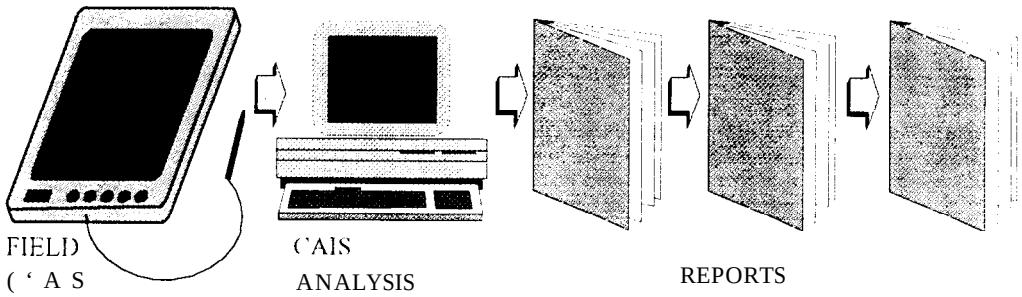
The advantages in using this technology for the DOE CAS Program are exceptional. The efficiency gained by using the hand-held computer technology to prompt the inventory and facility inspection process will be significant. This eliminates the manhour-intensive and error-prone process of converting manually developed data into an automated database. This technology system ensures that all pertinent data is collected, guiding the inspector through each step of the process. This method will significantly enhance the effectiveness of quality assurance/quality control of the DOE CAS Program, permitting editing as data is entered, eliminating illogical or erroneous choices.

In short, the CAS process will be conducted in a carefully structured, "standardized" manner to ensure that the quality of raw inspection data is consistent throughout all DOE installations.

WHAT IS GAS?

CAIS PROGRAM FOR HAND-HELD & PCs SUPPORT THE CAS PROGRAM

- INSPECTION DATA DOWNLOADED TO PC-BASED CAIS PROGRAM
- DATA ANALYZED, CATEGORIZED, AND SORTED
- REPORTS GENERALIZED, INCLUDING UNIVERSAL AND SUMMARY VERSIONS
- REPORTS WILL INCLUDE DEFICIENCY DESCRIPTIONS, COSTS TO REPAIR/REPLACE, AND SCHEDULE



INTRODUCTION

WHAT IS CAS? - The **CAIS** Connection

Asset condition information is uploaded directly to the PC and the CAIS program, eliminating the laborious hand input of data. If the hand-held is the “eyes and eats” of CAS, then the CAIS database is the "brain." In the program, raw data is sorted and analyzed to create CAS reports Several key factors are determined during the process:

Deficiencies Affecting Survey Assets:

The Inspector describes each deficiency notrng its severity and coverage, i.e. how much of the component or assembly reflects the deficiency The inspector also codes each component or assembly as to condition and the urgency and purpose of proposed repair or replacement actions.

Corrective Repairs:

Based on these recorded deficiencies, corrective actions and their associated repair codes ate defined and processed by the CAIS database.

Project Costs:

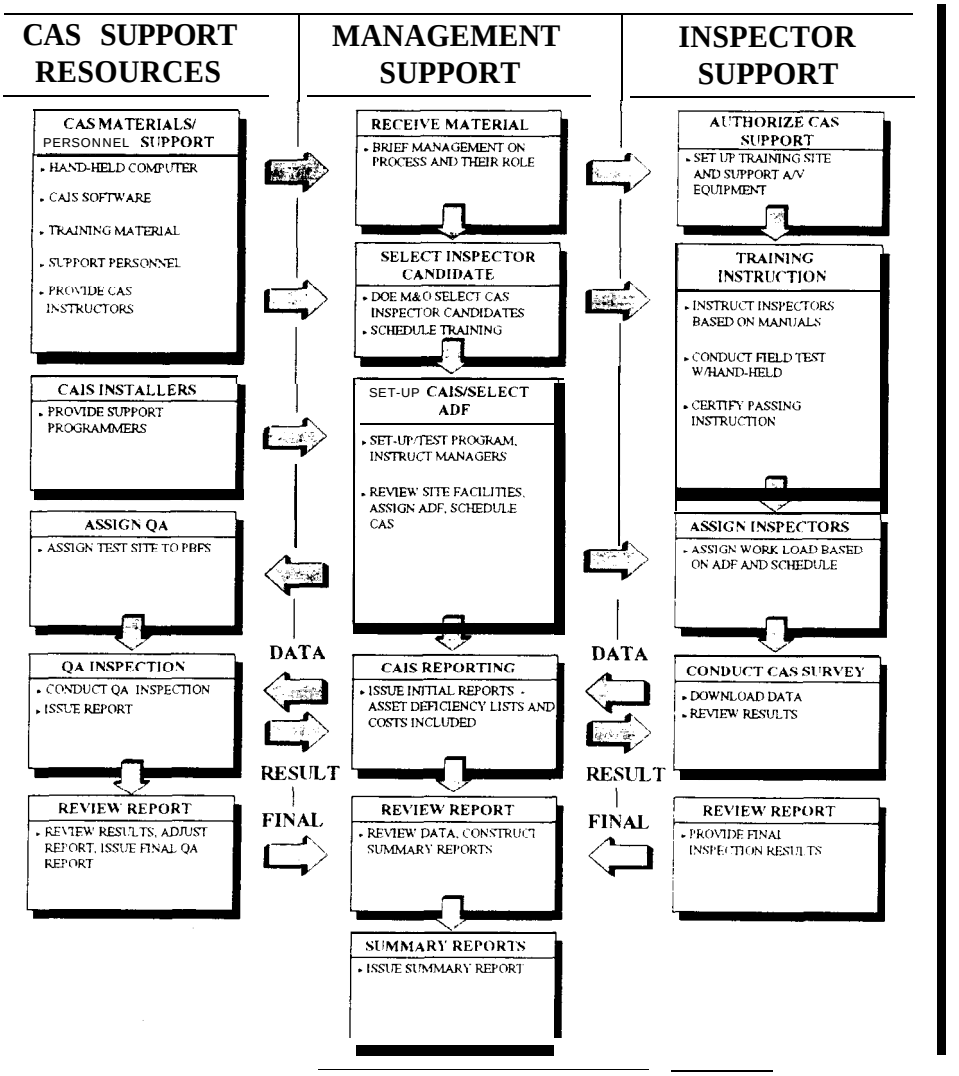
Costs to accomplish repairs and replacements are generated by the manipulation of field data in the CAIS program, which employs several methods including determining cost as a percentage of total replacement and/or direct entry of costs. (See Section 1, Subsection **1.1** for discussion of cost development.)

Asset Reports:

Preformatted reports and tables are generated by the CAIS System. Report types include “universal” reports listing all deficiencies and observations recorded by the Inspector, summary asset reports, and summary site reports. Data within the CAIS system can also be manipulated readily to create “custom” reports.

INTRODUCTION

HOW IS CAS IMPLEMENTED?



INTRODUCTION

HOW IS CAS IMPLEMENTED? - Support Roles

While CAS manuals, hardware and the CAIS database ate the main building blocks of the CAS Program, CAS support personnel will form the standing framewotk. Your role in the implementation process is crucial if the CAS system is to succeed. In reviewing this process, three key support groups are highlighted.

CAS Contractor Support **Personnel:**

In conjunction with DOE managers and Site Management & Opetations (M&O) contractors, CAS contractor support personnel will work closely with DOE in setting up and conducting the training program, installing CAIS, and validating CAS through a Quality Assurance (QA) program. This team of CAS trainers, CAIS programmers, and QA engineers and architects will form, along with DOE M&O personnel, the strong team required to support the CAS Program as it proceeds.

Manager Support:

No group is more important in implementing CAS than the DOE managers and M&O contractors. Their in-depth knowledge of the sites and their personnel will help guide and strengthen the entire CAS system.

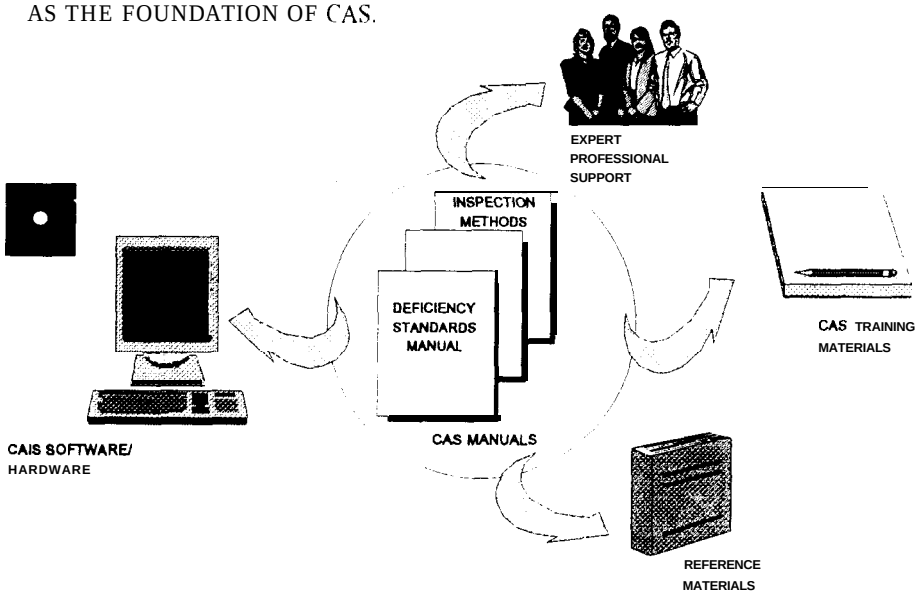
CAS Inspectors:

Without highly skilled, knowledgeable inspectors, the CAS Program will not succeed. The integrity of these inspectors and their expertise will ensure that the base data supporting the entire CAS process will be an accurate reflection of the condition of the DOE inventory of facilities and assets.

HOW IS CAS IMPLEMENTED?

CAS SUPPORT RESOURCES

- DEFICIENCY STANDARDS AND INSPECTION METHODS MANUALS SERVE AS THE FOUNDATION OF CAS.



INTRODUCTION

HOW IS CAS IMPLEMENTED? • CAS Support Resources

We have spoken generally of the CAS Process and those resources (manuals, hardware, CAIS software) required to implement the system Additionally, the CAS contractor will supply all of the technical personnel to support, implement, and guide the CAS Program Among those key professionals are

CAS Training Instructors:

Professionals with a technical background and well-versed in training methods, will train CAS inspector candidates. Their mission will be to Instruct and guide CAS inspector candidates through the entire process supervise field exercises, and provide final testing. Their goal is that all candidates will be successful participants in the CAS Inspection process.

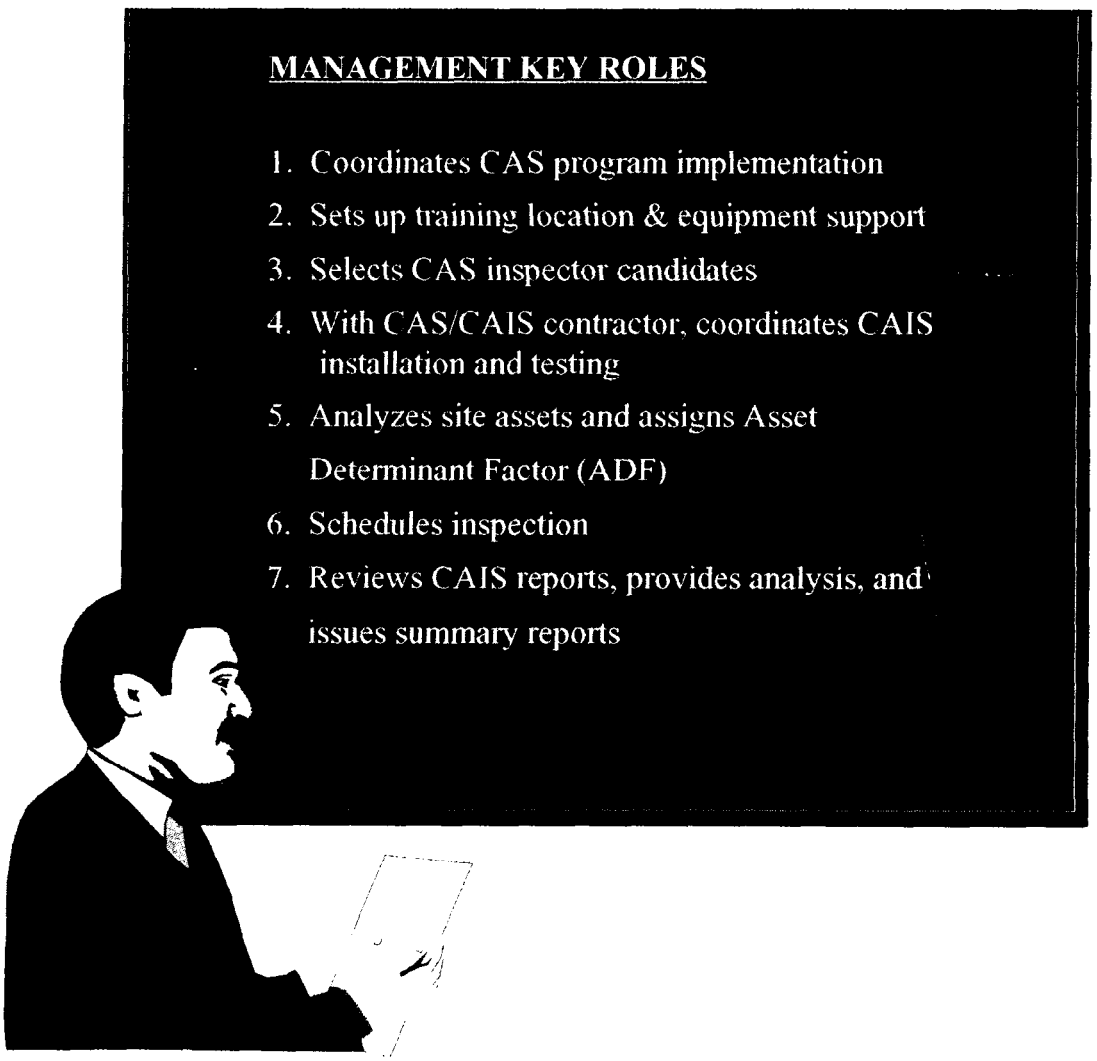
CAIS Programmers:

A key CAS Program element is the CAIS. Expert programmers will supervise the installation of the PC-based program and provide guidance and instruction for DOE M&O managers in using the system.

CAS/CAIS Hotline:

The Contractor will provide support resources in order to field questions from various site locations. Expert engineers, architects, and computer programmers will answer with written and/or verbal responses all inquiries originating from the field.

HOW IS CAS IMPLEMENTED?



INTRODUCTION

HOW IS CAS IMPLEMENTED? ▪ The Management Role

The critical role DOE M&O managers will piay in the CAS process cannot be overstated Their understanding and direct input wilt guide the construction of the CAS Program Their ci ief responsibilities are:

Initial Implementation:

CAS start-up will include a general briefing by the CAS contractor at designated sites to instruct all key managers in the process and their responsibilities. DOE M&O management actions include training site set-up (to hold maximum of 25 students), arrangements for required A/V equipment (overheads slide projectors, etc.), and CAS inspector candidate selection (see Guidelines for Implementation of CAS Certification Training under separate cover).

Setting Up CAIS:

In conjunction with CAIS programmers, DOE M&O managers will be instructed in the function and various uses of CAIS software. Data input, system operation, report generation with predetermined report format, and how data can be manipulated to customize reports, will be examined during this training.

ADF Selection 8 CAS Schedule:

A vital element of the CAS Program is the development of a CAS "strategy." DOE M&O managers wiil be instructed in the use of the Asset Determinant Factor (ADF) to sort site assets into varied inspection effort levels. See Section 1, Subsection 1.1 Asset Determinant Factor (ADF), CAS Repair Codes, and CAS Cost Factors. The ADF will guide the DOE M&O managers in scheduling the survey and assigning CAS Inspectors to various assets.

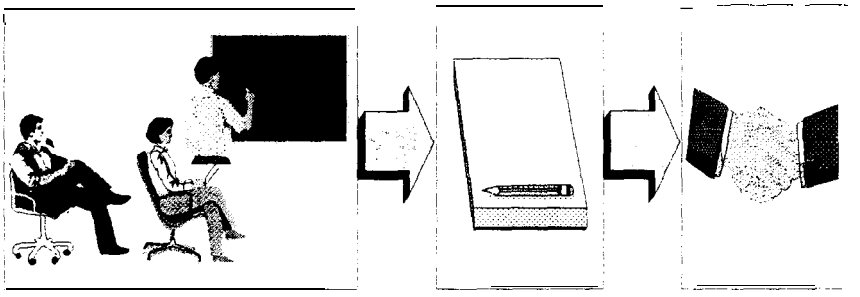
Report Analysis:

The process of up-loading CAS field data to the PC-based CAIS program will be demonstrated to the M&O CAS managers. Analysis processes will be examined using predetermined, formatted reports. Final management project "sorts" and prioritization schemes, and construction of summary reports for higher authorities, will comprise the basic CAS report development sequence.

HOW IS CAS IMPLEMENTED?

CAS INSPECTOR CERTIFICATION

- INSPECTOR CANDIDATES ARE TRAINED, TESTED, AND CERTIFIED USING THE CAS PROGRAM



CLASSROOM TRAINING

TESTING

CERTIFICATION

INTRODUCTION

HOW IS CAS IMPLEMENTED? CAS **Inspector** Certification

While the CAS manuals, hand-held computer, and CAIS software program are the tools of the CAS system the CAS Inspector is the system "operator ." The old adage, "The data output is only as good as the data Input," truly applies to the Inspectors' role in the CAS process. As part of the effort to assure accurate, consistent results, the CAS Program includes an Inspector training phase that will "certify' all candidates in the use of the CAS system It should be noted that it is not the training course's intent to train personnel to be Inspectors: it is assumed that candidates will come to the CAS Program with a strong background and past experience in the disciplines they will Inspect (see Guidelines for Implementation of CAS Certification Training (GICT) under sepatate covet for detailed information) Key phases of the course include.

Prequalification:

Based on experience levels set by GICT, candidates are selected by the M&O contractors and sent to the CAS training program.

Classroom Training:

Classroom instruction will be conducted at the sites selected by DOE. Course materials, based on the Deficiency Standards and Inspection Methods sections in the manuals, will clearly demonstrate the nature of the CAS system and how it is to be used. Hand-held computers will be used during the course. At course conclusion, these units will be turned over to the inspectors for use in the CAS Program and become the property of the site that the inspectors represent.

Field Exercise:

During the training course, a field exercise using the hand-held will be conducted at a predetermined test asset. This survey and its results will be an integral part of the inspection education program.

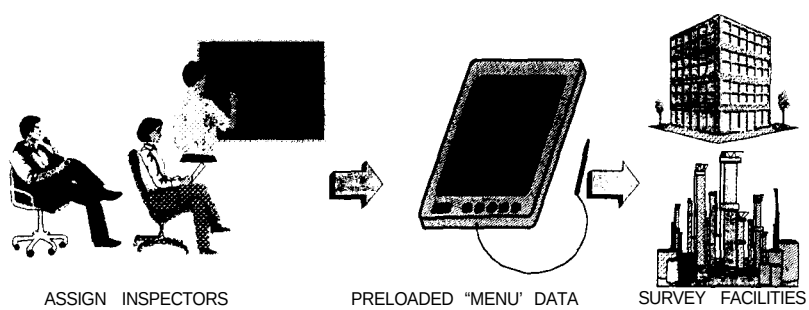
Certification Test:

At the completion of the CAS training, each candidate is required to take and pass a written examination based on the material covered in the class. It is the goal of the training team to pass 100% of the candidates. Those having difficulty will receive additional instructor attention during the class as required. After passing this examination, candidates will be fully certified CAS Inspectors.

HOW IS CAS IMPLEMENTED?

THE SURVEY PROCESS

- CERTIFIED CAS INSPECTORS FOR EACH MAJOR DISCIPLINE ARE ASSIGNED FACILITY ASSETS TO INSPECT
- PRE-LOADED SURVEY ROUTINES FOR EACH SYSTEM ARE PROVIDED THROUGH HAND-HELD COMPUTER CAS SOFTWARE PROGRAM



ASSIGN INSPECTORS PRELOADED "MENU" DATA SURVEY FACILITIES

INTRODUCTION

HOW IS CAS IMPLEMENTED? • The Survey Process

At the completion of CAS training and upon the M&O managers' ADF asset selection and development of survey schedules, certified CAS inspectors will be assigned assets to inspect. This step initiates the CAS process, which will involve several major phases.

start-up:

The objective during start-up is to prepare a profile information file for the asset being surveyed and to verify preloaded Information (RPIS data, name, and address, etc.). Such a review might include part and/or all of the material listed below:

- As-built and/or construction documents
- Square footage, type of construction, and age of each building
- Existing studies, surveys, and reports; and
- Existing repair, alteration, or construction projects

Conduct CAS Inspection/Evaluation:

With the benefit of the information contained in the asset file, the CAS Inspector will perform a thorough evaluation of the WBS systems required for each of the assigned assets. The Inspector will initially review the asset file to note particular problems. With this accomplished, the CAS Inspector will methodically survey each of his assets and record deficiencies (in terms of severity and coverage) and other observations on the preprogrammed hand-held computer. He accomplishes this data recording through "menu" screens contained in the CAS hand-held computer software, which will guide the CAS Inspector through the process (see Section 3 for full detailed information outlining step-by-step the CAS inspection process).

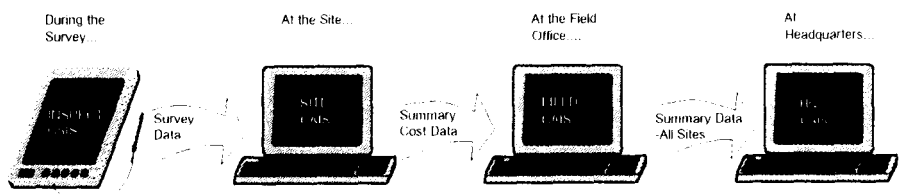
CAS Report Generated by **CAIS:**

After completing the CAS Inspection, information is uploaded to the PC-based CAIS system. "Universal" reports showing all asset deficiencies, observations, associated cost, scheduling priorities, and repair purposes will be produced. As part of the QA, the Inspector will review this information with the manager to ensure that all aspects of the inspection asset information are correct.

HOW IS CAS IMPLEMENTED?

SUMMARY REPORTS

- IMPROVE ACCURACY AND PROVIDE QA FOR ALL SITE INSPECTION DATA
- FINAL REVIEW OF PRELIMINARY REPORTS BY THE MANAGERS TO "PKIOKITIZE" REPAIR/REPLACEMENT REQUIREMENTS FROM ASSET TO ASSET
- ISSUE SUMMARY RESULTS WITH FULL HACK-IJP AT SITE



INTRODUCTION

HOW IS CAS IMPLEMENTED? ▪ Report Development

With the completion of the CAS Inspector's survey, data uploaded into the PC-based CAIS programs analyzed to provide the survey reports. The primary prefotmatted reports include

"Universal" Report:

This document contains all the information recorded concerning deficiencies found in the WBS systems surveyed in each asset. The report lists all deficiencies and observations system by system The summary section provides the cost of repairing surveyed asset deficiencies and repair codes showing condition, purpose, and urgency. Costs are calculated in CAIS based on deficiencies noted Inspectors can also directly input repair costs either as a percentage of replacement costs or as an absolute dollar value.

Asset Summary Report:

This report contains summary asset deficiency data at the WBS system level only. The report lists deficiency/corrective repair action by codes (see Subsection 1 .1 for more information). All assets surveyed by the Inspector will be listed here. Manager input to these reports includes resorting the priority list (including additions and/or deletions) and recommendations.

Site Asset Summary Report:

After all inspector surveys have been processed, analyzed, and final recommendations input by the manager, this preliminary site-wide report lists all assets included and preliminary manager sorts (Asset Summary Report). Manager input includes selecting of final projects recommended for the budget cycle, including cost and priority schedules.

Site Summary Report:

This report, issued to DOE Headquarters, contains a site project summary and synopsis of back-up data. This report will serve as the basis for establishing the site maintenance and repair backlog which in turn supports funding recommendations to OMB and Congress.

OTHER REPORTS

QA Report:

As part of the QA process, the contractor QA team will randomly select assets inspected by site CAS Inspectors. Results will be analyzed to determine both accuracy and content of the CAS Program to ensure the validity of CAS procedures.

Custom Reports:

Data within the CAS/CAIS database can be manipulated to create various reports. Examples might include a report showing all site roofs, cost magnitude, and/or by building type.

CAS SUMMARY

- STANDARD APPROACH TO CONDITION ASSESSMENT
- EASE/ACCURACY OF DATA COLLECTION
- SITE-CONTROLLED DATABASE
- SUMMARY DATA TO FIELD OPERATIONS & HQ LEVELS
- MORE CREDIBLE DOE BUDGET SUBMISSIONS

INTRODUCTION

THE CAS SYSTEM: • A Summarv

In summary, the CAS System has been designed to support the vital process of cleating a facility condition baseline that is founded on recognized, fully defined Standards. This established baseline will determine the direction and cost of future assets required to define the DOE's changing mission against a background of government fiscal constraint. As you have seen, your role in this overall program is vital if the CAS framework is to be created and supported. The CAS System is your tool for constructing the essential, realistic requirements needed to obtain budgetary funding. Obtaining these funds is the final measure of whether a site program will move forward or be eliminated

We began this introduction by promising you a "new way" of seeing familiar things. The CAS Program's combination of state-of-the-art technology and the DOE M&O's talented professionals will be the essential mix to successfully initiate and sustain the CAS process.

ASSET DETERMINANT FACTOR/CAS REPAIR CODES/CAS COST FACTORS

GENERAL

The CAS Program is built on the physical analysis of each asset through the inspection of the major systems as defined by the WBS. System-specific deficiencies (as defined for each assembly/component in the Deficiency Standards section of this Manual) and the extent of their severity "bracket" the general asset conditions as of the inspection date. Recording actual deficiencies, however, is only part of the process. The CAS process also documents the urgency and purpose of repairs or replacements as well as the overall condition of the assembly/component surveyed.

The following elements are important parts of the CAS process and will be discussed in detail in this subsection:

- ASSET DETERMINANT FACTOR (ADF): Discusses various possible levels of CAS inspections, and the manager's role in determining the type survey appropriate for each asset.
- CAS REPAIR CODES: Describes categories used by the inspector to document the urgency and purpose of repairs and replacements, and the general condition of the assembly/-component
- CAS COST FACTORS: The general overview of CAS cost development and the factors used to build project costs are outlined in this section.

CAIS Interface:

As outlined in the Introduction "A CAS Program Overview," the Condition Assessment Information System (CAIS) is a key element. CAIS software will provide critical data analyses required to process CAS raw field data, including repair codes and costing factors for recorded facility asset conditions. The CAS Manuals, the hand-held data collection device and software, and the CAIS Program together form the foundation of the CAS process.

In DOE's vast inventory, asset conditions vary widely in terms of age and use, new or renovated facilities are mixed with assets built during the 1940s and 1950s. It is therefore recognized that not all assets at a given site require the full CAS inspection. The ADF has been developed as a tool that provides site facility managers with a means to categorize each site asset by identifying the type of survey to conduct.

CAS Survey Levels:

For the purposes of allowing flexible CAS Program implementation, three broad categories of asset inspections are defined:

- CAS - Base Level: Assessment is primarily a visual inspection (augmented in some instances by simple testing; eg., light level measured by light meter) recorded at the assembly level of the Work Breakdown Structure (WBS). Deficiencies typical to each assembly are recorded in terms of severity and coverage.
- CAS - Component Level: Provides more extensive inspection information based on conducting the assessment at a component level. Components are defined as major parts of an assembly.
- CAS - Limited: Survey not requiring assessments of all systems for a given asset.

ASSET DETERMINANT **FACTOR/CAS** REPAIR CODES/CAS COST FACTORS

ASSET DETERMINANT FACTOR (ADF)

Ten key categories to be used as ADF guidelines are illustrated below. These classifications are sensitive to key DOE criteria, including short-term and mothballed facilities

ADF#	Guidance	Description	Systems
1	Existing asset (>3 years), program projected to last 5 years	Full CAS Inspection (base CAS - assembly level or optional component level)[1]	ALL
2	Existing temporary asset (>3 years) program projected to last <5 vears	Limited CAS Inspection (base CAS - assembly level only)	ALL
3	Asset decommissioned - "warm mothball" (maintained for future unidentified function)	ARCH(ext), MECH & ELEC (base CAS - assembly level or optional component level)[1]	0.04, 0.05, 0.08, 0.09
4	Asset decommissioned - "cold mothball" (to be removed, dismantled, destroyed at some future date)	Exterior envelope (base CAS - assembly level only)	0.04, 0.05
5	Asset ROOF inspection only	ROOF inspection (base CAS - assembly level or optional component level)[1]	0.05
6	Asset ARCHITECTURAL only	ARCH/STRUCTURAL inspection (base CAS - assembly level or optional component level)'	0.01, 0.02, 0.03, 0.04, 0.05, 0.06, and 0.11
7	Asset MECHANICAL only	MECHANICAL inspection (base CAS - assembly level or optional component level including incidental electrical)'	0.07, 0.08
8	4sset ELECTRICAL only	ELECTRICAL inspection (base CAS - assembly level or optional component level)'	0.09
9	Asset SITE inspection only	SITE inspection (base CAS - assembly or optional component evel)[1]	0.12
10	4s developed by each site	4s constructed by site2	As Required

GENERAL NOTES

1 Surveymaycombine levels (eg ADF #1 Systems 0 01-0.06, 0.11, and 0 12 Assembly level survey; 0 07, 0 08, and 0 09 Component level survey)

2 Other surveys may be structured on an as-required by sites

3 ADF values are guidelines only and systems may be added to base ADF values as required.

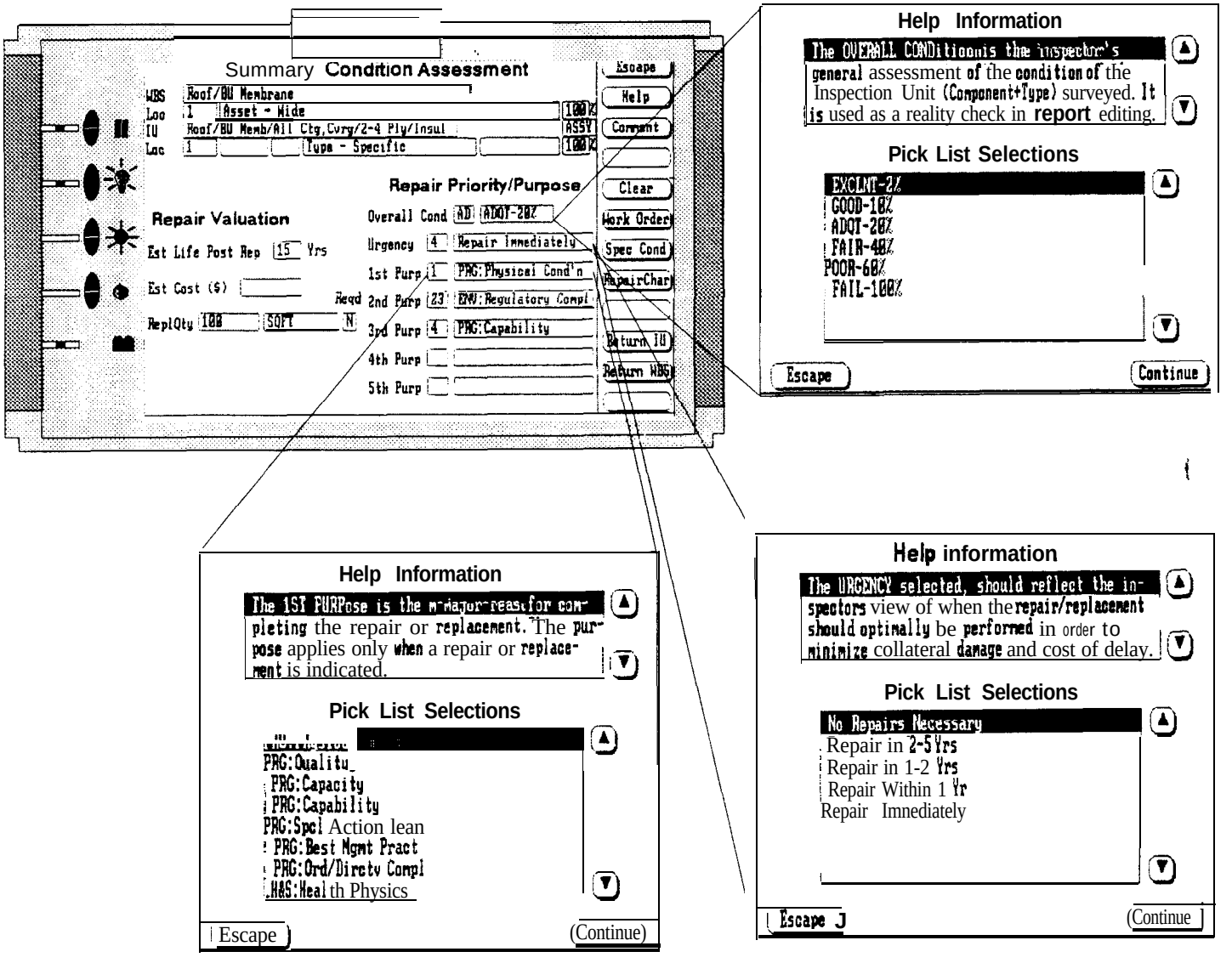
ASSET DETERMINANT **FACTOR/CAS** REPAIR CODES/CAS COST FACTORS

ASSET DETERMINANT FACTOR (ADF) (Continued)

ADF #	Definition
1	Assets within this factor represent "typical" DOE facility assets. These assets are over three years old and serve current programs projected to last over five years. A full CAS inspection at the assembly level is required. Component level CAS may be conducted as resources permit.
2	For temporary facilities supporting short-term programs (less than five years), a limited CAS inspection at assembly level involving all systems.
3	For currently unused assets that will be considered for future program development. In this case, only exterior envelope and interior mechanical and electrical systems are assessed at the assembly level.
4	For facilities deemed unfit for future use, a limited CAS inspection is recommended. This would involve exterior envelope only to ensure that asset will not deteriorate prior to scheduled decommission and disposal action (eg., destroy, dismantle).
5	Covers circumstances when only a roof inspection is required.
6	For assets requiring architectural survey only, including 0.01 Foundations and Footings, 0.02 Substructure, 0.03 Superstructure, 0.04 Exterior Closure, 0.05 Roofing, and 0.06 Interior Finishes and Construction, and 0.11 Specialty Systems.
7	For assets requiring mechanical survey only, including 0.07 Conveying, and 0.08 Mechanical.
8	For assets requiring electrical survey only, 0.09 Electrical.
9	General site survey system 0.12 Site Systems only.
10	This factor allows sites to build their own inspection. These will be reviewed by Headquarters for possible addition to the ADF Guidelines.

ASSET DETERMINANT **FACTOR/CAS** REPAIR **CODES/CAS** COST FACTORS

CAS REPAIR CODES



Refer to the following page for definitions of the three (3) major **CAS** Repair Codes.

ASSET DETERMINANT FACTOR/CAS REPAIR CODES/CAS COST FACTORS

CAS REPAIR CODES

One of the key aspects of the assessment process, once significant deficiencies are recorded, is determining the repair category. CAS defines three major repair codes: condition, purpose, and urgency. Condition is derived both by the CAIS algorithm based on raw deficiency data and by the inspector's subjective judgment. Purpose and urgency are each selected by the inspector. Definitions for each major code are listed as follows:

(CAS Repair Codes are guidelines only. Codes may vary as required by sites.)

CONDITION CODE	DEFINITION
A	Excellent: Performs to original specifications as measured using non-standard tests; easily restorable to "like new" condition; only minimal routine maintenance required at cost <2% of reolacement value.
B	Good: Performs to original specifications as measured using historical data and non-standard tests; routine maintenance or minor repair required at cost <5% of replacement value.
C	Adequate: Performance meets requirements; some corrective repair and/or preventive maintenance required at cost <10% of replacement value.
D	**Fair:** Performance fails to meet code or functional requirement in some cases; failure(s) are inconvenient; extensive corrective maintenance and repair required at cost <25% of reolacement value.
E	Poor: Consistent substandard performance; failures are disruptive and costly; fails most code and functional requirements; requires constant attention, renovation, or replacement. Major corrective repair or overhaul required at cost <60% of replacement value.
F	Fail: Non-operational or significantly substandard performance. Replacement required because repair cost is >60% of replacement cost.

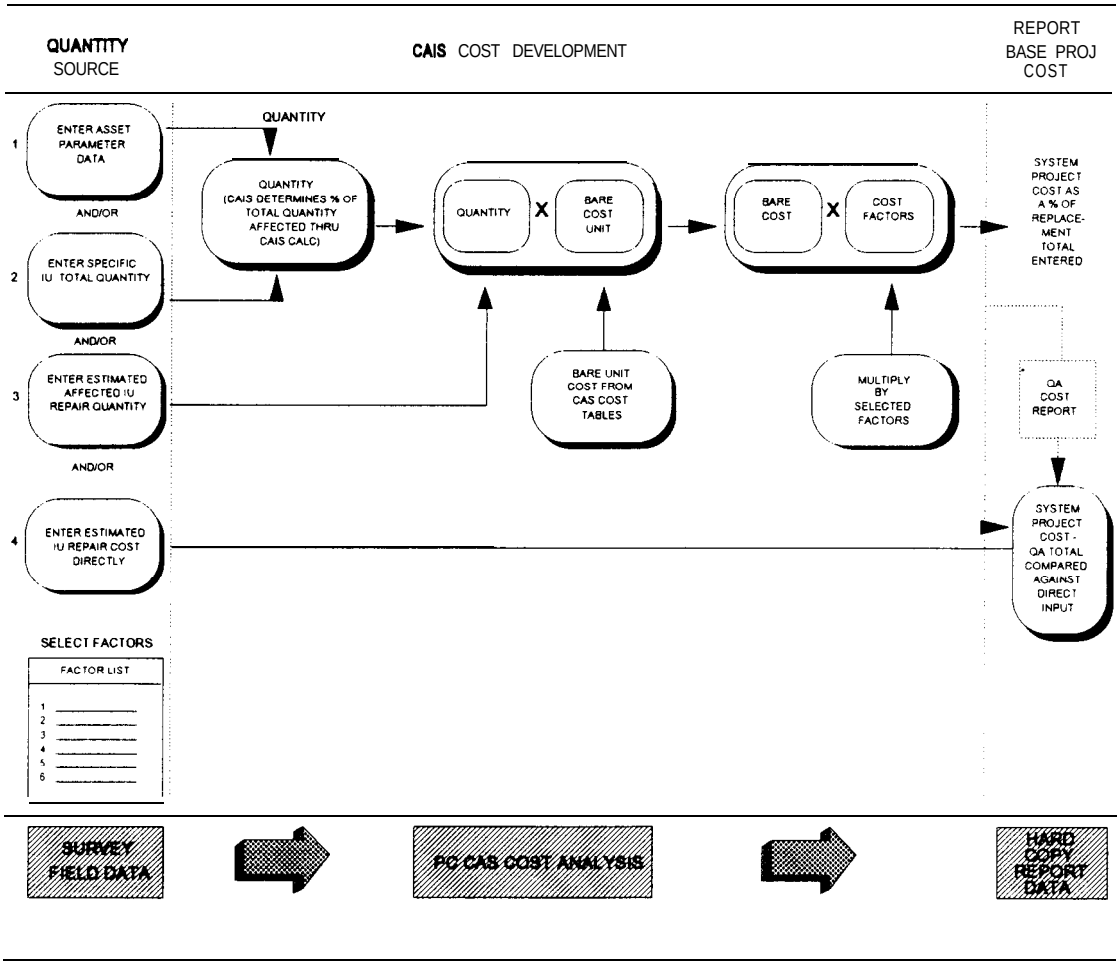
PURPOSE CODE*	DEFINITION
P2	PRG: Capacity
H2	H&S: industrial Safety
E2	ENV: Solid Waste Management
S4	S&S: Security
•	Partial list based on CAMP Order DOE 4330.4A dated 1 O-l 7-90.

URGENCY CODE	DEFINITION
1	Repair Immediately: Asset condition critical; initiate corrective action immediately.
2	Repair within 1 Year: Asset condition serious; initiate corrective action within 1 year.
3	Reoair in 1 to 2 Years: Asset condition dearaded: initiate reoair in 1- 2 vears.
4	Repair in 3 to 5 Years: Asset stable for period; integrate repairs into appropriate schedules.
5	No Repairs Necessary: Continue life cycle maintenance actions.

ASSET DETERMINANT **FACTOR/CAS** REPAIR CODES/CAS COST FACTORS

The following illustrates the cost development process for the Department of Energy CAS/CAIS Project and the various processes involved.

COST DEVELOPMENT PROCESS



END OF SUBSECTION

GUIDE SHEET TOOL & MATERIAL LISTING

SAFETY REQUIREMENTS

Inspections shall comply with all Federal, State, and Local regulations and all applicable safety and health regulations or requirements (including reporting requirements) of DOE.

TOOLS

This subsection contains tool and material listings for use in standard and non-standard inspections for 0.04 Exterior Closure in addition to the Basic Tool Group outlined below.

Accomplishing the activities identified in the inspection guides requires tools: basic, craft (standard), and specialized (non-standard). Specialized tools included in the non-standard tool group consist of special instruments as well as unique tools identified in the guides.

All crafts involved in inspecting Exterior Closure assemblies and components should employ a standard or basic tool set. This basic tool set may vary somewhat between equally qualified personnel; however, the following is a representative set of common basic tools.

BASIC TOOL GROUP

- Flashlight
- Measuring Tape
- Mirror
- Pocket Knife
- Rags

STANDARD TOOL GROUP

- 12' measuring tape
- 3/8" drive socket set and ratchet
- 3x5 card stock for indicating photograph locations
- Aerosol can of bright colored paint for marking deficiency locations
- Assorted center punches, drift punches, steel chisel
- Ball peen hammer
- Camera
- Claw hammer
- Crescent wrenches 4" and 8"
- Emery cloth
- Extension cords and inspection lights
- File
- Grease guns and oilers
- Hack saw and spare blades
- Level - 4 foot
- Metal square
- Open and box end wrenches 1/4" and 3/8"
- Permanent black marker
- Pipe wrenches to 14"
- Pliers - vise grip (2), slip joint, needle-nose, diagonal, cutting pliers, side cutters
- Pocket knife
- Small crowbar
- Small set of Allen wrenches
- Standard and phillips head screwdrivers - various sizes
- Stiff bristle brush
- Torpedo level
- Various cleaning tools - brushes, scrapers, etc.
- Wire brush

NON-STANDARD TOOL GROUP

- Acoustical emission analyzer
- Borescope or fiberscope
- Core driller
- Eddy current (electrical resistance) measuring device
- Infrared measuring device
- Magnetic scanning device
- Microwave absorption scanning device
- Moisture detection devices
- Nuclear analysis mechanism
- Ultrasonic measuring device
- Video camera
- X-Ray or radiography testing device

GUIDE SHEET TOOL & MATERIAL LISTING

TOOLS (Continued)

The basic tool set may be augmented to accomplish inspection actions on a specific assembly or component. The Guide Sheets identify this augmentation. Also, test methods for Exterior Closure system are defined in subsection 1.3.

END OF SUBSECTION

as required by sites.)

(CAS Repair Codes are guidelines only. Codes may vary a

CONDITION CODE	DEFINITION
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TESTING METHODS

GENERAL

During the course of the Condition Assessment Survey, various tests will be employed to better ascertain the condition of the assets. These are indicated on the Component Specific Guide Sheets included in Section 3 of this Manual. Testing will not be required on all assets. Where indicated, results of testing will be recorded in the Data Collection Method.

The critical nature of concrete, masonry, metal, or wood and its overall condition cannot be understated. Concrete, masonry, metal, or wood compressive strength is vital to maintain structural integrity. Where direct characteristics can be observed, surface deficiencies such as cracks, spalling, and exposed reinforcing may indicate hidden problems. In this case, underlying deterioration can be determined by further test measures. Testing materials in-situ seeks to gauge current conditions including position and size of any reinforcement, poor consolidation areas, voids, cracks, honey-combing, material integrity, degree of rot or decomposition, and moisture content to quantify current strength, durability, and elastic parameters as they exist in view of observed physical deficiencies.

Testing methods do not specify the following:

- Expertise of user (to use the instrument or interpret results).
- The advantage of one testing method versus another.
- The limitations of the testing method.
- Whether the user must be trained and licensed to operate (such as the Nuclear Moisture Meter Test, which requires licensing).

Variability

Estimating in-situ concrete strength by the following test methods may provide site readings that vary from lab test calibrations between 2 to 10%. Pulse velocity tests are the most accurate with a site and lab calibration difference of approximately 2%. Other methods will generally range from 6 to 10% between site and lab conditions.

Standard vs Non-Standard

Inspection Methods are classified as Standard versus Non-Standard based on techniques employed.

Standard Methods are generally quick, visual, hands-off walk-throughs not requiring a component to be taken out of service. Few tests are required in the associated Guide Sheets. Where tests are indicated, they are non-invasive. An example is Stress Monitor Analysis.

Non-Standard Methods are generally those that require specialized equipment and analysis as well as destructive testing. Examples include Infrared, Nuclear Analysis, Core Sampling, Ultrasonic Pulse Velocity Testing, Surface Hardness Testing, etc.

Some of the tests could be conducted as part of either type inspection. For discussion purposes, they will be classified according to their specialized equipment and analysis; i.e., if a test can be conducted without specialized services, it will be listed under Standard Test Methods.

TESTING METHODS

STANDARD TEST METHODS

- Stress Monitor Analysis

STANDARD TEST DESCRIPTION

Stress Monitor Analysis

Stress analysis consists of documenting the location, pattern, depth and width, presence of foreign materials, and elevation differences between two cracked concrete or masonry masses and other horizontal or vertical surfaces. Determine if crack is active or dormant by following the steps:

- Mark the end of the crack and check after a few days to see if crack has extended past the mark. Note direction.
- Place a notched piece of tape across the crack. Wait for a period of a month of more. If tape tears or compresses (wrinkles) the crack is active, and if the tape shows no apparent change the is dormant.
- Apply pins and gauge points on either side of crack. Measure distance between points at regular intervals with vernier calipers to determine the extent of movement.

NON-STANDARD TEST METHODS

- Acoustic Emission Testing
- Borescope or Fiberscope
- Core Sampling
- Electrical Resistivity Testing
- Flood Testing
- Infrared Testing
- Magnetic Testing
- Maturity Concept Analysis
- Microwave Absorption Scanning
- Nuclear Analysis
- Pick Test
- Radiography (X-Ray Testing)
- Surface Hardness Testing
- Ultrasonic Pulse Velocity Testing

NON-STANDARD TEST **DESCRIPTION**

Acoustic Emission Testing

Acoustic Emission testing measures the acoustic or stress emissions from cracks or surfaces under strain. The stresses are detected as small displacements by sensors positioned on the surface. This type of testing has been used in recent years; however, its major drawback is that it can only be used during periods of high stress and deformations and does not work for static loading conditions.

Core Sampling

Core sampling involves taking core samples at various controlled sections to ascertain the condition or strength of the material by laboratory mechanical/chemical analysis. Sample holes must be patched immediately.

Borescope or Fiberscope

This method involves instruments to view into materials, primarily masonry, to visually locate deficiencies such as cracks, spalls, or material deterioration. These instruments involve drilling or creating holes in the sample material, which must be patched when complete.

Source: School and College • "A Systematic Approach to Roofing." October 1989, Mary E. **Skelly,** Author.

TESTING METHODS

NON-STANDARD TEST DESCRIPTION (Continued)

Electrical Resistivity Testing

Electrical Resistivity testing involves passing electrical currents through the material to determine the resistance offered. This test is used to determine reinforcement corrosion and thickness of concrete pavements. This method may also determine the moisture content or penetration of concrete surfaces and degree of decay in wood members. Even though this is a relatively simple test method, it is highly dependent on moisture and salt content and material temperature.

Flood Testing

Flood testing involves forcing water under pressure at an exterior surface to locate any cracks or penetrations by observing any water leaks on the interior.

Infrared Testing

Infrared testing measures heat loss or gain. The areas of the superstructure that absorb water will not insulate. Heat is lost more rapidly through these water absorbing areas, and higher temperatures are detected with an infrared scanner. Cracks, voids, and other discontinuities in the surface all affect heat emissions: scanners can show the difference between sound and unsound surfaces. Infrared is done by scanning the surface with a hand-held instrument. This method requires further research and development.

Magnetic Testing

Magnetic testing involves scanning concrete surfaces with a U-shaped magnetic core with two coils. An alternating current is passed through one coil, and the current is measured in the second. This test is used to measure the depth and detect position of reinforcement in concrete. It should be noted, however, that temperatures below freezing and heavily reinforced sections adversely affect performance and results.

Maturity Concept Analysis

The maturity concept used in measuring in-situ concrete is based on the fact that concrete strength varies as a function of both time and temperature. These conditions are measured by thermocouples and/or instruments.

Microwave Absorption Scanning

Microwaves are electromagnetic in nature and can be reflected, diffracted, and absorbed. Wave absorption by water determines moisture content of the material. This is relatively new and unproven, while the technique based on the reflection of electromagnetic waves has been used successfully. Although this method is fast and easy to perform, planning and skill are required to interpret and evaluate the results.

Nuclear Analysis

Nuclear analysis is accomplished using a mechanism that scatters neutrons on the surface being tested. Where water is present, radiation or neutron energy is taken back into the unit, The surface is squared off in a grid pattern and readings are taken from various points. Another method (relatively new and underdeveloped) involves bombarding the concrete surface with neutrons, which causes the surface materials to become radioactive. A comparative analysis is performed as the radioisotopes decay to a stable state.

Source: School and College - "A Systematic Approach to Rooting." October 1989, Mary E. **Skelly,** Author.

TESTING METHODS

NON-STANDARD TEST DESCRIPTION (Continued)

Pick Test

Pick testing consists of inserting any pointed tool into the surface of wood to lift a sliver. A sharp break indicates it is sound wood, and a brash break suggests decay. A similar test is striking the wood surface with a hammer. A sharp ring usually indicates sound wood, and a dull or hollow sound indicates decay or rot. This is not a very reliable test; additional testing should be performed if decay is suspected.

Radiography (X-Ray) Testing

Radiography testing involves passing radiation in the form of X-rays through an object to expose photographic film on the opposite side to detect cracking, voids or position of reinforcing. This test is seldom used for these building systems due to the cost and dangerous equipment required. Testing with gamma rays, on the other hand, is relatively portable and easier to use. The only limiting factors appear to be high cost and safety concerns.

Surface Hardness Testing

This test consists of impacting the concrete or masonry surface using standard instruments with a given energy pulse to measure the size of rebound. A rebound hammer is most commonly used. Problems and limitations are affected by concrete surface smoothness, carbonation, and moisture condition as well as size, age, and aggregate type.

Ultrasonic Pulse Velocity Testing

Ultrasonic testing is done by passing ultra-high frequency sound waves through a material. An oscilloscope, chart recorder, or computer printout then records or displays the sound waves converted into electrical signals deflected off the rear surfaces or any defects within the material.

The basic concept consists of generating an ultrasonic wave through the concrete, masonry, or wood and measuring the travel time. This technique is excellent for establishing existing concrete, masonry, or wood uniformity and strength. It should be noted, however, that concrete conditions such as age, moisture, aggregate to cement ratio, aggregate type, and steel reinforcement placement location may adversely influence test results.

Source: School and College ▪ "A Systematic Approach to Roofing." October 1999, Mary E. **Skolly,** Author.

END OF SUBSECTION

INSPECTION FREQUENCY

CAS INSPECTION SCHEDULE

The following constitutes recommended inspection frequencies for the listed assemblies and components. The purpose of these inspections is to support the CAS and are not necessarily for maintenance purposes. Each site has the option of varying the inspection frequencies to meet individual site requirements.

The recommended base CAS inspection frequencies are listed below in Table One for the system described in this manual. The base CAS constitutes standard inspections only and use the standard Guide Sheets as a reference. All Non-Standard inspections are optional for Exterior Closure system assemblies and components.

TABLE ONE

Assembly/Component	Year One	Year Two	Year Three	Year Five
Walls				
Concrete			S	
Masonry - CMU		S		
Masonry Brick	S			
Masonry Stone		S		
Masonry Composite		S		
Masonry Cavity		S		
Glass Block		S		
Siding				
Metal		S		
Wood		S		
Exterior Insulation & Finish Wall System		S		
Doors				
Wood	S			
Steel	S			
Overhead	S			
Specialty Metal	S			
Vertical Lift	S			
Glass	S			
Aluminum & Glass/Storefront	S			
Sliding	S			
Rolling/Specialty	S			
Windows & Glazed Walls				
Windows	S			
Wood	S			
Steel	S			
Aluminum	S			
Custom	S			
Glazed Curtain Walls	S			

S - STANDARD INSPECTIONS — NS - NON-STANDARD INSPECTIONS

INSPECTION FREQUENCY

TABLE ONE

Assembly/Component	Year One	Year Two	Year Three	Year Five
Paint Finishes/Coatings				
Latex			S	
Enamel			S	
Alkyds			S	
Oil				S
Vinyl/Chlorinated Rubber Coatings				S
Bituminous Coatings				S
Chemically Cured Coatings				S
Zinc Rich Coatings				S
Urethane Coatings				S
Ceramic-Like Coatings				S
Varnish/Polyurethane/Stains			S	

S - STANDARD INSPECTIONS — NS - NON-STANDARD INSPECTIONS

END OF SUBSECTION

NOTES 1 Severe weather or facility operational conditions may require additional inspections
2 Non-Standard inspections will be provided on an as-reaulred basis unless noted otherwise.

STANDARD SYSTEM DESIGN LIFE TABLES

GENERAL

The Standard (nominal) Design Life of a given System Assembly/Component is defined as the projected service design life measured from the date of installation to the date of replacement. These time periods are based on manufacturers' product specifications and tests that determine the average "outside" time parameter a given System Assembly/Component will last. The Standard Design Life Tables that follow list design life and replacement cost parameters for WBS. TABLE ONE below illustrates key column headings.

TABLE ONE

ITEM DESCRIPTION	Replacement Life, Years*	Percent Replaced
Note 1:	Used to document the replacement life* of significant WBS System Assembly/Components.	
Note 2:		Used to estimate percent of WBS System Assembly/Component cost replaced at the year specified (measured from installation date to end date specified by the replacement life period*).

*Note. The term Replacement Life is synonymous with Design Life.

STANDARD SYSTEM DESIGN LIFE TABLES

TABLE TWO

ITEM DESCRIPTION	Replacement Life, Years	Percent Replaced
0.04 EXTERIOR CLOSURE		
Masonry veneer: 4" brick and 4" block, insulation and vapor barrier	75	100
Precast concrete veneer insulation and vapor barrier	75	100
Stucco on metal studs: insulation and vapor barrier	35	100
Stone veneer, block backup insulation, and vapor barrier	75	100
Aluminum panel: insulation and vapor barrier	50	100
Metal panel: insulation and vapor barrier	40	100
Cast-in-place 8" concrete wall: insulation and vapor barrier	Life	100
Concrete block (standard) 8" wall insulation and vapor barrier	Life	100
Split-face concrete block 8" wall: insulation and vapor barrier	Life	100
Plywood siding, texture 1-11 with wood studs: insulation and vapor barrier	30	100
Cedar siding, rough-sawn with wood studs: insulation and vapor barrier	40	100
Redwood siding, board, and batten: insulation and vapor barrier	40	100
Screen louvers, galvanized steel	15	100
Screen louvers, copper	25	100
Storm proof louvers, galvanized steel	15	100
Storm proof louvers, copper	25	100
Air grills, galvanized steel	15	100
Glass screen and metal frame	15	25
Preformed metal screen and metal frame	15	25
Fabric screen and metal frame	15	25
Cast-in-place concrete	75	100
Precast concrete	75	100
Brick masonry	75	100
Concrete unit masonry	60	100
Stone	75	100
Wood	30	100
Metal panels	40	100
Glass panels	40	100
Exterior gypsum board including metal hangers	12	100
Cement asbestos including metal hangers	16	100
Metal panels including metal hangers	40	100
Fixed glazing, frame, hardware	40	100
Operable glazing, frame, hardware	35	100
Single glazing, fixed frame, hardware	40	100
Double glazing, fixed frame, hardware	40	100
Reflective single glazing, fixed frame, hardware	40	100
Tinted single glazing, fixed frame, hardware	40	100
Aluminum spandrel panel	50	100

STANDARD SYSTEM DESIGN LIFE TABLES

TABLE TWO

ITEM DESCRIPTION	Replacement Life, Years	Percent Replaced
0.04 EXTERIOR CLOSURE (Continued)		
Stainless steel panel	50	100
Porcelain enamel panel	50	100
Weathering steel panel	50	100
Opaque colored-glass panel	40	100
Ceramic tile facing or panel	50	100
Stone facing or panel	75	100
Hollow metal door, frame, hardware	40	100
Solid-core wood door	40	100
Overhead metal service door, frame, hardware	30	100
Rolling metal service door, frame, hardware	30	100
Telescoping metal service door, frame, hardware	25	100
Revolving door, frame, hardware	25	100
Automatic sliding door, mechanism, frame, hardware (2 horsepower)	15	50
Aluminum panel, framing, insulation	50	100
Hollow metal panel, framing	40	100

STANDARD SYSTEM DESIGN LIFE TABLES

END OF SUBSECTION

SYSTEM WORK BREAKDOWN STRUCTURE

GENERAL

Facilities are composed of various assemblies/components which, in turn, form the primary facility systems. These systems, such as foundations, roofs, heating and cooling units, and electrical distribution, have varying life spans. They require maintenance, repair, and renovation over a period of time and do not all "fail" at the same time. Systems have varying life spans. Their condition may be influenced by the deterioration of other assembly/component parts within the systems.

To consider each facility and their major systems, the CAS Program uses the Work Breakdown Structure (WBS) based on the R.S. Means square foot costing system. This industry accepted standard allows a logical "breakdown" of facilities into their major systems, assemblies, components, etc. The WBS is a heirarchical structure; this concept is illustrated in Figure 1. The development of project costs are then applied within this framework as shown in Figure 2.

The Work Breakdown Structure for this volume follows.

SYSTEM WORK BREAKDOWN STRUCTURE

0.04 SYSTEM • EXTERIOR CLOSURE

0.04.01	WALLS
0.04.01 .01	Concrete
0.04.01.02	Masonry
0.04.01.03	stucco
0.04.02	SIDING
0.04.02.01	Metal
0.04.02.02	Wood & Plastic
0.04.03	EXTERIOR INSULATION & FINISH WALL SYSTEM
0.04.04	DOORS
0.04.05	WINDOWS & GLAZED WALLS
0.04.05.01	Windows
0.04.05.02	Glazed Curtain Walls
0.04.06	PAINT FINISHES/COATINGS
0.04.06.01	Conventional Paints
0.04.06.02	Special Coatings
0.04.06.03	Finishes

SYSTEM WORK BREAKDOWN STRUCTURE

WBS LEVEL TABLE		
0.05	LEVEL 1	0.08
ROOFING	SYSTEM	MECHANICAL
0.05.01	LEVEL 2	0.08.01
BUILT-UP	ASSEMBLY	PLUMBING
0.05.01.01	LEVEL 3	0.08.01.01
MEMBRANE	COMPONENT	DOM. WATER
0.05.01.01.01	LEVEL 4	0.08.01.01.01
3-PLY ASPHALT	SUBCOMPONENT/ TYPE	PIPE
0.05.01.01.01.01	LEVEL5	0.08.01.01.01.01
NOT USED	TYPE	3/4" DIA. COPPER

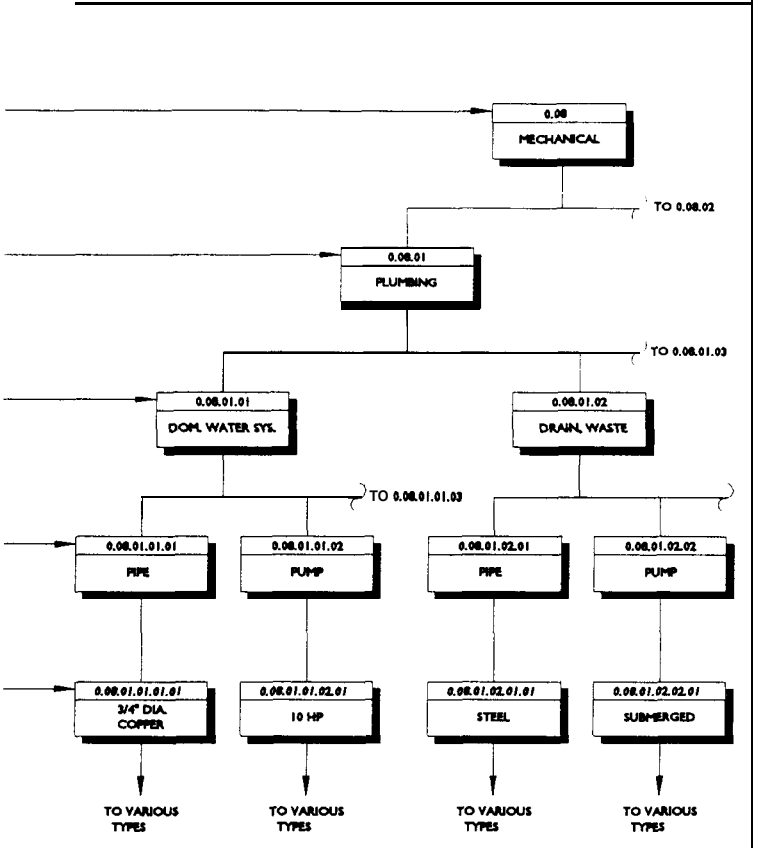

FIG. I

SYSTEM WORK BREAKDOWN STRUCTURE

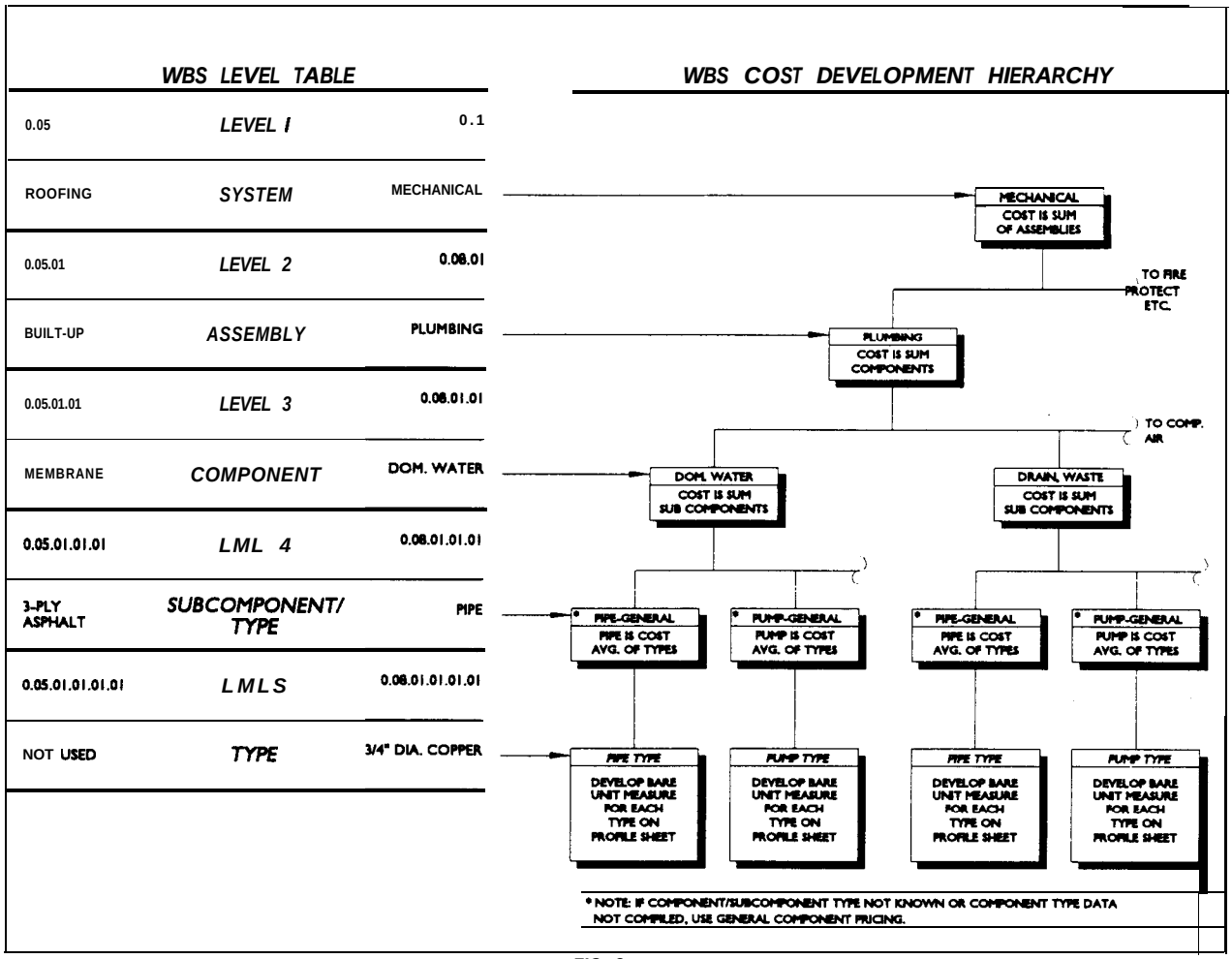

FIG. 2

END OF SUBSECTION

GENERAL SYSTEM/MATERIAL DATA

INTRODUCTION

With the increasing cost of new construction and equipment, it is becoming more of a necessity to ensure that existing buildings and systems are maintained at regular intervals and repairs are made to last over the long term. This section is composed of several tables consisting of Concrete Deterioration, Deterioration of Structural Steel, Imperfections in Wood, Causes of Timber Deterioration, Preservations, Effects of Chemicals on Concrete, and Common Paint Finish/Coating Irregularities.

The purpose of this section is to give a general description of damages, diagnosis, and causes of deterioration of building materials such as concrete, structural steel, wood, and paint finishes/coatings. This is oriented toward locating defects and potential material failure problems prior to major damage or complete failure of system/components. Recognizing Exterior Closure defects and their effects on the building and its occupants and contents are stressed. Special attention should be given to the causes and correction or repair of common defects. Data herein should be used in conjunction with specific System/Assembly data that follows this general section.

GENERAL SYSTEM/MATERIAL DATA

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GENERAL SYSTEM/MATERIAL DATA

COMMON CAUSES OF CONCRETE DETERIORATION
(Similar for Pre-Cast Concrete)

Damage	Diagnosis	Cause
Alkali-Aggregate Expansion	Slight cracking to complete breakup.	Chemical reaction between aggregate and cement paste.
Cavitation	Spalling around projections. Honey-combing. Popping and cracking noises when water moves over the surface.	Rapid movement of water or other liquids across the surface.
Cracks (Active and Dormant)	Random, isolated or patterned cracks.	Construction movement, settlement, shrinkage around reinforcement. Setting shrinkage due to inadequate finishing and curing.
Before hardening of the concrete:	Patterned cracking, protruding aggregate, popouts. Chemical analysis indicates deterioration of cement paste.	Chemical reactions, such as corrosion.
After hardening of the concrete:	Surface cracking, patterned.	Physical, such as drying shrinkage.
	Extreme change in measured temperatures between inner and outer surfaces. Shallow cracking.	Thermal changes (subjected to temperature extremes, such as from freezing and thawing cycles).
	Localized cracking.	Stress concentration.
	Cracks, usually isolated.	Structural design.
	Cracks can be isolated or patterned depending on crack-producing agent.	Accidents from overload, vibration, fatigue and earthquake.
Corrosion of Reinforcing Steel	Cracks will occur at the level of the reinforcement and parallel to it. Rusting or discoloration will be evident.	Insufficient cover of steel. Quality of concrete. Over-use of calcium chloride as admixture.
Crazing	Shallow cracks forming a hexagonal pattern.	Surface shrinkage more rapid than interior of concrete to the surface and depositing salts.
Dusting	Appearance of a powdery substance on the surface of the concrete.	Too wet of a concrete mixture. Premature or excessive working of the surface. Organic materials in the aggregate. Inadequate curing.
Efflorescence	Appearance of crystalline salts on the concrete surface.	Water migrating from the interior mass of the concrete to the surface and depositing salts.
Fire	Charred and spalled surfaces.	Fire.
Form Scabbing	Difficult to remove forms. Uneven, spalled areas.	Form oil improperly applied.
Holes (Small and Large)	Popouts, holes, random pattern or isolated in extreme.	Chemical reaction. Inadequate construction and desian.
Honeycombing	Surface defects-voids. Coarse aggregate broken away from the surface.	Placing concrete aggregate with insufficient type of mortar. Improper placing techniques, such as inadequate vibration.

Source: Moans **Facilities** Maintenance **Standards** - 'R.S. Means Co., Inc., Kingston, **Massachusetts"**

GENERAL SYSTEM/MATERIAL DATA

COMMON CAUSES OF CONCRETE DETERIORATION
(Similar for Pm-Cast **Concrete)**

Damage	**Diagnosis**	**Cause**
Popouts	Breaking away of a particle near the surface. Excessive amount of moisture or temperature changes in the region.	Depressions left by material popping out Presence of disintegrated material near the popout.
Sand Streaking	Vertical streaks of sand which appear on the surface, most noticeable when forms are immediately stripped.	Concrete mixed with a high water content or a deficiency of finer sand sizes are placed in a formwork that is not water-tight.
Scaling	Flaking or peeling away of thin layers of concrete.	Severe freeze/thaw conditions. Improper use of deicing salts. Repeated wetting and drying of concrete. Improper finishing. Chemical attack of concrete. Heat blast.
Spalling	Fragments of concrete that have been broken from the surface. Corrosion of reinforcement.	Corrosion of reinforcement. Mechanical damage. Incorrect form removal. Shock-waves.
Stain and Uneven Color	Discoloration or lacking uniformity in appearance.	Chemical action of foreign materials on the surface. Mixing of different types of cement with each other. Reaction of materials comprising the concrete mixture.

A SUMMARY OF THE TYPES & CAUSES OF DETERIORATION OF STRUCTURAL STEEL

Type of Deterioration	**Cause**
Abrasion	Members subjected to contact with moving parts. Members subjected to wave action. Members immersed in a moving liquid. Worn, smooth appearance, general depression of the abraded area.
Corrosion	Resulting from a chemical or electrochemical reaction which converts the metal into an oxide, carbonate and sulfides. Pitted, oxidized surface showing loose flakes, reddish-brown rust colored appearance.
Fatigue	Repetitive, cyclic loading occurring at stresses at or below allowable design values. Small fractures oriented perpendicular to the line of stress.
Impact	Local distortion of the member in the form of a sharp crimp. Will occur in a tension member of flange.
Lamellar Tearing	Minute, often times unseen cracking in the weldment. May need microscopic instruments to observe. Incorrect welding process.
Loosening of Connections	Impact and fatigue loading. Vibrations and improper tightness.

source: **Means Facilities Maintenance Standards** • 'U.S. **Means** Co., Inc., **Kingston, Massachusetts"**

GENERAL SYSTEM/MATERIAL DATA

COMMON IMPERFECTIONS IN WOOD

Imperfection	Description	Effects on Stronath	Effect on Grading Structural Lumber
Checks and Splits	Split in the wood.	In lumber subjected to bending, checks and splits reduce the resistance to shear; they do not affect the strength for longitudinal compression.	Checks and splits are restricted in those parts of a bending member where shearing stresses are highest.
Holes	Either a knothole or a hole caused by some other means.	Reduces tensile strength some what more than compressive and shear strength and affect stiffness.	The size, number and location of knots is restricted for structural lumber; cluster knots are prohibited.
Knots	Localized imperfections.	Same as for holes.	Same as for holes,
Pitch Pockets	Opening between growth rings containing pitch or bark.	Little or no effect.	Usually disregarded except if a large number occur; shake may be present or bond between annual growth rings may be weakened.
Shakes	A separation of the wood between the annual growth rings.	Same as for checks and splits.	Same as for checks and splits.
Slope of Grain	Areas where the direction of the wood grain is not parallel to the edges of the piece of lumber.	Will twist with changes in moisture content.	Cross-grained pieces are undesirable; reduction of strength due to cross grain in structure is taken as twice the reduction observed in tests of small clear specimens,
Wane	Bark or lack of wood on the edge or corner of the piece of lumber.	Affects nailing and bearing.	Limited in structural lumber require ments for fabrication, bearing, nailing and appearance and not for effect on strength.

SUMMARY OF CAUSES OF TIMBER DETERIORATION WITH SYMPTOMS

Cause of Deterioration	Symptoms
Carpenter Ants, Beetles & Carpenter Bees	Similar to termites.
Termites	Bore holes; lacing/cavitation of wood; connecter tunnels from grade to wood source (usually mud). Premature wood bowing and failure.
Decay (Rot) Due to Fungi	Softening and discoloration of wood, fluffy or cottony appearance, destruction of wood cells, appearance of fruity bodies in the form of mushrooms, incrustations in the advanced stage.
Excessive Splitting and Checking	Excessive relative amount of members at a joint, bowing of compression members (shown by broken paint lines or newly exposed wood), elongated bolt holes.
Fire Damage	Surface cellular damage, charred surfaces, easily probed with a knife.
Hardware	Loose connections, formation of rust on hardware surfaces, discoloration of wood adjacent to hardware.
Loosened Connections	Loose connections, excessive deflection
Marine Borers	Minute openings in the timber, hollow sound when struck with a hammer, a myriad of surface grooves, narrowing of a section giving it an hourglass appearance.

Source: Means Facilities Maintenance Standards • 'R.S. Means Co., Inc., Kingston, Massachusetts"

GENERAL SYSTEM/MATERIAL DATA

PRESERVATIVES -ADVANTAGES & DISADVANTAGES

Oil-Based Wood Preservatives

Type of Preservative	Advantages	Disadvantages
Anthracene Oils	High toxicity to wood-destroying organisms; insoluble in water; low volatility; ease of application; permanence.	Dark brown color, cannot be painted; strong, unpleasant odor; easily ignited when first applied.
Coal-Tar Creosotes	See Anthracene Oils.	See Anthracene Oils,
Copper Naphthenate	High protection against decay fungi and termites; can be painted; not unpleasant odor; less easily ignited than coal-tar creosotes.	Gives wood greenish or dark color and provides less protection against marine borers than creosote.
Creosotes Derived From Wood, Oil and Water Gas	Same as Anthracene Oils and Coal-Tar Creosotes.	About the same as Anthracene Oils and Coal-Tar creosotes, but less effective.
Creosote Solutions	See Anthracene Oils and Coal-Tar Creosotes.	About the same as Anthracene Oils and Coal-Tar creosotes, but less effective.
Water-Repellent Preservatives	Retards moisture changes in wood; good protection against decay and insects.	Cannot be used in contact with ground or areas where continual dampness can occur unless preservative is thoroughly applied.

Water-Based Wood Preservatives

Acid Copper Chromate	Provides protection against decay and insects; can be painted; no objectionable odor; if thoroughly impregnated has some resistance to marine borers.	Wood can be used in contact with ground, but generally not recommended for contact with water.
Ammonical Copper Arsenite	Good protection against decay and insects and some protection against marine borers.	Wood can be used in contact with ground, but generally not recommended for contact with water.
Chromated Zinc Chloride	Provides protection against decay, insects and fire; can be painted; no objectionable odor.	Wood cannot be used in contact with ground or water.
Chromated Zinc Chloride (FR)	See Chromated Zinc Chloride.	See Chromated Zinc Chloride.
Copperized Chromated Zinc Chloride	See Chromated Zinc Chloride.	See Chromated Zinc Chloride.
Tanalith (Wolman Salts)	Protects against decay and insects; can be painted; no objectionable odor.	Wood cannot be used in contact with ground or water.
Zinc Meta Arsenite	Good protection against decay and insects; can be painted; no objectionable odor.	Wood can be used in contact with ground, but generally not recommended for contact with water.

Source: Means Facilities Maintenance Standards - **"R.S. Means** Co., Inc., **Kingston, Massachusetts"**

GENERAL SYSTEM/MATERIAL DATA

Acetic Acid, all Concentrations	Disintegrates slowly.
Acetone	Liquid loss by penetration. May contain acetic acid as impurity.
Acid **Waters**	(pH of 6.5 or less) (a) Disintegrates slowly. In porous or cracked concrete, attacks steel.
Aluminum Chlorldo	Disintegrates rapidly. In porous or cracked concrete, attacks steel.
Ammonia Vapors	May disintegrate moist concrete slowly or attack steel in porous or cracked moist concrete.
Ammonlum **Bisulfate**	Disintegrates. In porous or cracked concrete, attacks steel.
Ammonium Carbonate	Not harmful.
Ammonium **Cyanide**	Disintegrates slowly.
Ammonlum **Fluoride**	Disintegrates slowly.
Ammonlum **Nitrate**	Disintegrates. In porous or cracked concrete, attacks steel.
Ammonium **Oxalate**	Not harmful.
Ammonium Sulfldo	Disintegrates.
Ammonium **Sulfite**	Disintegrates,
Ammonlum **Superphosphate**	Disintegrates. In porous or cracked concrete, attacks steel.
Ammonlum **Thiosulfate**	Disintegrates.
Ashes	Harmful if wet, when sulfides and sulfates leach out (see sodium sulfate).
Ashes, hot	Cause thermal expansion.
Automobllo and **Diesel** Exhaust **Gases** (d)	May disintegrate moist concrete by action of carbonic, nitric, or sulfurous acid.
Benzol (Benzene)	Liquid loss by penetration.
Bromine	Gaseous bromine disintegrates. Liquid bromine disintegrates if it contains hydrobromic acid and moisture.
Butyl **Stearate**	Disintegrates slowly.
Calcium Bisulfite	Disintegrates rapidly.
Chlorine Gas	Slowly disintegrates moist concrete.
Chrome Plating Solutlons **(e)**	Disintegrates slowly.
Chromlo Acid, **& Concentrations**	Attacks steel in porous or cracked concrete.
Cinders	Harmful if wet, when sulfides and sulfates leach out (see, for example, sodium sulfate).
Coal	Sulfides leaching from damp coal may oxidize to sulfurous or sulfuric acid, or ferrous sulfate (see ferrous sulfate).
Coal Tar **Oils**	See anthracene, benzol, carbazole, chrysen, creosote, creosol, cumol, paraffin, phenanthrene, phenol, toluol, xylol.
Cobalt Sulfate	Disintegrates concrete of inadequate sulfate resistance.
Coke	Sulfides leaching from damp coke may oxidize to sulfurous or sulfuric acid.
Copper Chlorldo	Disintegrates slowly.
Copper Sulfate	Disintegrates concrete of inadequate sulfate resistance.
Copper Sulfldo	Harmful if it contains copper sulfate.
Corrosive Sublimate	See mercuric chloride.
Creosote	Phenol present disintegrates slowly.
Crssol	Phenol present disintegrates slowly.
Cumol	Liquid loss by penetration.
Deicing Salts	Scaling of non-air-entrained or insufficiently aged concrete (b).
Diesel Gases	See automobile and diesel exhaust gases.
Ferric Chlorldo	Disintegrates slowly.
Ferric Sulfate	Disintegrates concrete of inadequate quality.
Ferric Sulfldo	Harmful if it contains ferric sulfate.
Ferrous Chlorldo	Disintegrates slowly.
Ferrous Sulfate	Disintegrates concrete of inadequate sulfate resistance.

GENERAL SYSTEM/MATERIAL DATA

Flue Gases	Hot gases (400-l 100°F) causes thermal stresses. Cooled, condensed sulfurous, hydrochloric acids disintegrate slowly.
Gas **Water (e)**	Ammonium salts seldom presenl in sufficient quantity to disintegrate.
Gasoline	Liquid loss by penetration.
Hydrofluoric Acid, all Concentrations	Disintegrates rapidly, including steel.
Hydrogen Sulfide	Not harmful dry. In moist, oxidizing environments converts to sulfurous acid and disintegrates slowly.
Hypochlorous Acid, 10 percent	Disintegrates slowly.
Iodine	Disintegrates slowly.
Kerosene	Liquid loss by penetration of concrete.
Lead Nitrate	Disintegrates slowly.
Lead Refining Solutions **(f)**	Disintegrates slowly.
Lignite Oils	If fatty oils are present, disintegrates slowly.
Locomotive Gases	May disintegrate moist concrete by action of carbonic, nitric or sulfurous acids (see also automobile and diesel exhaust gases).
Lubricating Oil	Fatty oils, if present, disintegrate slowly.
Machine Oil	Fatty oils, if present, disintegrate slowly.
Magnesium Nitrate	Disintegrates slowly.
Manganese Sulfate	Disintegrates concrete of inadequate sulfate resistance.
Mercuric Chloride	Disintegrates slowly.
Mercuroua Chloride	Disintegrates slowly.
Methyl Alcohol	Liquid loss by penetration.
Methyl Ethyl Ketone	Liquid loss by penetration.
Methyl **Isobutyl** Ketone	Liquid loss by penetration.
Mine Water, Waste	Sulfides, sulfates, or acids present disintegrate concrete and attack steel in porous or cracked concrete.
Mineral **Spirits**	Liquid loss by penetration.
Muriatic Acid	See hydrochloric acid.
Nickel **Plating** Solutions	Nickel ammonium sulfate disintegrates slowly.
Nickel Sulfate	Disintegrates concrete of inadequate sulfate resistance.
Nitric Acid, all **Concentrations**	Disintegrates rapidly.
Ores	Sulfides leaching from damp ores may oxidize to sulfuric acid or ferrous sulfate.
Oxalic **Acid**	Not harmful. Protects tanks against acetic acid, carbon dioxide, salt water. Poisonous. Do not use with food or drinking water.
Paraffin	Shallow penetration not harmful, but should not be used on highly porous surfaces like concrete masonry (g).
Perchloric Acid, 10 percent	Disintegrates.
Perchloro- Ethylene	Liquid loss by penetration.
Petroleum Oils	Liquid loss by penetration. Fatty oils, if present, disintegrate slowly.
Phenanthrene	Liquid loss by penetration,
phenol, 5-25 percent	Disintegrates slowly.
potassium Cyanide	Disintegrates slowly.
Potassium **Dichromate**	Disintegrates.
Potassium **Hydroxide,** 25 percent or over	Disintegrates concrete.
Potassium Permanganate	Harmless unless potassium sulfate present.
Potassium Persulfate	Disintegrates concrete of inadequate sulfate resistance.
Pobaalum Sulfate	Disintegrates concrete of inadequate sulfate resistance.

GENERAL SYSTEM/MATERIAL DATA

Potassium Sulfide	Harmless unless potassium sulfate present.
Pyrites	See ferric sulfide, copper sulfide.
Sal Soda	See sodium carbonate.
Salt for Deicing Roads	Also calcium chloride, magnesium chloride, sodium chloride.
Saltpeter	See potassium nitrate.
Sea Water	Disintegrates concrete of inadequate sulfate resistance. Attacks steel in porous or cracked concrete.
Sewage	Usually not harmful (see hydrogen sulfide).
Silage	Acetic, butyric, lactic acids (and sometimes fermenting agents of hydrochloric or sulfuric acids) disintegrate slowly.
Sodlum **Bisulfate**	Disintegrates.
Sodium **Bisulfite**	Disintegrates.
Sodium Bromide	Disintegrates slowly.
Sodlum **Carbonate**	Not harmful, except to calcium aluminate cement.
Sodlum **Chloride**	Magnesium chloride, if present, attacks steel in porous or cracke concrete. (b) Steel corrosion ma cause concrete to spall.
Sodium **Cyanide**	Disintegrates slowly.
Sodlum Dlchromak	Dilute solutions disintegrate slowly.
Sodlum **Hypochlorite**	Disintegrates slowly.
Sodlum **Nitrite**	Disintegrates slowly.
Sodium **Phosphate** (Monobasic)	Disintegrates slowly.
Sodium **Sulfate**	Disintegrates concrete of inadequate sulfate resistance.
Sodium **Sulfide**	Disintegrates slowly.
Sodlum **Thiosulfate**	Slowly disintegrates concrete of inadequate sulfate resistance.
Strontium **Chloride**	Not harmful.
Sulfite Liquor	Disintegrates.
Sulfite Solutlon	See calcium bisulfate.
Sulfurous **Acid**	Disintegrates rapidly.
Toluol (Toluene)	Liquid loss by penetration.
Tung **Oil**	Liquid disintegrates slowly. Dried or drying films are harmless.
Turpentine	Mild attack. Liquid loss by penetration.
Urine	Attacks steel in porous or cracked concrete.
Xylol **(Xylene)**	Liquid loss by penetration.
Zinc **Nitrate**	Not harmful.
Zinc **Refining** Solutlons **(l)**	Hydrochloric or sulfuric acids, if present, disintegrate concrete.
Zlno Slag	Zinc sulfate sometimes formed by oxidation.
Zinc Sulfate	Disintegrates slowly.

SPECIAL NOTATIONS

a. Waters of pH higher than 6.5 may be aggressive, if they also contain bicarbonates. (Natural waters are usually of pH higher than 7.0 and seldom lower than 6.0 though pH values as low as 0.4 have been reported. For pH values below 3, protect as for dilute acid.)

b. Frequently used as a deicer for concrete pavements. If the concrete contains too little entrained air or has not been aged more than one month, repeated application may cause surface scaling. For protection under these conditions, see "deicing salts."

c. Water used for cleaning coal gas.

d. Composed mostly of nitrogen, oxygen, carbon dioxide, carbon monoxide, and water vapor. Also contains unburned hydrocarbons, partially burned hydrocarbons, oxides of nitrogen, and oxides of sulfur. Nitrogen dioxide and oxygen in sunlight may produce ozone, which reacts with some of the organics to produce formaldehyde, peracylnitrates, and other products.

e. These either contain chromium trioxide and a small amount of sulfate, or ammonium chromic sulfate (nearly saturated) and sodium sulfate.

f. Contains lead fluosilicates and fluosilicic acid.

g. Porous concrete which has absorbed considerable molten paraffin and then been immersed in water after the paraffin has solidified, has been known to disintegrate from sorptive forces.

h. Contains nickelous chloride, nickelous sulfate, boric acid, and ammonium ion.

i. Usually contains zinc sulfate in sulfuric acid. Sulfuric acid concentration may be low (about 6 percent in "low current density" process) or higher (about 22-28 percent in "high current density" process).

GENERAL SYSTEM/MATERIAL DATA

COMMONI PAIM FINISHES/COATINGS IRREGULARITIES

Film Irregularities	Probable Cause	Correction
ALLIGATORING Cross-hatch pattern of surface cracking.	1. Incompatibility of topcoat and underfilm, or coating over a soft underfilm	1. Remove failed coating and recoat with compatible system suitable for exposure conditions. Do not topcoat until underfilm is dry enough to recoat.
BUBBLING Bubbles on the surface of the dried film. May be microscopic in size.	1 Rapid volatilization of sol-vents within the film.	1. Level surface defects by sanding and reapply coating at lower air or surface temperature, or add slower solvent to increase open time of wet film.
	2. Air displacement resulting from absorption of wet film into porous substrate.	2a. Bridge or fill voids by applying a mist coat, a filler or sealer. 2b. Hose down concrete and masonry with water and allow to drain before applying water-thinned coat.
CRACKING Visible cracks through the surface of the film.	1. Stress or compression cracking or rigid substrate.	1. Patch cracks and recoat
	2. Bending or flexing on non-rigid substrates.	2. Replace with coating having sufficient flexural strength to tolerate condition.
	3. Physical damage: Impact, heat, cold, exposure, etc.	3. Replace with coating that will tolerate physical conditions.
	4. Surface freezing of fresh latex coating.	4. Recoat when air and surface temperatures are above minimum recommendations.
	5. Application of excessive number of coats.	5. Remove failed coating and recoat with appropriate system.

GENERAL SYSTEM/MATERIAL DATA

COMMON **PAINT** FINISHES/COATINGS **IRREGULARITIES**

Film Irregularities	Probable Cause	Correction
CRATERING Round-shaped thin spots or voids	1. Caused when bubbles break. 2. Water in spray equipment lines.	1. See "Bubbling " 2. Level defect by sanding Correct equipment malfunc-tion and flush lines before recoatrng.
CRAZING Fine line cracking forming a network or overall pattern.	1. See "Cracking."	1. See "Cracking."
DRY SPRAY Rough, sandy surface texture on spray applied coating.	1. Spray particles partially dry before reaching surface.	1. Sand smooth and adjust material, equipment and technique for prevailing temperature and humidity conditions.
FLATTING Loss of gloss	1 Rain, fog, high humidity or damp surfaces. 2. Overthinning or use of wrong solvent.	1 Recoat when surface is dry and weather conditions are satisfactory. 2. Remove coating if film properties or adhesion are affected and recoat with properly thinned material.
FRAMING Color texture or hiding variations where roller applied surfaces join work cut in with brush.	1. Uneven film build between roller and brush applied work.	1. Recoat deficient work, apply heavier wet film or additional coat on new work.
(POOR) HIDING Uneven color or shadowy appearance of topcoat.	1. Insufficient number of coats or low film build. 2. Insufficient mixing	1. See "Framing." (Note: Some colors have weak hiding properties and require an additional coat for satisfactory hiding.) 2. Stir material thoroughly before use and keep in suspension during appli-cation.
HOLIDAYS Skipped or missed area		1. Touch-up or recoat.

GENERAL SYSTEM/MATERIAL DATA

COMMON PAINT FINISHES/COATINGS IRREGULARITIES

Film Irregularities	Probable Cause	Correction
LAPPING (Lap Marks) Color sheet or texture variations where one freshly painted area overlaps another.	1. First area painted has set up before overlap was made.	la. Adjust material equipment and technique for weather conditions. 1 b. Work smaller areas to reduce lap time.
MUD CRACKING Cross-hatched pattern of surface cracking.	1. Excessive film build or hot, dry weather.	1. Remove failed coating and recoat at recommended film thickness. Add additional solvent or slower solvent to retard drying during hot, dry weather.
ORANGE PEEL Fine pebbled surface texture on spray applied coating.	1. Insufficient atomization	1. Sand smooth and recoat after adjusting material, equipment and technique to obtain better flow and leveling.
OVERSPRAY Rough sandy areas on spray applied work.	1. Deflected spray mist that settles on dry or partially dry coated surfaces.	1. Sand smooth and recoat using proper application technique and lap time. Protect dry film from overspray
PINHOLING Small holes or discontinuities in the film. May be microscopic.	1. Solvent migration through the film after the film has begun to set. (Also see - "Bubbling" and "Crack-ing.")	l a If occasional pinholes are detected, touch-up or recoat l b If pinholing is a general surface condition, it indicates that coating was applied and cured under adverse environmental conditions. Apply a thin or mist coat to fill surface voids, followed by a full wet coat when environmental conditions are suitable for recoating.

GENERAL SYSTEM/MATERIAL DATA

COMMON PAINT FINISHES/COATINGS IRREGULARITIES

Film **Irregularities**	Probable Cause	Correction
ROLLER TRACKS (a) V-Shaped texture pattern on roller applied surface (Chicken Tracks) or (b) Lines at edge of roller passes.	1. Use of long nap roller cover on smooth surfaces 2 Material not properly thinned. 3 Material not rolled properly	1 Change to shorter nap roller cover 2 Make solvent adjustment to improve flow and leveling. 3. Sand runs smooth and recoat with properly thinned material.
RUNS Heavy V-shaped or pencil shaped vertical build-ups on surface of coating.	1. Excessive film build. 2. Overthinning.	1. Sand runs smooth and touch-up or recoat. 2. Sand runs smooth and recoat with properly thinned material.
SAGS Heavy U-shaped buildups or horizontal lips on the surface of coatings. (Long sags may also be referred to as curtains.)	1. See "Runs."	1. See "Runs."
SANDY (Appearance) Dull, rough appearance of film.	1. Dust and dirt contam-ination of the wet film.	1. Sand smooth and recoat. protect freshly painted areas against dust' and dirt contamination or sus-pend painting operations until environmental conditions are satisfactorv.
SHADOWING See "Hiding."		
SOLVENT TRAP Residual solvents remaining within film.	1. Excessive film build. 2. Low temperature curing.	1. Try to drive solvents out of film by force drying. (See manufacturer's data.) Test for hardness and adhesion. If film will not adhere or cure properly, remove and recoat. 2. Same as "1."

GENERAL SYSTEM/MATERIAL DATA

EXTERIOR PAINT SYSTEMS

Material	Surfaces	Finish	Vehicle Type
Wood, Painted	Clapboard, Siding, Factory Primed Hardboard	Flat	Alkyd-Modified Vinyl Acrylic Latex
			Alkyd
	Siding, Doors, Trim	Eggshell	Alkyd
	Sash, Fascia, Rough Sawn		Alkyd-Modified Vinyl Acrylic Latex
		Low Lustre	Vinyl Acrylic Latex
		Medium Gloss	Acrylic Latex
	Textured Siding, Shakes & Shingles	Soft Gloss	Acrylic Latex
		High Gloss	Lona Oil Alkyd
			Maleinized Linseed Oil
	Doors, Trim Shutters	High Gloss	Acrylic Latex Alkyd
Wood, Stained	Textured or Rough Sawn	Semi-Transparent	Acrylic
			Linseed Alkyd
			Linseed Alkyd
			Alkyd
	Siding, Trim, Decks, Patios, Shakes, Shingles Fencing	Flat	Alkyd-Modified Vinyl Acrylic Latex
			Vinyl Acrylic
			Linseed Alkyd
Wood, **Weathered**		Bleaching Oil	Linseed Alkyd
wood, Natural		Penetrating Clear	Phenoiic Linseed Castor-Tuna Oil Resin
Wood, Varnished	Doors, Trim, Shutters	High Gloss	Phenolic Modified Tung, Linseed Castor Oil
	Porches, Platforms, Steps, Decking	High Gloss	Urethane Modified
Metal, Ferrous	Structural Steel and Iron Sash, Trim, Doors, Storage Tanks,	Flat	Alkyd-Modified Vinyl Acrylic Latex
			Alkyd-Modified Vinyl Acrylic Latex
			Alkyd
		Eggshell	Alkyd
		Low Lustre	Alkyd-Modified Vinyl Acrylic Latex
		Medium Gloss	Acrylic Latex
		Soft Gloss	Acrylic Latex
		High Gloss	Acrylic Latex

GENERAL SYSTEM/MATERIAL DATA

EXTERIOR **PAINT** SYSTEMS

Material	Surfaces	Finish	Vehicle Type
Metal, Ferrous (Continued)	Fire Escapes, Ornamental Iron Catwalks, Handrails	High Gloss	Long Oil Alkyd
			Maleinized Linseed Oil
			Alkyd
			Modified Epoxy
			Polyamide Epoxy
Metal, Aluminum	Doors, Vents, Gutters, Downspouts, Miscellaneous Surfaces	Flat	Alkyd-Modified Vinyl Acrylic Latex
			Alkyd
		Eggshell	Alkyd
		Low Lustre	Alkyd-Modified Vinyl Acrylic Latex
		Satin	Alkyd
		Medium Gloss	Acrylic Latex
		Soft Gloss	Acrylic Latex
		High Gloss	Acrylic Latex
			Long Oil Alkyd
			Maleinized Linseed Oil
			Alkyd
			Polyamide Epoxy
Metal, Galvanized **Iron**	Siding, Doors, Vents, Gutters, Downspouts, Ducts, Framing	Flat	Alkyd-Modified Vinyl Acrylic Latex
			Alkyd
		Eggshell	Alkyd
		Low Lustre	Alkyd-Modified Vinyl Acrylic Latex
		Medium Gloss	Acrylic Latex
		Soft Gloss	Acrylic Latex
		High Gloss	Acrylic Latex
			Long Oil Alkyd
			Maleinized Linseed Oil
			Alkyd
			Polyamide Epoxy
	Chain Link Fencing	Satin	Linseed Coumerone Indene
Masonry, **Textured**	Concrete Masonry Units	Flat	Alkyd-Modified Vinyl Acrylic Latex
			Alkyd
		Eggshell	Alkyd

GENERAL SYSTEM/MATERIAL DATA

EXTERIOR PAINT SYSTEMS

Material	Surfaces	Finish	Vehicle Type
Masonry, Textured (Continued)	Concrete Masonry Units	Low Lustre	Alkyd-Modified Vinyl Acrylic Latex
		Medium Gloss	Acrylic Latex
		Soft Gloss	Acrylic Latex
		Satin	Vinyl Acrylic Latex
Masonry, Smooth	stucco, Brick, Poured and Precast Concrete	Flat	Alkyd-Modified Vinyl Acrylic Latex
			Alkyd
		Eggshell	Alkyd
		Low Lustre	Alkyd-Modified Viny! Acrylic Latex
		Medium Gloss	Acrylic Latex
		Soft Gloss	Acrylic Latex
		High Gloss	Acrylic Latex
		Low Sheen	Silicone Acrylic
		Satin	Epoxy-Modified Acrylic Latex
		High Gloss	Phenolic Reinforced Alkyd
			Modified Epoxy
			Polyamide Epoxy
Masonry, Weathered	Cement & Cinder Block, stucco, Brick, Poured & Precast Concrete	Flat	Alkyd-Modified Vinyl Acrylic Latex
			Alkyd
		Eggshell	Alkyd
		Low Lustre	Alkyd-Modified Vinyl Acrylic Latex
		Medium Gloss	Acrylic Latex
		Soft Gloss	Acrylic Latex

GENERAL SYSTEM/MATERIAL DATA

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GENERAL SYSTEM/MATERIAL DATA

SPECIAL COATINGS SYSTEMS & APPLICATIONS

Exposure	Applications	Type System	Resistance													
			ALIPHATIC HYDRO ALCOHOLS	ALKALI SOLUTION	AROMATIC HYDROCARBONS	FRESH WATER IONS	KETONES HYDROCARBONS	MINERAL ACIDS	MINERAL OILS	ORGANIC ACIDS	OXIDIZING AGENT	SALT SOLUTIONS	VEGETABLE OILS S	WASTE WATER	WEATHERING		ING
Rural, Urban Light Industrial	Warehouses, Manufacturing Plants, Schools, Storage Tank Exteriors	Alkyd Primer &Alkyd Topcoat		③	③	④	④	③	④	④	①	④	④	④	④	④	G
Mild Chemical	Wood Yards, Plywood Plants Sawmills	High Build Epoxy Polyamide Cured & Urethane Topcoat		①	①	①	③	①	④	③	①	③	③	①	①	①	E
Fresh & Salt Water Immersion; Moderate Chemical Exposure	Pilings, Waste Treatment Plants, Pulp & Paper Mills, Marine Structures & Barges, Cogeneration	Coal Tar Epoxy Polyamide Cured		①	①	①	①	②	④	③	①	③	③	②	①	②	F
Fresh & Potable Water Immersion	Water Storage Tank Interiors, Locks & Water Control Gates	High Build Epoxy Amine Cured		①	①	①	①	②	③	③	①	③	③	②	②	②	F
Severe Chemical	Pulp & Paper Mills, Coal Handling, Chemical Plants, Sour Crude Refineries, Fertilizer Plants	High Build Epoxy Polyamide Cured & Urethane Topcoat		①	①	①	③	①	③	③	①	③	③	①	①	①	E
Severe Chemical-Acid Resistance	Pulp & Paper Mills, Dockside Exposures, Fertilizer Plants, Acid Loading Docks, Dye Plants	High Build Epoxy Amine Cured		①	①	①	①	②	③	③	①	③	③	②	②	②	F
Severe Chemical-Alkali & Solvent Resistance	Pulp & Paper Mills, Coal Handling Facilities, Dockside Exposures	Organic Zinc Rich Epoxy Primer & High Build Epoxy Polyamide Cured Topcoat		①	①	①	①	②	③	③	①	③	③	①	①	②	F
Severe Chemical-Alkali Resistance	Capital structures where color & gloss retention are needed	Organic Zinc Rich Epoxy Primer, High Build Epoxy Polyamide Cured & Urethane Topcoat		①	①	①	③	①	③	③	①	③	③	①	①	①	E
Severe Chemical Solvent & Alkali Resistance	New Construction, Pulp & Paper Mills, Power Plants, Coal Liquification, Cogeneration	Inorganic Zinc Rich Primer & High Build Epoxy Polyamide Cured Topcoat		①	①	①	①	②	③	③	①	③	③	①	①	②	F

GENERAL SYSTEM/MATERIAL DATA

SPECIAL COATINGS SYSTEMS & APPLICATIONS

Exposure	Applications	Type System	Resistance													
			ALCOHOLS	ALIPHATIC HYDROCARBONS	ALKALI SOLUTIONS	AROMATIC HYDROCARBONS	FRESH WATER	KETONES	MINERAL ACIDS	MINERAL OILS	ORGANIC ACIDS	OXIDIZING AGENTS	SALT SOLUTIONS	VEGETABLE OILS	WASTE WATER	WEATHERING
Severe Chemical	Where gloss retention and color are important	Zinc Rich Primer & Urethane Topcoat	①	①	①	③	①	①	③	③	①	③	③	①	①	E
High Temperature (up to 1200" F)	Stacks, Incinerators, Super Heated Steam Lines, Boiler Casings & Drums	Heat Resistant Silicone Aluminum	③	③	④	④	④	④	④	①	④	④	④	④	④	E
Immersion, Severe Exposures	Waste Treatment Plts., Pulp & Paper Mills, Cogeneration, Power Plants., Sour Crude Exposures	Coal Tar Epoxy Polyamide Cured	①	①	①	③	②	④	③	①	③	③	②	①	②	F

CODES: ① = frequent contact; ② = immersion; ③ = occasional contact; ④ = not recommended; F = fair; G = good; E = excellent

END OF SUBSECTION

0.04.01 .01 CONCRETE WALLS (CSI 03300)

DESCRIPTION

Concrete walls may function as the structural components of a building, as well as form the building fenestration. The design of the cast-in-place concrete walls is affected by the formwork and is also directly influenced by types and brand of cement, admixtures, uniformity in mixing and technique, curing methods, and other quality control factors. Graphic assembly details that follow illustrate general assembly/component types only and are not meant as a definitive, exhaustive, in-depth system breakdown. Field conditions will vary and are subject to project type, local requirements, and facility design.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Cast-in-Place Concrete (CSI 03300)

Cast-in-place concrete is placed in forms at its final location. Concrete is a composite material that consists essentially of a binding medium with embedded particles or fragments of aggregate; in Portland cement concrete, the binder is a mixture of Portland cement and water. The structure it is to support and the design mix play a great part in foundation wall strength. ACI publications 318" Building Code Requirements for Reinforced Concrete" and 301 "Specifications" have been indicated a preference for proportioning and design of mixes by other then prescriptive methods.

Design Mixes that Provide Normal Weight Concrete:

- 4000-psi, 28-day compressive strength w/c ratio; 0.44 max
- 3500-psi, 28-day compressive strength w/c ratio; 0.51 max
- 3000-psi, 28-day compressive strength w/c ratio; 0.58 max
- 2500-psi, 28-day compressive strength w/c ratio; 0.67 max

Concrete Reinforcement (CSI 03200)

Concrete reinforcement consists of bars, wires, strands, and other slender members embedded in concrete in such a manner that the reinforcement and the concrete act together in resisting forces. This is done due to concrete's limited resistance to tensile and shear stresses. Reinforcement must be accurately located to ensure proper cover and to reduce the chance of loss or corrosion of a structural section of reinforcing steel. When concrete is deposited directly against the earth for footings, at least 3 inches of concrete should exist between the steel and the earth. When concrete is deposited directly against formwork for footings there should be at least 2 inches of concrete between the steel and the formwork. Follow ACI 318 publication "Building Code Requirements for Reinforced Concrete."

Admixtures (CSI 03370)

An admixture is an ingredient other than cement, aggregate, or water that is added to a concrete mortar mix to affect the physical or chemical characteristic of the concrete. The most common admixtures affect the plasticity, air entrainment, and curing time.

Air-Entrainment Agents:

- Provide a more workable material.
- Definitely used when concrete surface will be exposed to freeze/thaw cycles

Retarder & Densifying Agents:

- Retard the set; suggested in warm weather to reduce cracking due to rapid set-up
- Increase the workability of the mix.
- Allow for delayed finishing, resulting in less permeable concrete.

0.04.01.01 CONCRETE WALLS CSI 03300)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Admixtures (CSI 03370) (Continued)

Accelerator:

- Useful in winter (cold weather concreting).
- Useful when working to seal against the water-flow.
- Should be used sparingly because the admixture tends to increase shrinkage

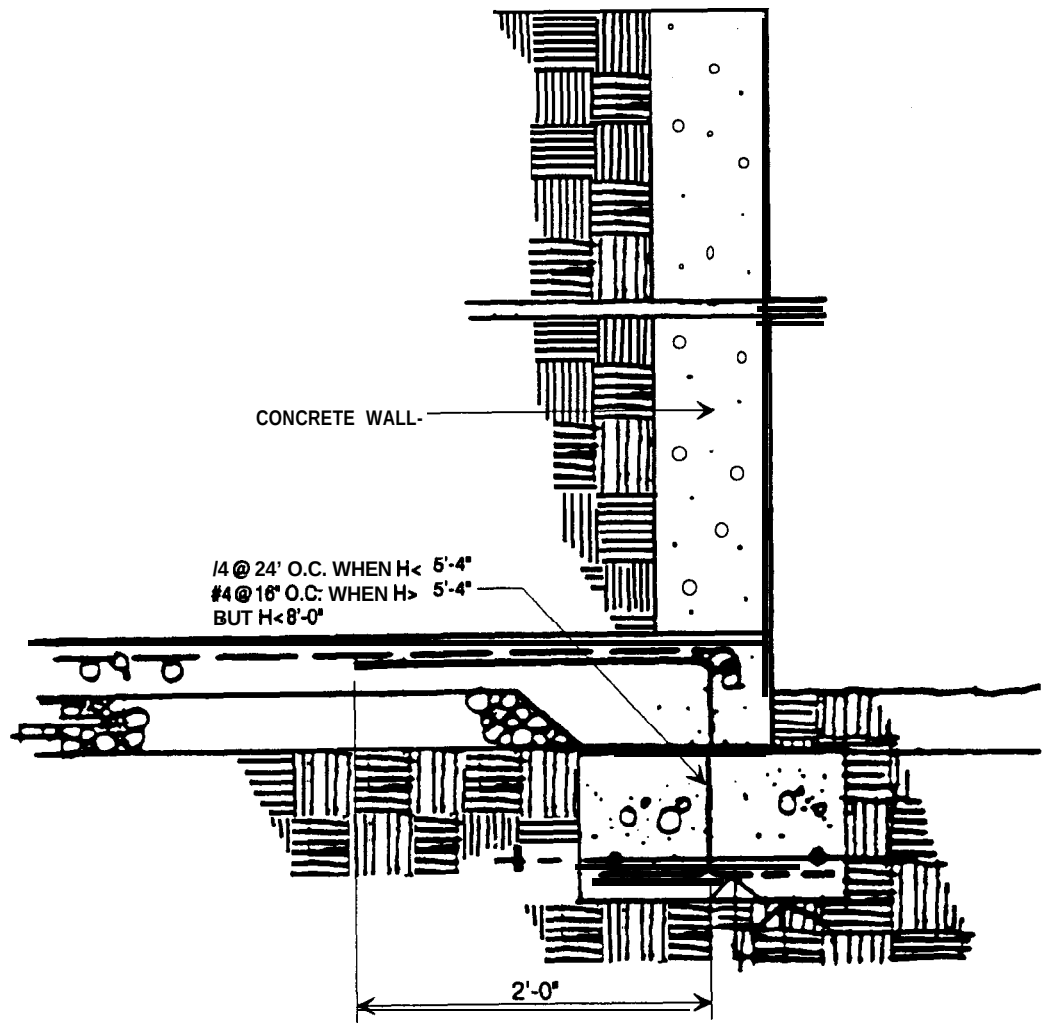
Special retarding agents applied to the formwork prior to the placing of the concrete are also used to carry out the surface-finishing process. These retarding agents weaken the final surface and facilitate its removal after the formwork has been stripped. If enough retarder is used, the surface may simply be washed down with pressurized water to exposed the aggregate without implementing abrasive methods. Acid etching is also a suitable option for removing the superficial layer of sand and cement to expose the aggregate.

Surface Sealers (CSI 07100)

Special Sealers may be sprayed on to the surface of concrete walls to minimize discoloration, especially in polluted environments. This method of finishing is particularly effective on walls where the aggregate is a light color or where the final surface is rough. In most cases, these sealers require reapplication every few years. If short-term curing compounds are used, they must be compatible with the long-term sealer.

OTHER RELATED COMPONENTS

Refer to Foundations & Footings and Substructure Systems, Volumes 1 and 2, for additional deficiencies that may impact this system.



CONCRETE WALL DETAIL

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	CIP CONCRETE WALL		
WALLS CONCRETE (CSI 03300)	Revision No.	Issue Date 5/93	Drawing No. A040101-1

DEFICIENCY FACTORS
0.04.01 .OI CONCRETE WALLS (CSI 03300)

PROBABLE FAILURE POINTS

- Lack of curing will increase the degree of cracking within a concrete structure.
- Reinforcement corrosion is an electro-chemical process that occurs in the presence of air and moisture.
- The weathering processes that can cause cracking include (1) freezing and thawing, (2)wetting and drying, and (3)heating and cooling.
- A number of deleterious chemical reactions may result in concrete cracks. These reactions may be due to the aggregate used to make the concrete or materials that come into contact with it after it has hardened.
- A wide variety of poor construction practices can result in cracking in concrete structures, especially adding water to concrete to improve workability. Added water has the effect of reducing strength, increasing settlement, and increasing ultimate drying shrinkage.
- Construction overloads induced during construction can be far more severe than those experienced in the lifetime of the structure. Unfortunately, these conditions may 'occur at early ages when the concrete is most susceptible to damage and often result in cracks.
- Errors in design and detailing the effects of improper design and/or detailing range from poor appearance to lack of serviceability to catastrophic failure.
- Externally applied loads are known to induce tensile stresses that result in concrete cracks. Current ACI 318 design procedures use reinforcing steel, not only to carry the tensile forces, but to obtain both an adequate crack distribution and reasonable limit on crack width.

SYSTEM ASSEMBLIES/DEFICIENCIES

Alkali-Aggregate Expansion:	Chemical reaction between aggregate and cement paste causing separation and bond break-up.
Cavitation:	Rapid movement of water or other liquids across the surface.
Cracking (Active & Dormant) :	Construction movement, settlement, shrinkage around reinforcement. Setting due to inadequate finishing and curing. Chemical reactions such as corrosion. Physical such as drying shrinkage. Thermal changes (subjected to temperature extremes such as freeze/thaw cycles). Stress concentration. Structural design. Accidents from overload, vibration, fatigue, and earthquake.
Crazing:	Surface shrinkage more rapid than interior of concrete mass. Too high a slump. Too rich a mix. Poor timing on finishing. Too rapid absorption of moisture.
Efflorescence:	A whitish, powdery deposit of soluble salts brought to the surface by moisture. Leaves a residue after evaporation.
Exposed Reinforcing:	Insufficient steel coverage. Concrete quality. Calcium chloride overused as admixture.
Form Scabbing:	Form oil improperly applied.
Holes (Small & Large):	Chemical reaction. Inadequate construction and design.

DEFICIENCY FACTORS
0.04.01 .01 CONCRETE WALLS (CSI 03300)

SYSTEM ASSEMBLIES/DEFICIENCIES (Continued)

Settlement:	Solid particles sink in fresh concrete, after placement and before initial set.
Spatting:	Concrete fragments broken from the surface, caused by the reinforcement corrosion.

SPALLING AND CRACKING OF CONCRETE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-EXTERIOR CLOSURE	CONCRETE WALL DETERIORATION		
WALLS CONCRETE (CSI 03300)	Revision No.	Issue Date 5/93	Drawing No. D040101-1

SPALLING AND CRACKING OF CONCRETE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-EXTERIOR CLOSURE	CONCRETE DETERIORATION		
WALLS CONCRETE (CSI 03300)	Revision No.	Issue Date 5/93	Drawing No. D040101-2

DEFICIENCY FACTORS
0.04.01 .OI CONCRETE WALLS (CSI 03300)

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DEFICIENCY FACTORS
0.04.01 .OI CONCRETE WALLS (CSI 03300)

END OF SUBSECTION

0.04.01.02 MASONRY-CMU (CSI 04200)

DESCRIPTION

Because of their strength, versatility, and economy, masonry assemblies are among the most frequently used materials for constructing walls and partitions. They may be used for many different types of bearing and nonbearing wall structures, including exterior and interior walls, infill panels, interior partitions, and fire walls. Graphic assembly details that follow illustrate general assembly/component types only and are not meant as a definitive, exhaustive, in-depth system breakdown. Field conditions will vary and are subject to project type, local requirements, and facility design.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Continuous Metal Ties (CSI 04150)

Continuous metal ties are called prefabricated joint reinforcement, mesh, or more commonly, joint reinforcement. They consist of two or more parallel longitudinal wires to which cross wires are welded. Joint reinforcement may be used for the following reasons:

- To act as horizontal reinforcement.
- To act as longitudinal reinforcement to control cracking due to drying shrinkage and temperature changes.
- To bond the wythes without using unit metal ties.

Joint reinforcement and ties must be corrosion-resistant. Cross wires in joint reinforcement are welded diagonally or perpendicularly to the longitudinal wires, usually at 16 inch spacings. The longitudinal wires are deformed to obtain a better bond with the mortar.

Control Joints (CSI 04150)

Control joints, also called contraction or movement joints, are continuous, vertically weakened sections built into the wall. If stresses or wall movements are sufficient to crack the wall, the cracks will occur at the control joints and be inconspicuous.

A control joint must permit ready wall movement in a longitudinal direction and be weatherproofed. In addition, it may be required to stabilize the wall laterally across the joint.

There are a number of types of control joints for building concrete masonry walls, but the most common types are the Michigan, the tongue and groove, and the premolded gasket.

- The Michigan uses conventional flanged units. A strip of building paper is curled into the end core covering the end of the block on one side of the joint laid and the core is filled with mortar. The filling bonds to one block, but the paper prevents bond to the block on the other side of the control joint. The control joint permits longitudinal wall movement while the mortar plug transmits transverse loads.
- The tongue and groove control joint is manufactured in sets consisting of full-length and half-length units. The tongue of one special unit fits into the groove of another or into the open end of a regular flanged stretcher. The units are laid in mortar exactly the same as any other masonry units. Also, part of the mortar is allowed to remain in the vertical joint to form a backing against which the caulking can be placed.
- Premolded gaskets allow movement at joints while maintaining wall alignment perpendicular to wall movement. These anchors are also adaptable for attaching concrete masonry walls to wood, steel, or concrete.

0.04.01.02 MASONRY-CM&J (CSI 04200)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Flashing (CSI 04150)

Flashing is installed in masonry construction to divert moisture, which may enter the masonry at vulnerable spots, to the outside. Flashing is provided under horizontal masonry surfaces such as sills and copings, at intersections of masonry walls with horizontal surfaces such as roof and parapets, overheads of openings such as doors and windows, and frequently at floor lines. To be most effective, the flashing usually extends through the outer face of the wall and is turned down to form a drop. Weepholes are provided at intervals of 18 inches to 2 feet to permit accumulated water on the flashing to drain to the outside.

Mortar Types (CSI 04100)

The following types of mortar are proportioned on a volume basis.

- Type S is also for general use and is recommended where high resistance to lateral forces is required.
- Type N is suitable for general use in exposed masonry above grade and is recommended specifically for exterior walls subjected to severe exposures. This mortar is recommended for load bearing walls of solid units where the compressive stresses do not exceed 100 psi and the masonry will not be subjected to freezing and thawing in the presence of excessive moisture.

Joint Finishing:

Exterior surfaces of mortar joints are finished to make the brickwork more waterproof and to improve appearance; there are several types. When joints are cut flush with the brick and not finished, cracks can easily occur between the brick and mortar.

The best joint, from the standpoint of weather-tightness, is the concave joint. This joint is made with a special tool after the excess mortar has been removed with the trowel.

The flush joint is the next best, followed by the weather joint, which sheds water more easily from the wall surface.

Concrete Masonry Walls (CSI 04200)

Concrete masonry walls may be classified as solid, hollow, cavity, composite, veneered, reinforced, or grouted. The classifications sometimes overlap, but the basic terminology and bonding directions remain the same. Modern concrete masonry wall construction is of two general types: unreinforced (plain) and reinforced. These classifications are characterized by some difference in motor type requirements, use of reinforcing steel, and erection techniques. Both types are usually subject to the provisions of applicable building codes.

Unreinforced (plain) concrete masonry is the ordinary type that has been in use for many years. Essentially unreinforced, any steel reinforcement used in this type of concrete masonry is generally of light gauge and placed in relatively small quantities in the horizontal joints.

Reinforced concrete masonry, on the other hand, contains reinforcing steel so placed and embedded that the masonry and steel act together in resisting forces. This structural behavior is obtained by placing deformed reinforcing steel bars in continuous vertical and horizontal cores or cavities in the masonry by filling these spaces with properly consolidated Portland cement grout, the bars, and masonry units, permitting reinforced concrete design theory to be adapted to produce building of reinforced concrete masonry.

0.04.01.02 MASONRY-CMU (CSI 04200)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Concrete Masonry Walls (CSI 04200) (Continued)

Reinforced concrete masonry is used where the compressive, flexural, and shear loads are higher than can be accommodated with plain concrete masonry. It is required by code in areas of recurring hurricane winds or earthquake activity where major damage to buildings is highly probable.

Various methods may be employed for insulating concrete block walls. Rigid foam inserts or loose perlite can be used to fill the voids in the blocks of single wythe walls, which can also be insulated by installing the insulating material between the furring strips for the interior wall face. For cavity walls, rigid-board insulation may be attached within the cavity to the surface of the inner wythe.

Different cleaning and finishing techniques may be used to enhance the appearance of block walls and to protect them from the elements. Small amounts of dried mortar and soiling can be cleaned from the block surface with a stiff brush. Exterior and interior block walls can be painted or coated with a variety of opaque and clear sealers.

Masonry Brick Walls (CSI 04210)

Masonry Brick consists of units of baked clay or shale of uniform size, small enough to be placed with one hand, and laid in courses with mortar joints to form walls of virtually unlimited length and height. Bricks are kiln-baked from various clay and shale mixtures. The dimensions of a standard building brick is 2 1/2 x 3 3/4 x 8 inches. The actual dimensions may vary a little due to shrinkage during burning.

Brick is among the most popular of wall materials because it is durable, economical to maintain, readily available in most areas, and varied in size and color. Brick can be used alone in single wythe walls or as the facing material in composite or cavity walls. Although the insulating value of a single wythe brick wall is low (1.6 rating), it has the relatively high fire rating of one hour.

Brick Classification:

A finished brick structure contains “face brick” (brick placed on the exposed face of the structure) and “back-up” brick (brick placed behind the face brick). The face brick is often of higher quality than the back-up brick. However, the entire wall may be built of “common” brick, made from pit-run clay, with no attempt at color control and no special surface treatment like glazing or enameling. Most common brick is red.

Types of Brick:

There are many types of bricks. Some are different in formation and composition while others vary according to their use. Some commonly used types of bricks are as follows:

Face brick is used in the exposed face of a wall and is a higher quality than back-up brick. They have better durability and appearance. The more common colors of face brick are various shades of brown, red, gray, yellow, and white.

Glazed brick consists of brick with a finished surface of ceramic glazing. This coating is composed of mineral ingredients that fuse together to form a glass-like coating during burning. It is generally used in or well suited for hospitals, dairies, laboratories, or other buildings where cleanness and ease of cleaning is necessary.

Fire brick is made of a special type of fire clay that will withstand the high temperatures of boilers and similar uses without cracking or decomposing. Fire brick is generally larger than regular structural brick and is often hand-molded.

0.04.01.02 MASONRY-CMU (CSI 04200)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Masonry Brick Walls (CSI 04210)

Types of Brick: (Continued)

Cored brick is made with two rows of five holes extending through the beds to reduce weight. There is no significant difference in strength between walls constructed with cored brick and those constructed with solid brick. Resistance to moisture penetration is about the same for both types of walls. The most easily available brick that will meet requirements should be used, whether the brick is cored or solid.

Sand-lime brick is made from a lean mixture of slacked lime and fine siliceous sand molded under mechanical pressure and hardened under steam pressure.

Brick Mortar (CSI 04100)

Mortar is used to bond brick together, and unless properly mixed and applied, will be the weakest part of brick masonry. Both strength and weather resistance penetration of brick masonry walls depend on the strength of the bond: brick walls usually leak through the mortar joints. Water in the mortar is essential to bond development and mortar with insufficient water will result in a weak and spotty bond.

Stone Masonry (CSI 04400)

Building stone may be used for many different types of structures, in random sizes and shapes, or in pre-cut sizes and shapes. Small, irregular building stone that has been quarried in random sizes is called “rubble” or “field-stone.” Flat, random pieces of rubble can also be assembled without mortar and will derive strength from adjacent pieces interlocking within the structure. Fieldstone may be split by hand onsite to provide a flat exterior surface for a patterned wall or fireplace.

Because of its durability, strength, and unique appearance, stone provides a wide range of structural and decorative applications as a building material. It can be installed in small units, referred to as “building stone,” which can be assembled in many different formats, with or without mortar, to create walls and veneers of all sorts.

Types of Stone:

Stone masonry units consist of natural stone. In rubble stone masonry, the stones are left in their natural state without any kind of shaping. Ashlar masonry, stones whose faces are placed in a smooth horizontal plane, are squared so that the surface of the finished structure will be more or less continuous. Both rubble and Ashlar work may be either coursed or random.

Random rubble is the roughest of all types of stonework. Stones are laid in random courses; each layer must contain bonding stones that extend through the wall. This produces a wall that is well tied together. The bed joints may run in any direction.

Coursed rubble is assembled of roughly squared stones in such a manner as to produce approximately continuous horizontal bed joints.

0.04.01.02 MASONRY-CMU (CSI 04200)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Stone Masonry (CSI 04400)

Types of Stone: (Continued)

Small stone units may also be quarry-split and processed to meet aesthetic needs. For example, decorative building stone can be purchased by the ton in 4 inch thick slabs, available in lengths ranging from 6 to 14 inch and in heights ranging from 2 to 16 inch. These pieces are commonly installed with mortar to create veneer walls of varying patterns, such as ledge stone, spider web, uncoursed rectangular, and squared. Ashlar stone, also priced by the ton, is the name given to building stones that have been sawn on the edges to produce a rectangular face. This shape makes Ashlar stone another veneer material because the pieces can be arranged in either a regular or random-coursed pattern within the face of a wall. Stone veneer can be tied to the backup wall with galvanized ties or 8 inch stone headers in a method similar to that used in brick veneer walls. Stone veneer coverage ranges from 35 to 50 square feet per ton for 4 inch wide veneer, with correspondingly reduced coverages per ton for veneers of 6 and 8 inches in width.

Large stone facing panels can be installed as decorative features in many types of commercial buildings. These panels, which are usually priced by the square foot, are available in widths of up to 5 feet and in thicknesses of approximately 1 to 5 inches. Panel faces may be clear or patterned with split, sawn, or sand-rubbed surface finish. The edges of the panel are saw-cut and the back is planed.

Masonry Composite (CSI **04210, 04220)**

Masonry composite is a multi-wythe wall designed to act as a single member in response to loads. Stress is transferred and shared by the wythes through the mortar or grout-filled collar joint and metal ties. Although not the preferred practice, a header can be placed across the filled or unfilled collar joint to provide shear transfer, instead of using metal ties and a filled collar joint. The inner wythe laid is parged with mortar not less than 3/8 inch thick before the adjacent wythe is laid. This provides composite action of the two wythes and may help prevent water penetration through the wall. In practice, the preferred method is to place and parge the inner wythe first before laying the facing wythe. All solid facing units are laid with full mortar bedding and the head is completely filled. In the header course the cross joints also should be completely filled; that is, mortar is spread over the entire side of header unit before it is shoved into place.

For walls greater than 10 inches thick, specially shaped header blocks are sometimes used to bond the facing headers and back-up units with 6th-course bonding.

Various methods may be employed for insulating concrete block walls. Rigid foams inserts or loose perlite can be used to fill the voids in the blocks of single wythe walls cans also be insulated by installing the insulating material between the furring strips for the interior face of the wall. For cavity walls, rigid-board insulation may be attached within the cavity to the surface of the inner wythe.

Different cleaning and finishing techniques may be used to enhance the appearance of block walls and to protect them from the elements. Small amounts of dried mortar and soiling can be cleaned from the block surface with a stiff brush. Exterior and interior block walls can be painted or coated with a variety of opaque and clear sealers.

0.04.01.02 MASONRY-CMU (CSI 04200)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

Masonry Cavity (CSI 04210, 04220)

Masonry cavity is a multi-wythe wall with noncomposite action, allowing each wythe to independently accept and react to stress relative to its stiffness. A cavity wall consists of two walls separated by a continuous air space. Cavity walls more than 4 inches wide must have ties designed to support the load without pullout or buckling to allow compatible lateral deflection between wythes. The facing wall usually consists of one wythe of solid or hollow masonry walls 3 1/2 to 4 inches thick. The backing may be single-or multi-wythe solid or hollow masonry wall. The backing thickness may be equal to or greater than that of the facing, depending on structural requirements such as wall height and loads to be carried by the backing; the outer wall serves as a weather-protective facing. Tied together, both walls act to resist the wind, although not necessarily equally.

In areas of severe weather exposure, the wall cavity offers three main advantages:

- It increases the insulating value of the wall and permits insulation within the wall.
- It prohibits water or moisture from passing across the wall.
- It prevents condensation from forming on interior surfaces; therefore, plaster may be applied directly to the masonry without furring or the interior surface may be used as the finished wall without plastering.

Insulation placed within the cavity consists of mats, rigid boards, or non-water-absorbent fill material. Mats or rigid boards may be glass fiber, foamed glass, or foamed plastics. A vapor barrier or dampproofing is required on the cavity face of the inner wall unless waterproofed insulation is used or the insulating rigid boards are held at least 1 inch away from the'exterior wall.

Glass Block (CSI 04270)

Glass block, which was a popular building material in the 1930s, has recently undergone a revival in the construction industry, particularly for exterior walls. It has the dual advantage of admitting light but preventing heat transmission. The maximum freestanding wall area recommended using glass block construction is 144 square feet, however larger areas are feasible using intermediate bracing.

Glass block offers the advantages of excellent light diffusion and good thermal insulation, and also comes in more decorative types. It can provide privacy yet allow limited visual accessibility, and is therefore used in places where limited privacy is required or desired. Patterns may be introduced into the glass during the forming process. Ceramic designs can be fused to the surface for a decorative finish, but this will increase the cost.

Glass block can be placed on a raised base, plate, or sill, provided that the surfaces to be mortared are primed with asphalt emulsion. Wall recesses and the channel tract that receive the glass block should be lined with expansion strips prior to oakum filler and caulking.

Jointing & Anchoring:

Horizontal joint reinforcing is specified for flexural as well as shrinkage control and is laid in the joints along with the mortar. End blocks are anchored to the adjacent construction with metal anchors, if no other provisions for attachment exist. If intermediate support is required, vertical I-shaped stiffeners can either be installed in the plane of the wall or adjacent to it, but the stiffeners should be tied to the wall with wire anchors. The top of the wall is supported between angles or in a channel track similar to the jambs.

Glass block is manufactured in sizes from 6 x 6 inches to 12 x 12 inches , with thickness from 3 to 4 inches. The block may be hollow or fused; the latter allows vision through the block. Inserts can be manufactured into the block to reduce solar transmission to the building interior.

0.04.01.02 MASONRY-CMU (CSI 04200)

OTHER RELATED COMPONENTS

Refer to Foundations & Footing and Superstructure Systems, Volumes 1 and 3, for additional deficiencies that may impact this system.

0.04.01.02 MASONRY-CMU (CSI 04200)

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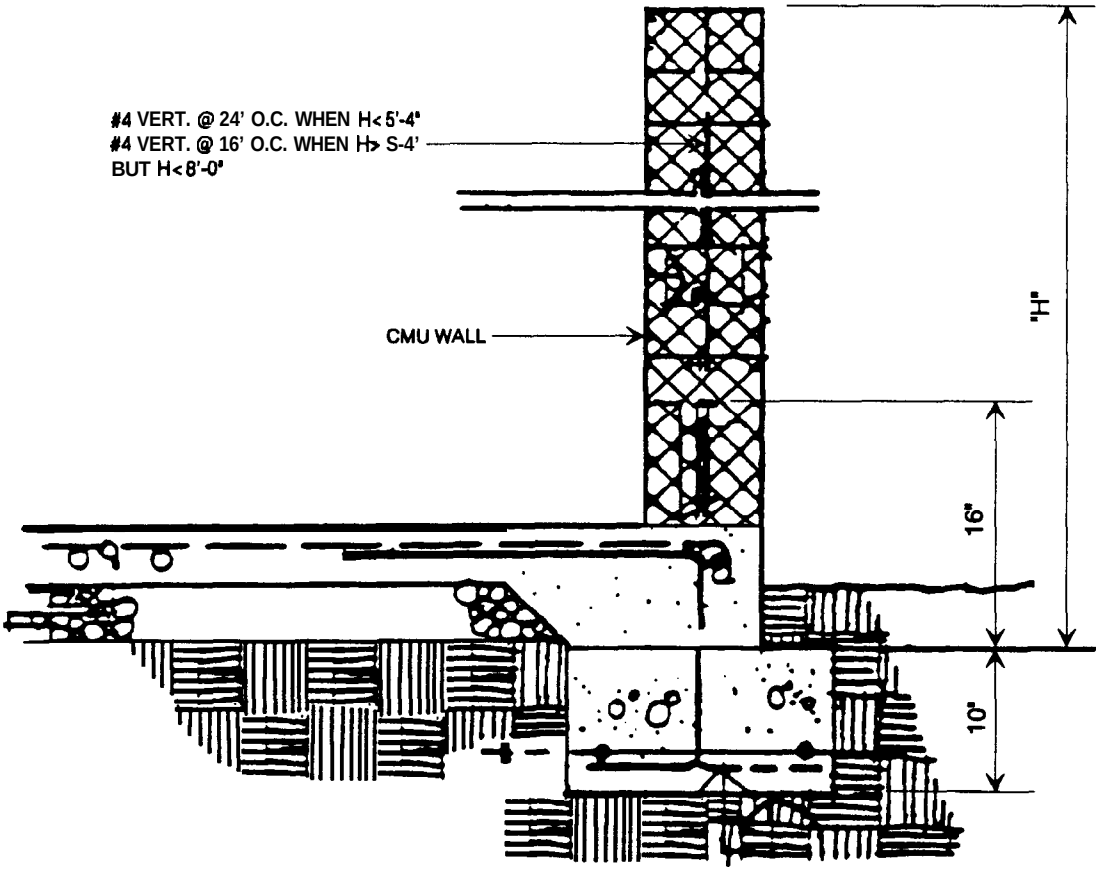
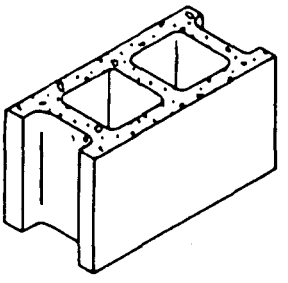
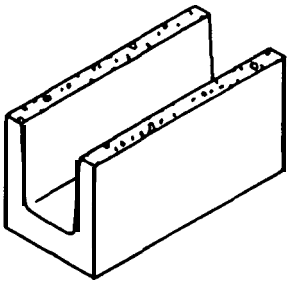


CMU WALL DE?-AIL

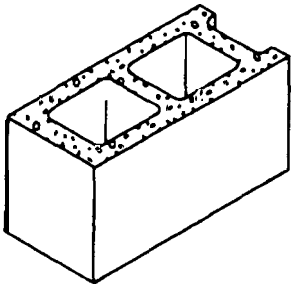
SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	WALL SECTION		
WALLS MASONRY (CSI 04220)	Revision No.	Issue Date 5/93	Drawing No. A040102-1



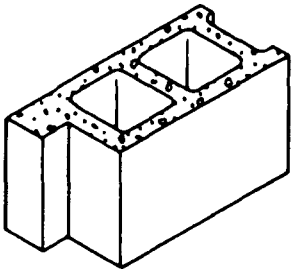
STRETCHER



BOND BEAM

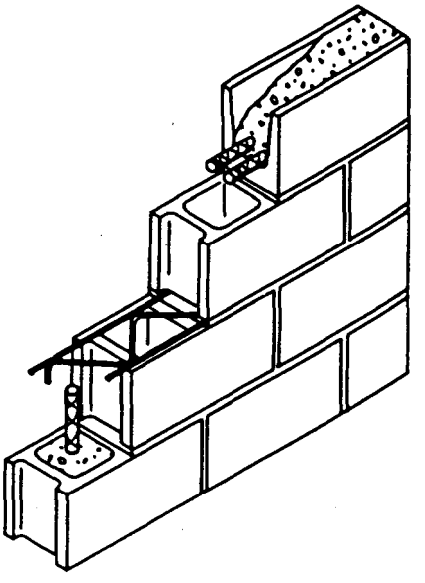


CORNER BLOCK



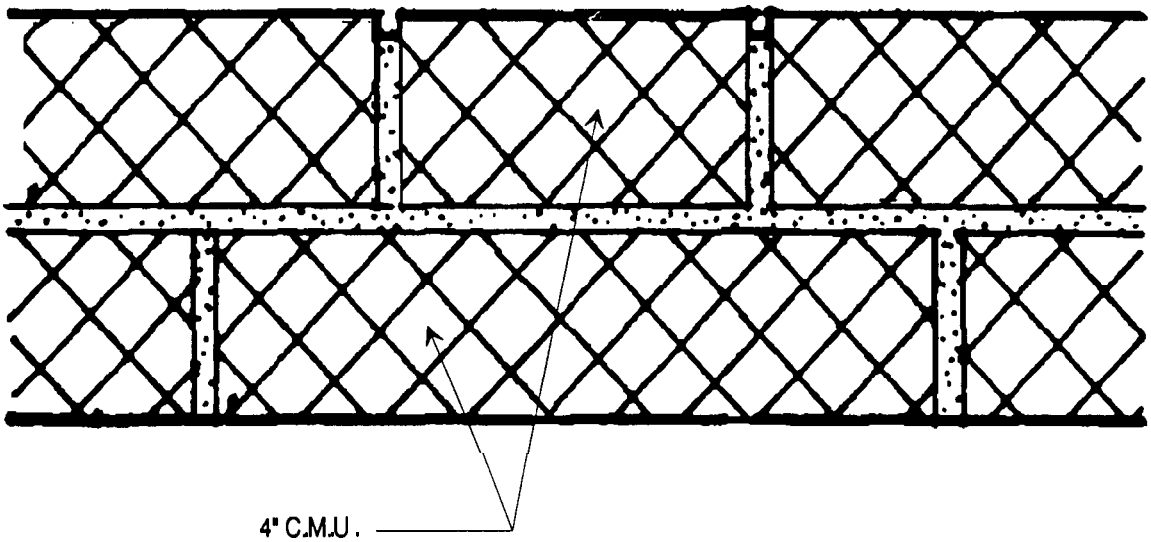
JAMB BLOCK

TYPICAL CONCRETE BLOCK SHAPES



REINFORCED, GROUTED CONCRETE MASONRY WALL

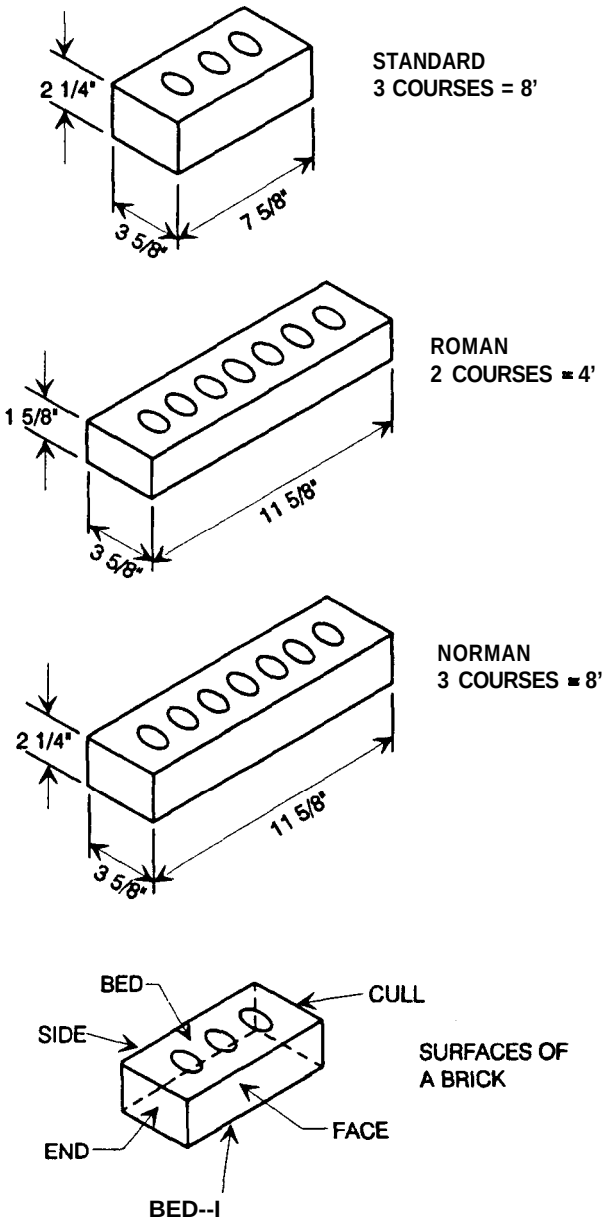
SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	MASONRY UNIT CONFIGURATIONS		
WALLS MASONRY (CSI 04220)	Revision No.	Issue Date 5/93	Drawing No. A040102-2



NOTE: PROVIDE DUROWALL. 16' O.C. VERTICALLY (TYP.)

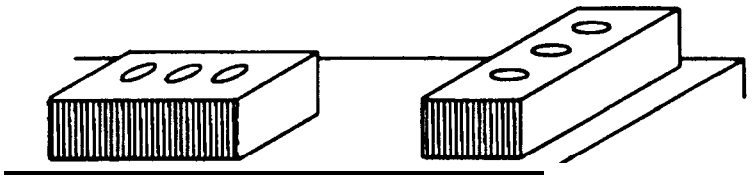
TYPICAL EXTERIOR WALL

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	CONCRETE MASONRY WALL		
WALLS MASONRY (CSI 04220)	Revision No.	Issue Date 5/93	Drawing No. A040102-3

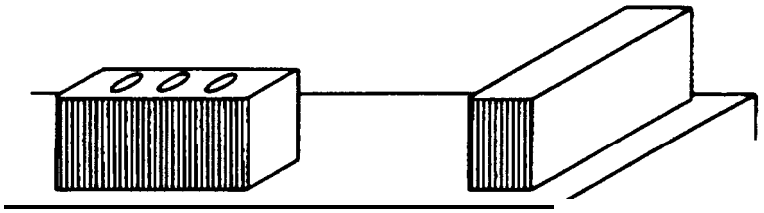


SIZES AND FACES OF BRICK

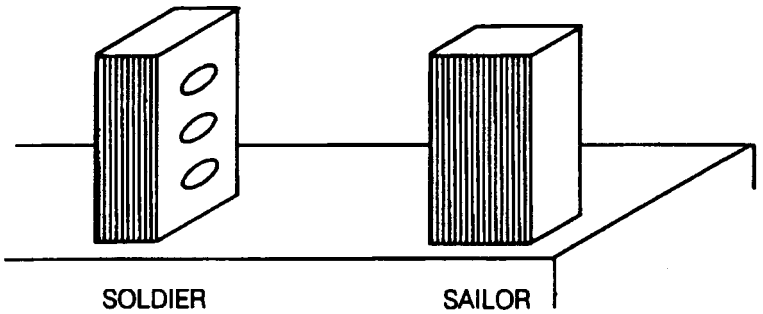
SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	BRICK SIZING		
WALLS MASONRY (CSI 04200)	Revision No.	Issue Date 5/93	Drawing No. A040102-4



STRETCHER HEADER



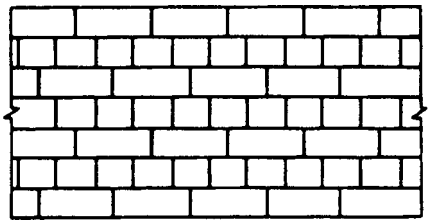
BULL STRETCHER BULL HEADER
(ROWLOCK COURSE)



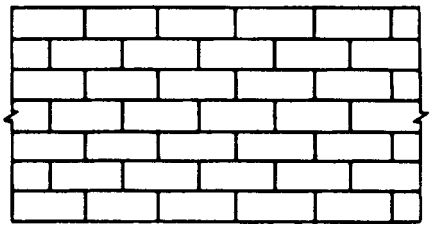
SOLDIER SAILOR

BRICK COURSES

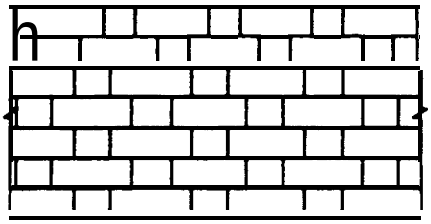
SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	BRICK PLACEMENT TERMINOLOGY AND CONSTRUCTION CONFIGURATIONS		
WALLS MASONRY (CSI 04200)	Revision No.	Issue Date 5/93	Drawing No. A040102-5



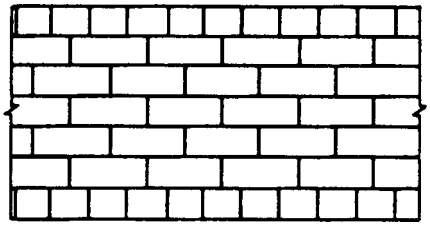
CROSS BOND



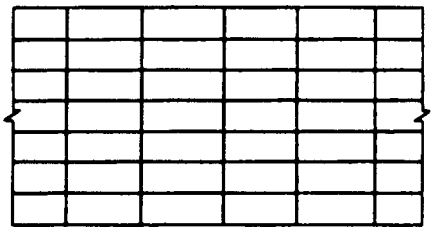
STRETCHER BOND
(ALSO KNOWN AS RUNNING BOND)



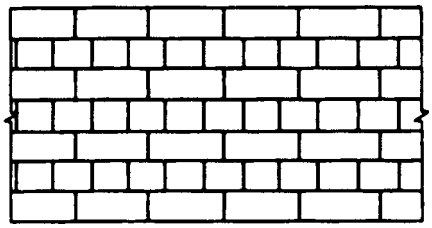
FLEMISH BOND



COMMON BOND



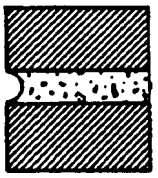
STACK BOND



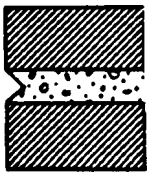
ENGLISH BOND

BRICK BOND PATTERNS

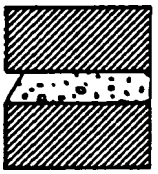
SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	BRICK WALL CONFIGURATIONS AND TERMINOLOGY		
WALLS MASONRY (CSI 04200)	Revision No.	Issue Date 5/93	Drawing No. A040102-6



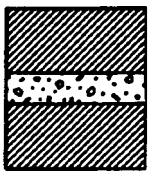
CONCAVE



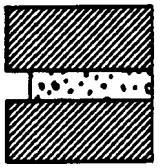
VEE



WEATHER STRUCK



FLUSH



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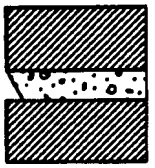
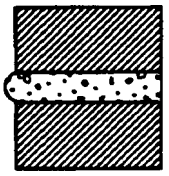


TROWEL STRUCK



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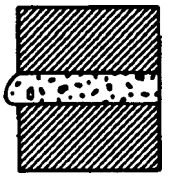
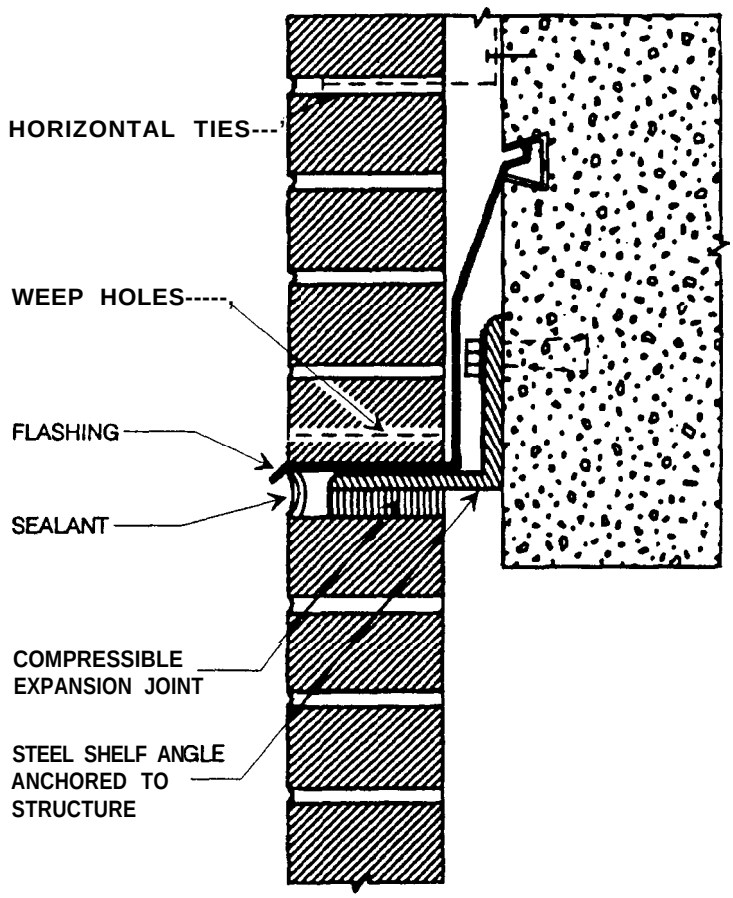


EXTRUDED

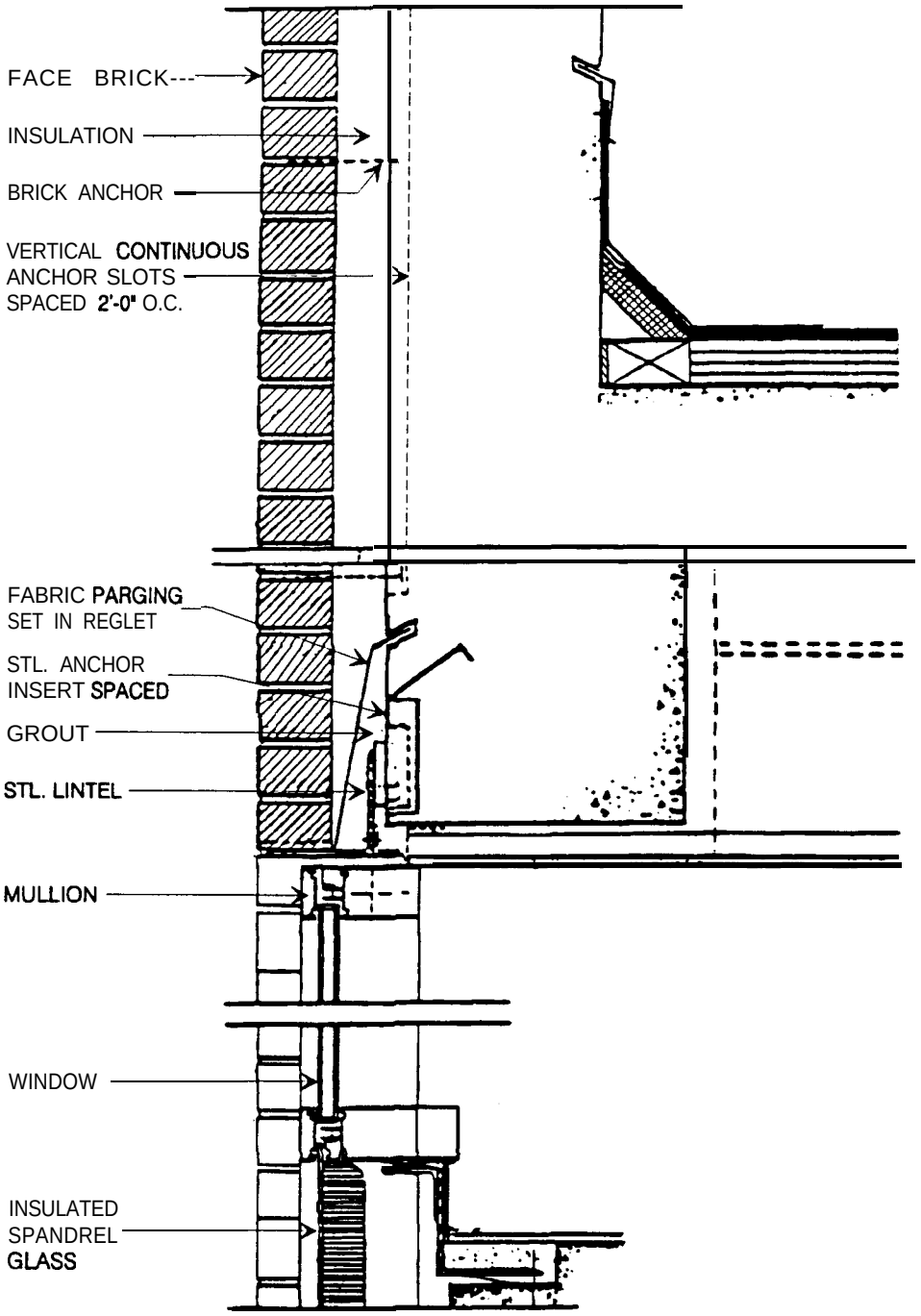
BRICK JOINTS

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	TYPES OF BRICK WALL GROUT JOINTS		
WALLS MASONRY (CSI 04200)	Revision No.	Issue Date 5/93	Drawing No. A040102-7



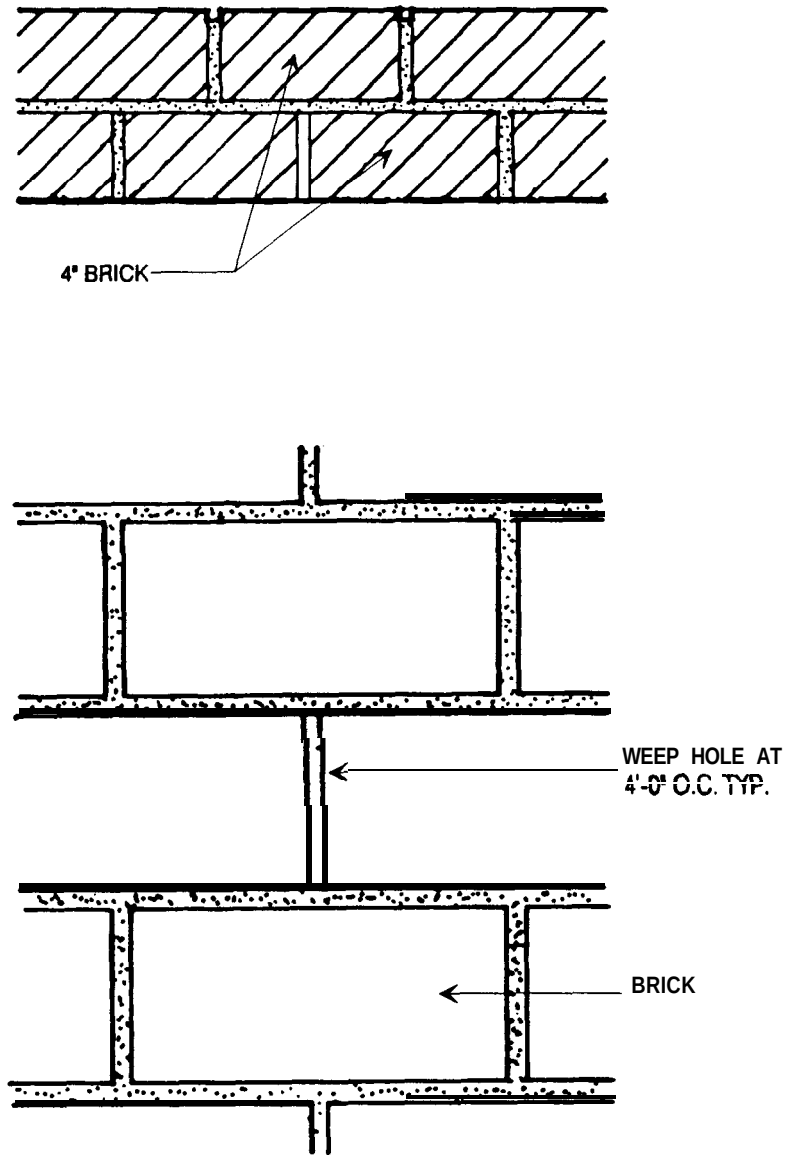
TYPICAL ATTACHMENT OF BRICK
FLASHING AT INTERMEDIATE FLOOR

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	BRICK WALL CONSTRUCTION		
WALLS MASONRY (CSI 04200)	Revision No.	Issue Date 5/93	Drawing No. A040102-8



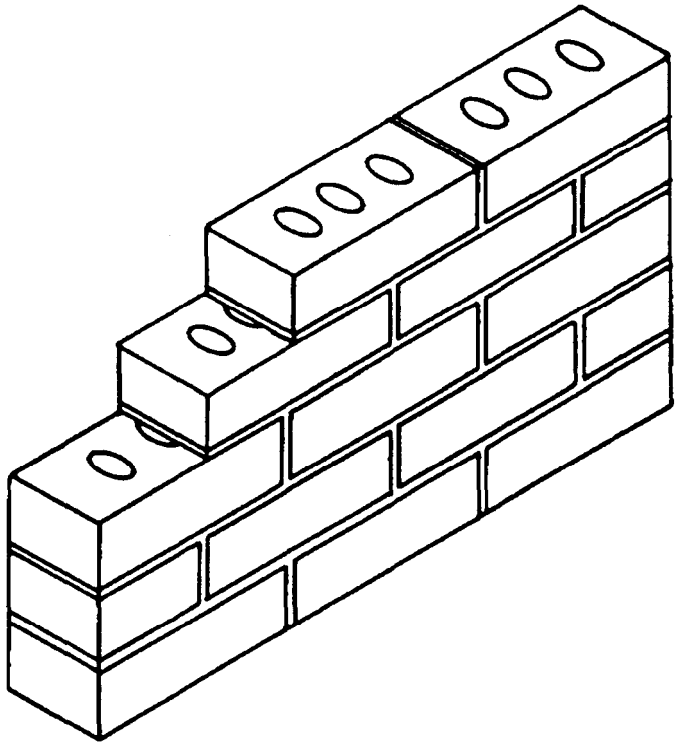
WALL SECTION

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	BRICK WALL CONSTRUCTION		
WALLS MASONRY (CSI 04200)	Revision No.	Issue Date 5/93	Drawing No. A040102-9



TYPICAL EXTERIOR WALL

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	TYPICAL BRICK WALL CONFIGURATION		
WALLS MASONRY (CSI 04200)	Revision No.	issue Date 5/93	Drawing No. A040102-10

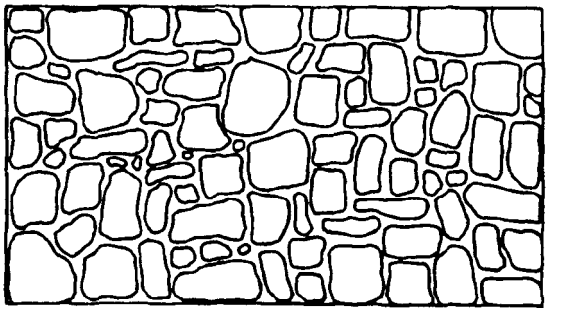


SINGLE WYTHE WALL

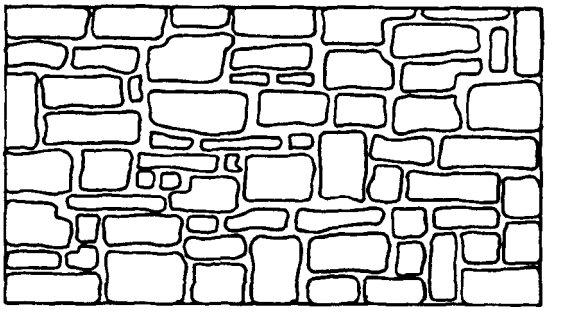
SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	BRICK WALL CONFIGURATION		
WALLS MASONRY (CSI 04210)	Revision No.	Issue Date 5/93	Drawing No. A040102-11

TYPES	USES
granite	exterior wall panels interior finish panels flooring base trim water courses counter tops thresholds lintels window sills stair treads hearths sculpture chips for terrazzo
marble	exterior wall panels interior finish panels flooring base trim toilet partitions thresholds table tops stair treads hearths window sills sculpture chips for terrazzo
limestone	exterior wall panels coping lintels sculptured trim
slate	flooring stair treads roofing blackboards counter tops
sandstone	flooring exterior paving

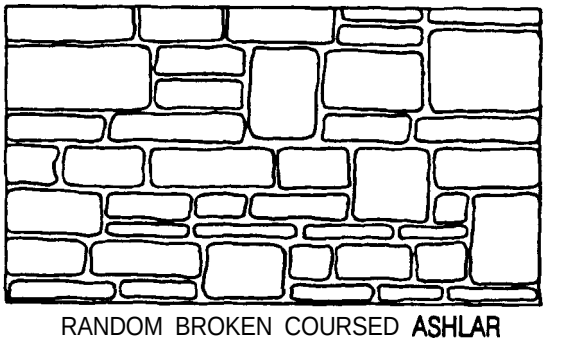
STONES USED IN CONSTRUCTION



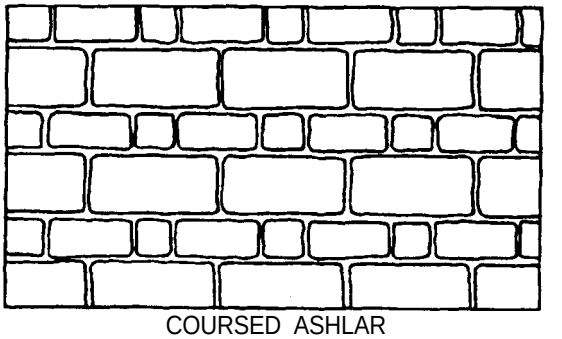
UNCOURSED RUBBLE
(RANDOM RUBBLE)



UNCOURSED ROUGHLY SQUARED



RANDOM BROKEN COURSED ASHLAR
(IRREGULAR COURSED ASHLAR)



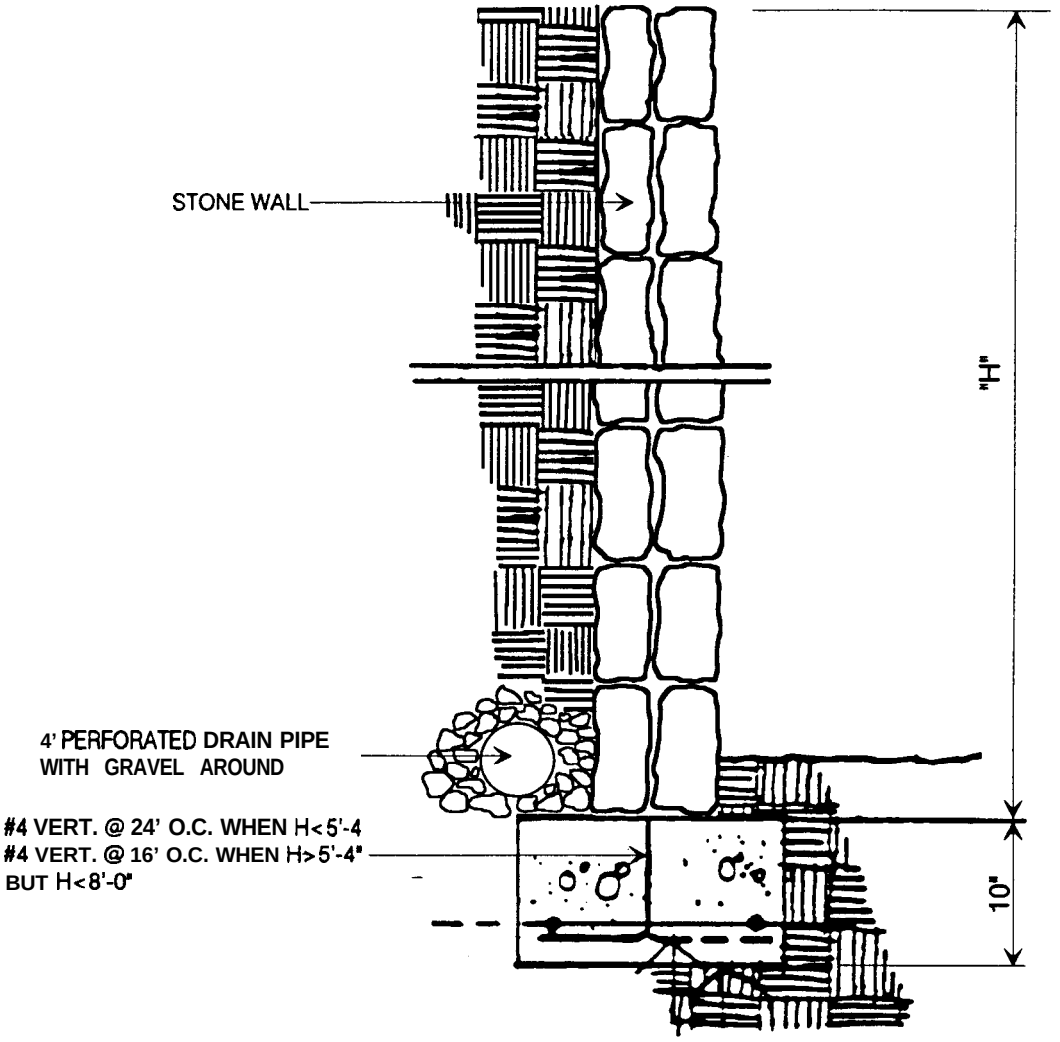
COURSED ASHLAR
(REGULAR COURSED ASHLAR)

STONE PATTERNS

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE

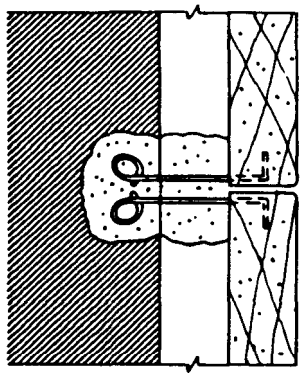
STONE WALL CONFIGURATIONS

WALLS MASONRY (CSI 04400)	Revision No.	Issue Date 5/93	Drawing No. A040102-12

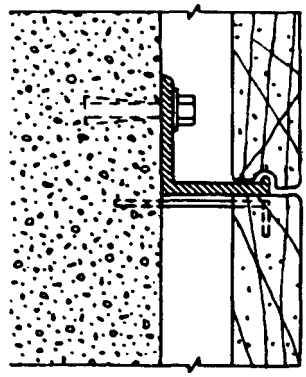


STONE RETAINING WALL DETAIL

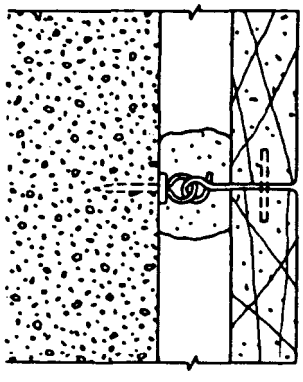
SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	STONE WALL CONSTRUCTION		
WALLS MASONRY (CSI 04400)	Revision No.	Issue Date 5/93	Drawing No. A040102-13



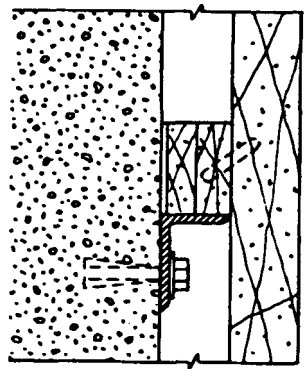
WIRE ANCHOR TO MASONRY



HORIZONTAL JOINT SUPPORT

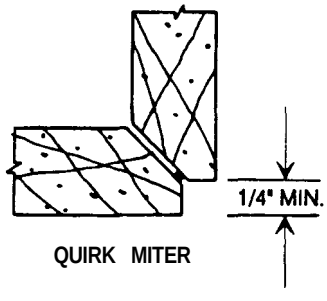


POWER ACTUATED ANCHOR

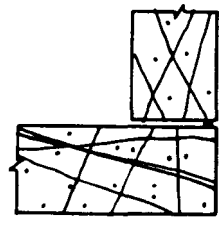


STONE LINER

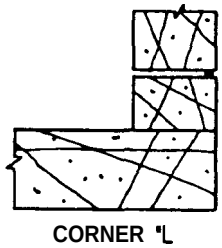
VENEER STONE ANCHORING DEAILS



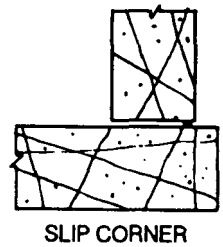
QUIRK MITER



BUTT JOINT



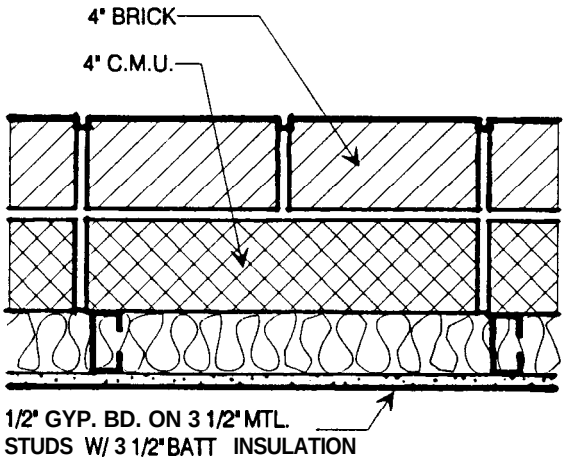
CORNER "L



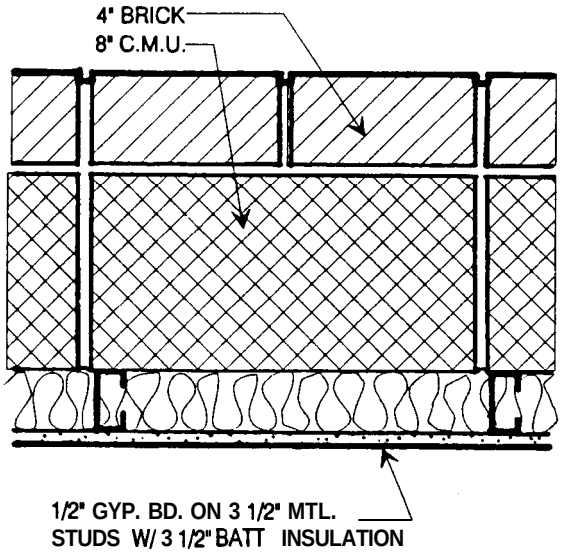
SLIP CORNER

VENEER STONE CORNER JOINTS

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	TYPICAL STONE VENEER CORNER JOINTS AND ANCHORING CONFIGURATIONS		
WALLS MASONRY (CSI 04400)	Revision No.	Issue Date 5/93	Drawing No, A040102-14

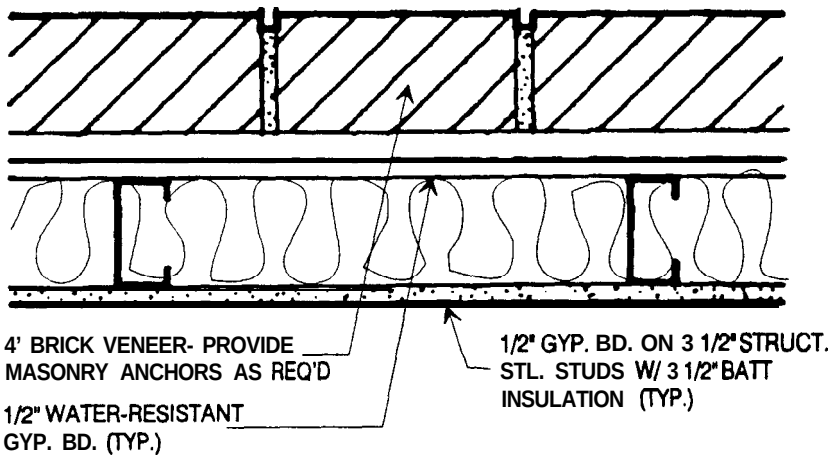


EXTERIOR COMPOSITE WALL

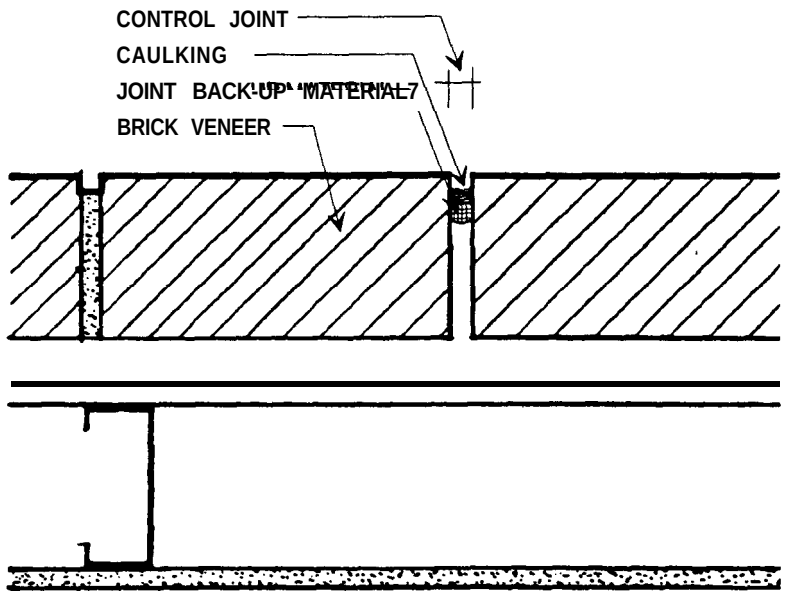


EXTERIOR COMPOSITE WALL

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	COMPOSITE WALL CONSTRUCTION		
WALLS MASONRY (CSI MULTIPLE)	Revision No.	Issue Date 5/93	Drawing No. A040102-15



EXTERIOR COMPOSITE WALL



EXTERIOR COMPOSITE WALL

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	COMPOSITE WALL CONSTRUCTION		
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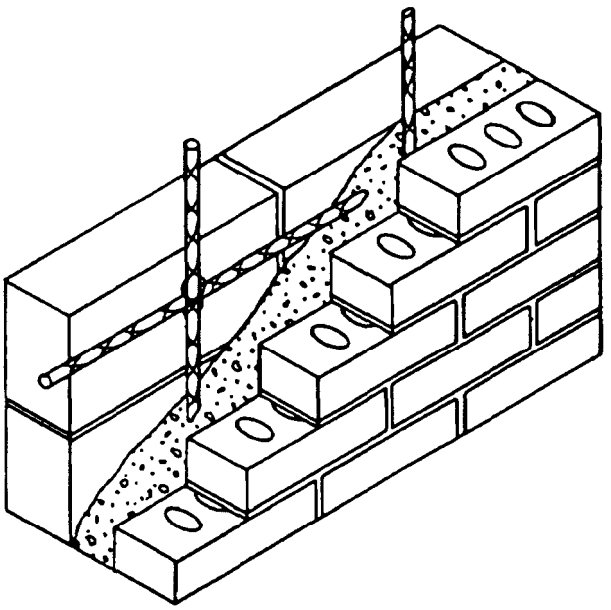
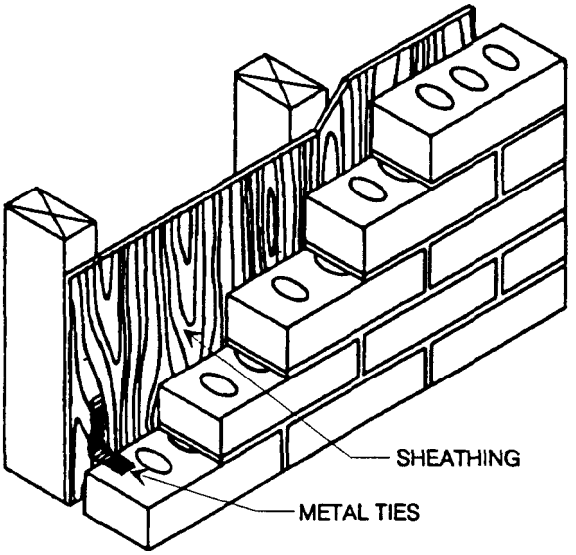
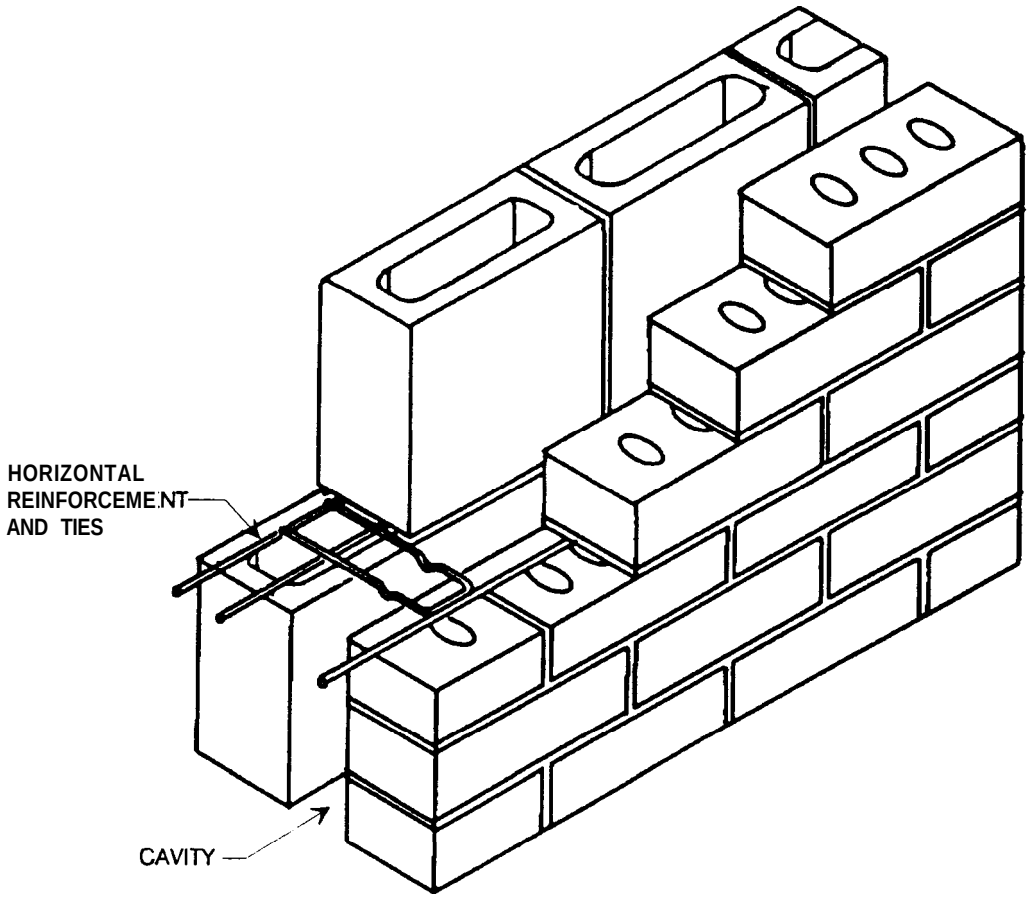


REINFORCED GROUTED MASONRY



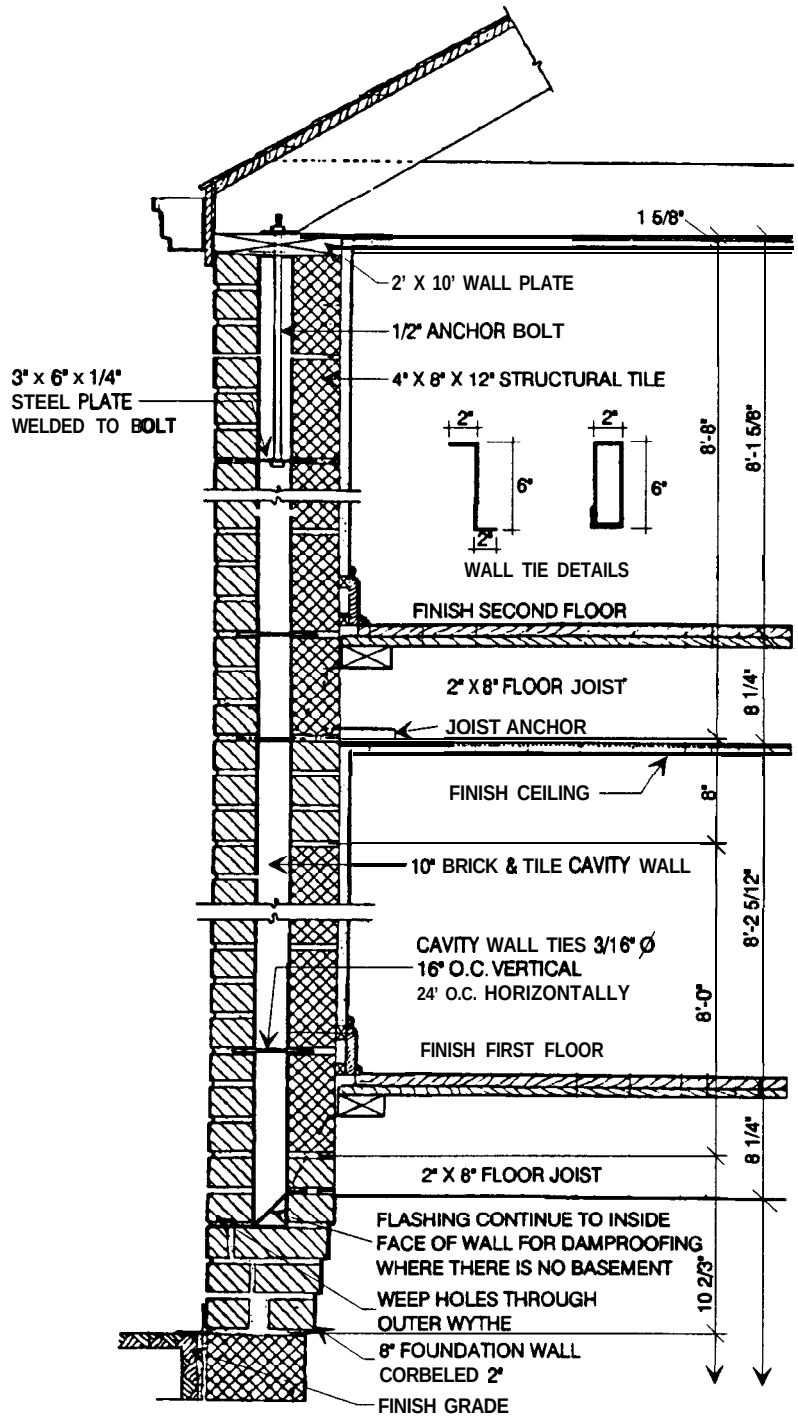
VENEERED WALL

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	COMPOSITE BRICK WALL CONSTRUCTION		
WALLS MASONRY (CSI MULTIPLE)	Revision No.	Issue Date 5/93	Drawing No. A040102-17



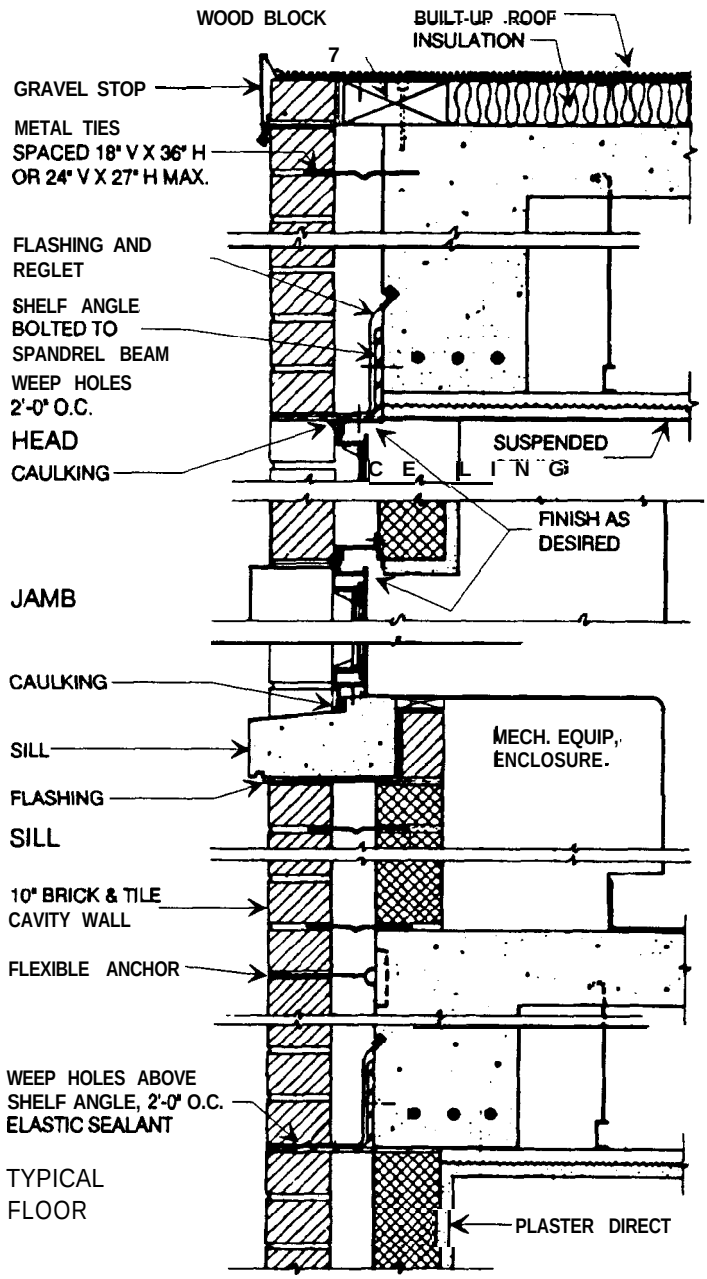
CAVITY WALL

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	CAVITY WALL CONSTRUCTION		
WALLS MASONRY (CSI 04210)	Revision No.	Issue Date 5/93	Drawing No. A040102-18



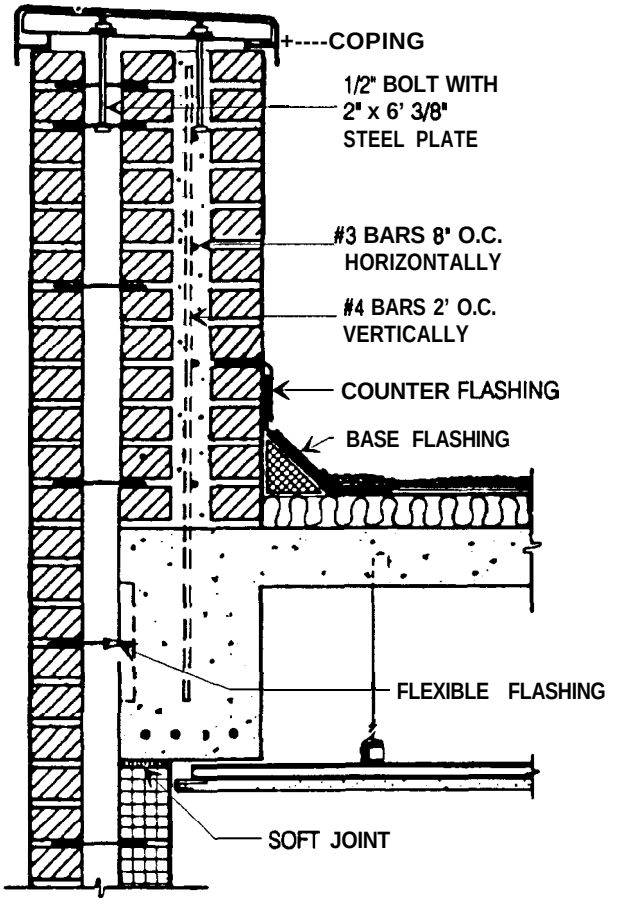
TYPICAL CAVITY WALL SECTION

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	CAVITY WALL CONSTRUCTION		
WALLS MASONRY (CSI 04210)	Revision No.	Issue Date 5/93	Drawing No. A040102-19



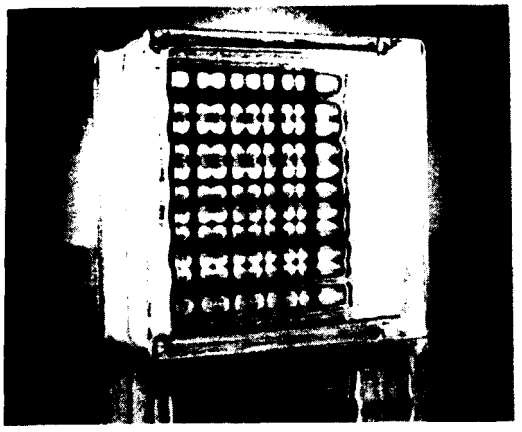
TYPICAL WALL SECTION • CAVITY CURTAIN WALL

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	CAVITY WALL CONSTRUCTION		
WALLS MASONRY (CSI 04210)	Revision No.	Issue Date 5/93	Drawing No. A040102-20

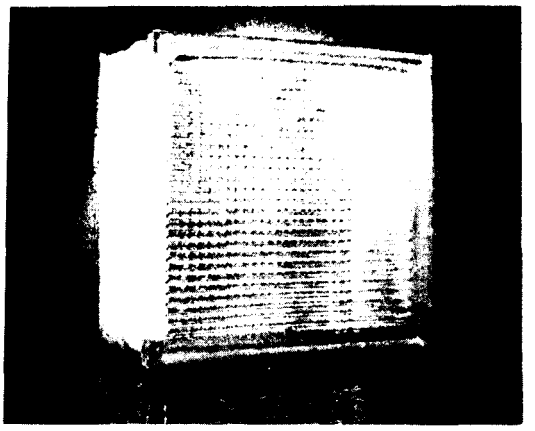


REINFORCED BRICK PARAPET WALL

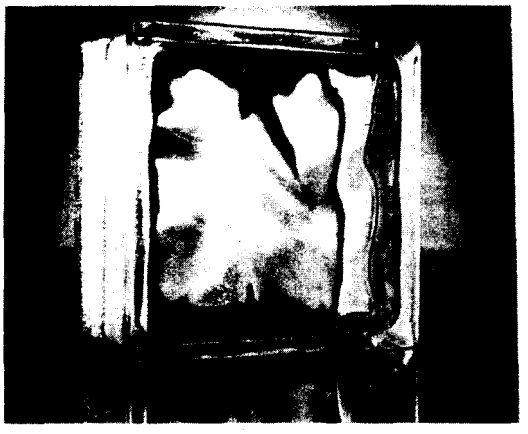
SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	CAVITY WALL CONSTRUCTION		
WALLS MASONRY (CSI 04210)	Revision No.	Issue Date 5/93	Drawing No. A040102-21



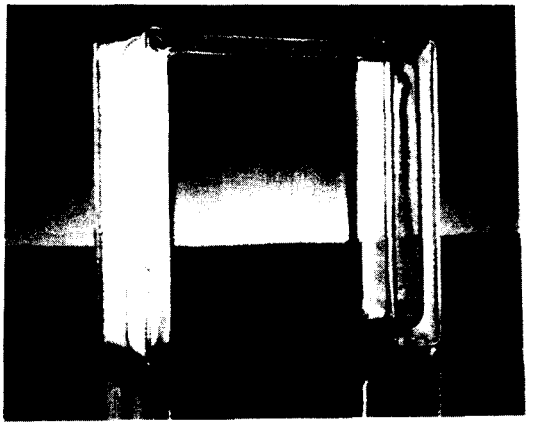
ROUNDED FLUTE



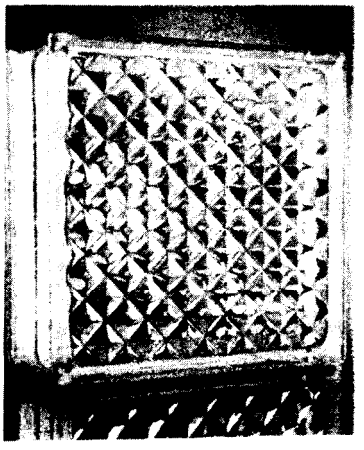
FINE GRID



WAVY FACE



SMOOTH FACE

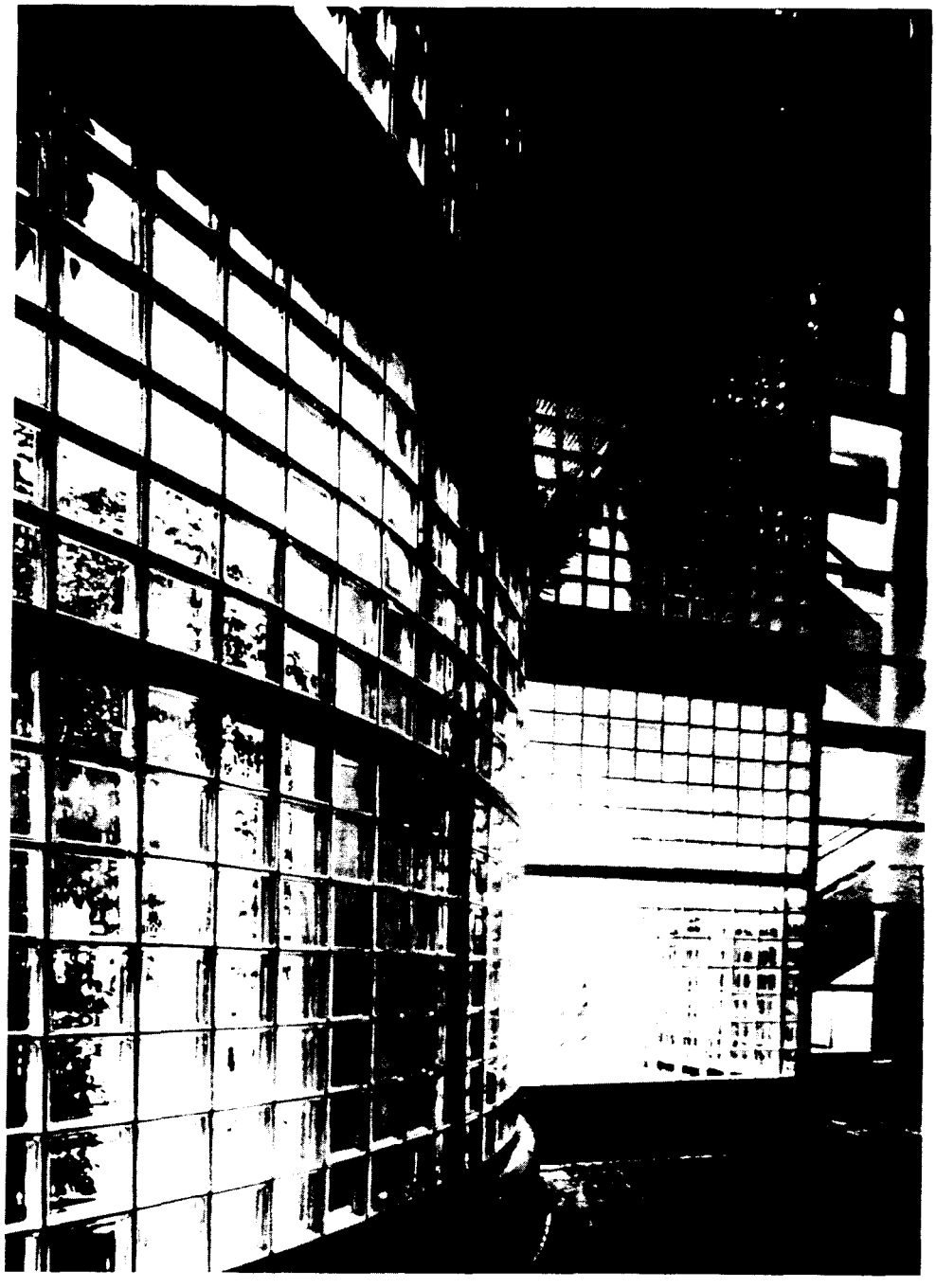


PRISMATIC PATTERN

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	GLASS BLOCK UNIT TYPES		
WALLS MASONRY (CSI 04270)	Revision No.	Issue Date 5/93	Drawing No. A040102-22

SOURCE: Pittsburgh Corning Corporation, PC GlassBlock Products

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	GLASS BLOCK CONFIGURATIONS		
WALLS MASONRY (CSI 04270)	Revision No.	Issue Date 5/93	Drawing No. A040102-23



SOURCE: Pittsburgh Corning Corporation, PC GlassBlock Products

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	GLASS BLOCK CONFIGURATIONS		
WALLS MASONRY (CSI 04270)	Revision No.	Issue Date 5/93	Drawing No. A040102-24

DEFICIENCY FACTORS
0.04.01.02 MASONRY-CMU (CSI 04200)

PROBABLE FAILURE POINTS

- A wide variety of poor construction practices can result in cracking in stone structure, especially adding water to mortar to improve workability. Added water has the effect of reducing strength, increasing settlement, and increasing ultimate drying shrinkage.
- Construction overloads load induced during construction can be far more severe than those experienced in the lifetime of the structure. Unfortunately, these conditions may occur at early ages when the concrete is most susceptible to damage and often result in cracks.
- Errors in design and detailing the effects of improper design and/or detailing range from poor appearance to lack of serviceability to catastrophic failure.
- A number of deleterious chemical reactions may result in mortar cracks. These reactions may be due to the aggregate used to make mortar or materials that come into contact with it after it has hardened or cured.

SYSTEM ASSEMBLIES/DEFICIENCIES

Masonry

Staining:	Discoloration in the surface of a material from a foreign substance or material.
Efflorescence:	A whitish powdery deposit of soluble salts brought to the surface by moisture; leaves residue after evaporating.
Plant Growth Moss/Algae:	Moss or algae growth over the surface, usually from excessive moisture.
Inadequate Expansion Joint:	Lack of expansion or control joints resulting in surface cracks from stresses.
Damaged/Missing Sections:	Broken, damaged, cracked, or missing units or sections.
Corrosion:	Corrosion of steel linters/shelf.
Cracks:	Caused by foundation/footing settling.
Spalling:	Fragment detached from masonry by action of weather, pressure, or expansion within the larger mass.
Joint Mortar Deteriorated/Missing:	Caused by weather, incorrect mortar joints, settlement,
Impact Damage:	Depressions, dents, or buckled surface from objects striking or impacting the surface.

DEFICIENCY FACTORS
0.04.01.02 MASONRY-CMU (CSI 04200)

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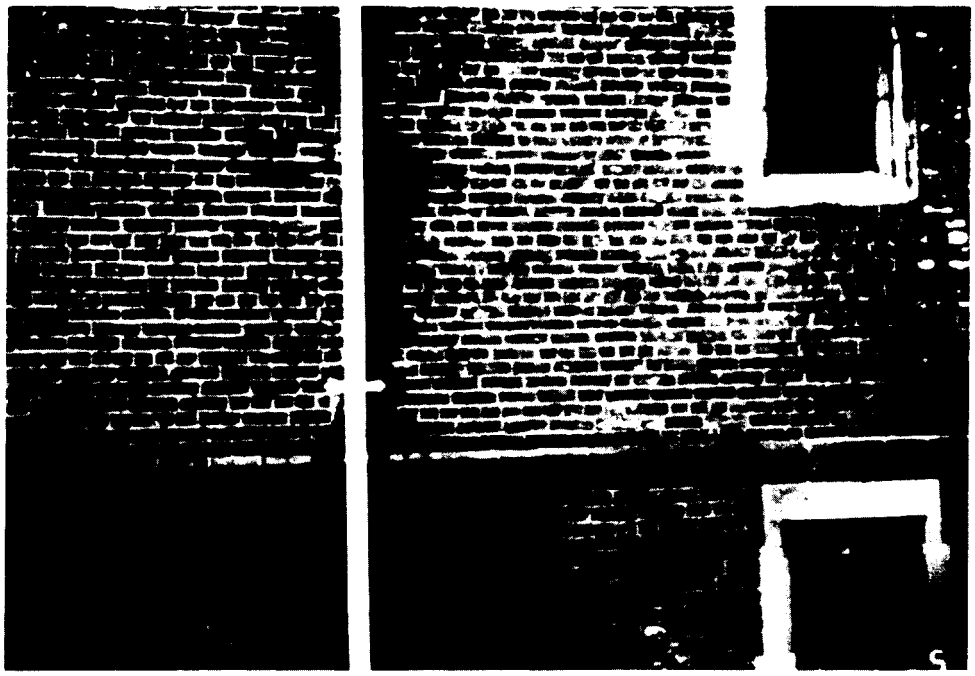


EFFLORESCENCE

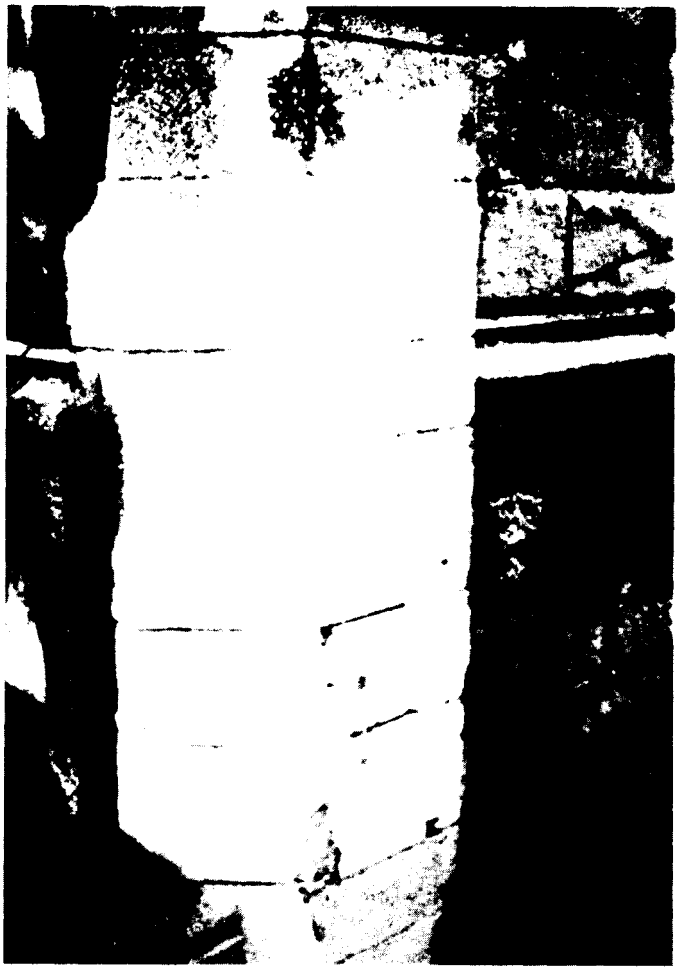
PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-EXTERIOR CLOSURE	EFFLORESCENCE ON BRICK WALLS		
WALLS MASONRY (CSI 04210)	Revision No.	Issue Date 5/93	Drawing No. D040102-1

SPALLING, CHIPPING AND EFFLORESCENCE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-EXTERIOR CLOSURE	STONE DETERIORATION		
WALLS MASONRY (CSI 04400)	Revision No.	Issue Dote 5/93	Drawing No. D040102-2



SPALLING, CHIPPING AND EFFLORESCENCE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-EXTERIOR CLOSURE	STONE DETERIORATION		
WALLS MASONRY (CSI 04400)	Revision No.	Issue Date 5/93	Drawing No. D040102-3

DEFICIENCY FACTORS
0.04.01.02 MASONRY-CMU (CSI 04200)

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DEFICIENCY FACTORS
0.04.01.02 MASONRY-CMU (CSI 04200)

END OF SUBSECTION

0.04.01.03 STUCCO (CSI 09200)

DESCRIPTION

Stucco is the term given to plaster whenever it is applied on the exterior of a building. Stucco can be applied over wood frames or masonry structures, but the surface must be prepared, eg., lath scoured gypsum. The end product has all the desirable properties of concrete: it is hard, strong, fire resistant, does not deteriorate after repeated wetting and drying, resists rot and fungus, and retains color. Graphic assembly details that follow illustrate general assembly/component types only and are not meant as a definitive, exhaustive, in-depth system breakdown. Field conditions will vary and are subject to project type, local requirements, and facility design.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

stucco (CSI 09200)

Stucco is a mixture of Portland cement, hydrated lime, aggregate, and water used as an exterior wall covering, durable when properly mixed and applied. Stucco hardens and sets slowly enough to permit texturing or finishing the final coat in any desired fashion. Properly mixed and applied stucco increases in strength and density with age and is a fairly good insulator against heat or cold.

Composition of Stucco:

Portland cement is a finely powdered material manufactured primarily from limestones and clays or shales. It is the binding agent in stucco and chemically interacts with water to form a paste that binds the other aggregate particles together into a solid state.

The aggregate in stucco is a fine natural sand or is prepared from stone or blast furnace slag, and should be in the same conformance as concrete sand. The importance of proper aggregates for Portland cement stucco cannot be overemphasized.

For finish coats, it may be necessary to use a somewhat finer aggregate, but an excessively fine aggregate is one of the principle causes of crazing and cracking.

Potable water is the only water that can be used for stucco application.

High-grade mineral pigments are used for coloring stucco. Such pigments have the highest color values and are the most economical because less is required to produce the desired effect.

Metal Lath (CSI 05400)

The most common method of applying stucco is on metal lath attached to metal or wood studs. Several types of metal lath are available: expanded diamond mesh, paper-backed diamond mesh, flat-rib lath, and high-rib lath.

Expanded diamond lath is a general-purpose type used for flat and curved surfaces. The paper-backed type has an asphalt-impregnated paper applied to it and is used as a base for plaster under ceramic tile. Rib lath is more rigid due to the one-way, V-shaped ribs about 4 inches on center. It is used for ceilings and solid partitions.

OTHER RELATED COMPONENTS

See the following subsections for related components:

0.04.01 Walls 2.1-1

0.04.01.03 STUCCO (CSI 09200)

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DEFICIENCY FACTORS
0.04.01.03 STUCCO (CSI 09200)

PROBABLE FAILURE POINTS

- Lack of curing will increase the degree of cracking within a stucco finish
- The weathering processes that can cause cracking include (1) freezing and thawing, (2)wetting and drying, and (3)heating and cooling.
- A number of deleterious chemical reactions may result in stucco cracks. These reactions may be due to the aggregate used to make the stucco that comes into contact with the concrete after it has hardened.
- A wide variety of poor construction practices can result in cracking in stucco finish, especially adding water to stucco to improve workability. Added water has the effect of reducing strength, increasing settlement, and increasing ultimate drying shrinkage.

SYSTEM ASSEMBLIES/DEFICIENCIES

Settlement:	Solid particles sink in fresh stucco mix, after placement and before initial set.
Alkali-Aggregate Expansion:	Chemical reaction between aggregate and cement paste causing separation and bond break-up.
Cavitation:	Rapid movement of water or other liquids across the surface.
Cracking (Active & Dormant):	Construction movement, settlement, shrinkage around reinforcement. Inadequate finishing and curing. Physical reactions such as drying shrinkage. Thermal changes (subjected to temperature extremes such as freeze/thaw cycles).
Crazing:	Too high a slump. Too rich a mix. Poor timing on finishing. Too rapid absorption of moisture.
Holes (Small & Large):	Chemical reaction. Inadequate construction and design.
Efflorescence:	A whitish, powdery deposit of soluble salts brought to the surface by moisture. Leaves a residue after evaporation.
Missing, Delamination of Surfaces:	Caused by condensation.
Surface Deterioration:	Small surface cracks, corrosion, and surface breakdown due to weather, pressure, or other actions.
Impact Damage:	Depressions, dents, or buckled surface from objects striking or impacting the surface.

DEFICIENCY FACTORS
0.04.01.03 STUCCO **(CSI 09200)**

END OF SUBSECTION

0.04.02.01 METAL SIDING (CSI 05500)

DESCRIPTION

Materials commonly used for metal exterior sidings include aluminum, protected metal, galvanized iron and steel, and prefabricated sheet metal. They span distances from 3 to 12 feet. The ability to transfer wind loads across these spans depends on the gauge of the sheet metal and the profile that is formed with the sheet during rolling. Where structural strength is not required, the corrugation can be regarded as merely an architectural feature. Graphic assembly details that follow illustrate general assembly/component types only and are not meant as a definitive, exhaustive, in-depth system breakdown. Field conditions will vary and are subject to project type, local requirements, and facility design.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Metal Siding (CSI 05500)

Metal siding can be finished with a variety of coatings for corrosion protection. Steel siding panels may be galvanized, aluminum, or stainless steel. Both aluminum and steel siding can have a baked enamel or porcelain finish.

Precision shop fabrication of metal siding and new methods of fastening panels with interlocking joints and clips generally ensure against misalignment in erecting buildings. For a more custom installation, panel ribs and flat sheets can be supplied as separate components to be installed to a stud and sheathing backup system within the constraints of the field conditions. The exposed open ends of ribs can be closed with “plugs” if coping is not desirable or crimped to form slope transitions. A very dramatic vertical rib effect can be obtained by mounting a standard 4 inch panel on horizontal carriers that will support the ribs in a variety of angles to the plane of the exterior wall, giving a “louvered” appearance.

A total siding system involves the metal panels fastened to a structural girt support, with the addition of insulation and back-up (liner) panels. In some metal siding systems, the liner panel and insulation are installed to the girt first. The face panel then interlocks with grooves in the liner panel. Face and liner panel thickness range from 20 to 24 gauge, and the span can reach 8 feet.

When the face and the liner panels are stiffened by inserting a subgirt between them, the allowable span will increase to 15 feet for 22 gauge and 30 feet to 18 gauge (and a deeper profile). The structural girt may be eliminated altogether if the liner panel and the liner system can be factory-assembled to save installation time in the field. The liner panel may be perforated to provide sound absorption. A multi-leaf gypsum wallboard layer can also be enclosed in a double-subgirt system with the face and liner panel to provide a fire-rated wall panel. Some factory-assembled panels have a foamed-in-place insulation that is bonded to the face and liner sheet to provide composite structural action.

OTHER RELATED COMPONENTS

See the following subsections for related components

0.04.01 Walls 2.1.1-I

0.04.02.01 METAL SIDING (CSI 05500)

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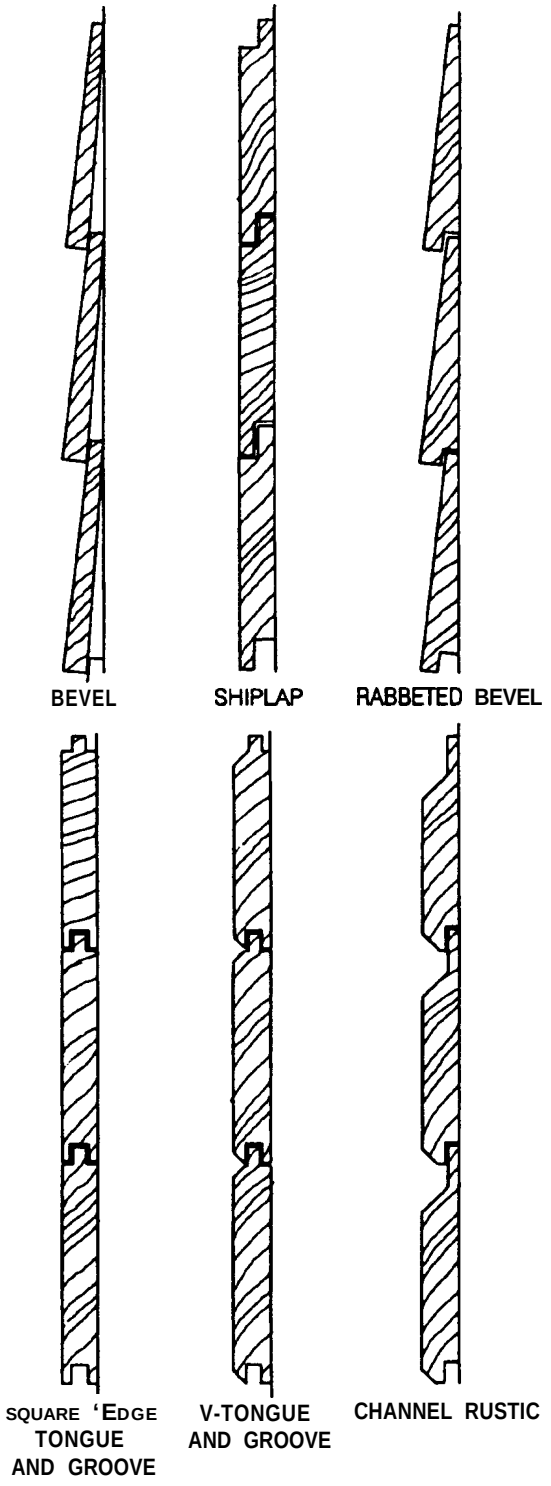

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	WOOD SIDING CONFIGURATIONS		
SIDING WOOD/PLASTIC (CSI 06220)	Revision No.	Issue Date 5/93	Drawing No. A040202-1

DEFICIENCY FACTORS
0.04.02.01 METAL SIDING (CSI 05500)

PROBABLE FAILURE POINTS

- Corrosion of metal electro-chemical process that occurs in the presence of air and moisture.
- Settlement/movement, poor materials, or improper construction
- Loose connections caused by vibration, temperature changes, or improper tightness.
- Impact damage caused by objects striking or impacting the surface

SYSTEM ASSEMBLIES/DEFICIENCIES

Abrasion:	Caused by contact with moving parts, wave action, or immersion in a moving liquid.
Corrosion:	Resulting from a chemical or electro-chemical reaction that converts the metal into an oxide, carbonate, and sulfides.
Out-of-Alignment:	Bowing, deflection, or other movement that brings the surface out-of-plumb or not level in one or more directions.
Impact Damage:	Depressions, dents, or buckled surface from objects striking or impacting the surface.
Loss of Protective Coating/Paint:	Chalking, peeling, chipping, blistering, or deterioration
Fatigue Cracking:	Caused by repetitive, cyclic loading occurring at stresses at or below allowable design values.
Loose Connections:	Caused by impact, vibration, fatigue loading, or incorrect tightness.
Missing Sections:	Due to corrosion of supporting accessories

DEFICIENCY FACTORS
0.04.02.01 METAL SIDING (CSI 05500)

END OF SUBSECTION

0.04.02.02 WOOD/PLASTIC SIDING (CSI 06100)

DESCRIPTION

Wood siding is usually milled of wood species that can withstand extreme weather variations. Redwood and cedar are two moisture-resistant woods used for board and sheet siding, as well as for shingles. Fir and pine are also used for board and sheet siding, but they must be finished with stain or paint after installation.

Man-made materials can also qualify for exterior applications. For example, hardboard and medium-density overlay products can be used, but must be painted or stained. Plywood sheet siding is manufactured with waterproof glue to provide weather protection. Graphic assembly details that follow illustrate general assembly/component types only and are not meant as a definitive, exhaustive, in-depth system breakdown. Field conditions will vary and are subject to project type, local requirements, and facility design.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Wood Siding (CSI 06100)

Water tightness is essential in wood siding. Cedar and redwood sidings are beveled in widths from 4 to 10 inches. Proper installation dictates that upper boards should overlap the lower boards by a minimum of 1 inch and be nailed through plywood sheathing back-up to wall studs. Horizontal boards are butted and caulked into vertical corner boards at exterior and interior corners.

Vertical tongue-and-groove board siding is blind-nailed through the sheathing to horizontal blocking spaced at 24 inches on-center. It is manufactured in widths from 4 to 12 inches. Channel and shiplap board siding are also lapped, but are face-nailed to the blocking. Vertical boards are installed with a 1/2 inch joint between the boards and are held in place with a nailed batten strip. All vertical board siding should extend to the corners and overlap with corner boards. Vertical siding is usually interrupted at floors with a horizontal wood beltline and flashing strip, or flashing strip alone.

Plywood sheet siding can be installed directly to the stud wall without sheathing and nailed along all panel edges and intermediate stud supports. Vertical edges can be lapped, battened, or simply butted and caulked. Horizontal joints are usually flashed.

Clapboard siding comes in the better grades of center and redwood; i.e., B, A, and clear grade. Rough saw and channel cedar are available in No. 3 grade and better.

Hardboard Siding (CSI 06100)

Manmade materials can also qualify for exterior applications. For example, hardboard and medium-density overlay products can be used, but they also must be painted or stained. Plywood sheet siding is manufactured with waterproof glue to provide weather protection.

“Hardboard” is a generic name for a panel manufactured primarily of felted lignocellulosic fibers. Other materials or procedures may be used during manufacture to improve certain properties. The most important of these is the process known as “ternping,” which substantially improves the properties of stiffness, strength, hardness, and resistance to water and abrasion.

Hardboard ranges in color from yellow to dark brown, depending on the manufacturing process used. It is dense and uniform in appearance and can easily be sawed, planed, drilled, or punched. It can be nailed, screwed, stapled, or glued in place and bent to smaller radii than can most other boards. It takes paint and other finishes well.

Hardboard is produced to industry standard established by The American Hardboard Association. This standard divides the field into three broad categories: basic hardboard, decorative finished wall panels, and siding.

0.04.02.02 WOOD/PLASTIC SIDING (CSI 06100)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Hardboard Siding (CSI 06100) (Contrnued)

The hardboard siding is basic hardboard adapted for use as siding on buildings; it is available unfinished or with the exposed surface and edges factory-primed. Siding may be embossed or machined with a pattern or texture. Unfinished hardboard siding must have the physical and mechanical as shown below.

Lap siding is available in lengths of 8 to 16 feet in increments of 2 feet, in widths up to 12 inches, and in thicknesses of 3/4 and 7/16 inch. Panel siding is available in lengths of 4, 6, 7, 8, 9, 10, 12, and 16 feet, a width of 4 feet, and thicknesses of 1/4, 3/8, and 7/16 inch.

Physical & Mechanical Properties of Basic Hardboard

					Tensile Strength (min. a ı. per panel		Water F stance	
Type designation	Surface	Nominal thickness designation s, in.	Thickness limits (min.-max. avg. per panel), in.*	Modulus of rupture (min. avg. per panel), psi*	Parallel to surface, psi	Perpendicular to surface, psı	Water absorption (max. per panel), percent	Thickness swelling (max per panel), percent
Service-tempered	S2S	1/8	0.115-0.155	4,500	2,000	100	25	22
		3/16	0.165-0.205				20	18
		7/32	0.205-0.250				20	16
		1/4	0.220-0.265				18	14
		3/8	0.350-0.400				18	14
Service	S1S	1/8	0.115-0.155	3,000	1,500	75	30	25
		3/16	0.165-0.205				25	15
		7/32	0.205-0.250				25	15
		1/4	0.220-0.265				25	15
		3/8	0.350-0.400				25	15
		7/16	0.410-0.460				25	15
Service	S2S	1/8	0.115-0.155	3,000	1,500	75	30	25
		3/16	0.165-0.205				27	22
		7/32	0.205-0.250				27	22
		1/4	0.220-0.265				27	22
		3/8	0.350-0.400				27	22
		7/16	0.410-0.460				27	22
		1/2	0 475-0.525				18	14
		5/8	0.600-0.650				15	12
		11/16	0.660-0.710				15	12
		3/4	0.725-0.775				12	9
		13/16	0.785-0.835				12	9
		7/8	0.850-0.900				12	9
		1	0.975-1.025				12	9
Industrialite	S1S or S2S	3/8	0.350-0.400	2,000	1,000		25	20
		7/16	0.410-o 460				25	20
		1/2	0475-0.525				25	20
		5/8	0.600-0.650				22	18
		11/16	0.660-0.710				22	18
		3/4	0.725-0.775				20	16
		13116	0.785-0.835				20	16
		7/8	0.850-0.900				20	16
		1	0.9X-1.025				20	16

• Minimum or maximum average per panel is the lowest or the highest allowable value an individual panel can have when all test values for the given property of an individual panel have been averaged.

ASTM D1037 Standard Methods of Evaluating the Properties of Wood-Base Fiber & Particle Panel Materials

0.04.02.02 WOOD/PLASTIC SIDING (CSI 06100)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Hardboard Siding (CSI **06100)**

Physical & Mechanical Properties of Basic Hardboard (Continued)

						Water resistance	
Impact, min value, in.	Hardness min value, lb	Modulus of rupture. min avg per panel, psi	Nailhead pull thru, min value, lb	Lateral nail resistance, min value, lb	Weatherability max value, in	Water absorption, max per panel, per cent	Thickness swelling, max per panel, per cent
9	450	1800	150	150	0010 Swelling and no visible fiber raising	20	15

* These requirements apply *only* to hardboard siding *used as a siding material and do not apply to hardboard combined with other materials as a siding.*

† *Each manufacturer. after establishing his siding manufacturing specifications and prior to marketing siding, shall test representative samples in accordance with the ASTM D1037-64, Accelerated Aging test method and determine that his siding, after cycling, retains 50 percent of the original modulus of rupture when calculated on the basis of the original board thickness.*

ASTM D1037 Standard Methods of Evaluating the **Properties** of Wood-Base Fiber **&** Particle Panel Materials

Plastic Siding (CSI 00100)

Plastic or vinyl siding are extruded polyvinyl chloride (PVC) compound as defined in ASTM D3679-81 “Standard Specification for PVC Siding.”

Vinyl siding is designed for use in residential and light commercial applications with building heights up to 30 feet.

Elongated nailing slots approximately 1 inch long are provided in the nail hem of the panels to permit proper expansion and contraction on the wall. The nail hem and the bottom lock of all panels are notched on both ends to provide for the proper overlapping of adjacent panels.

OTHER RELATED COMPONENTS

See the following subsection for related components

0.04.01 Walls 2.1.1-1

0.04.02.02 WOOD/PLASTIC SIDING (CSI 06100)

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DEFICIENCY FACTORS
0.04.02.02 WOOD SIDING (CSI 06100)

PROBABLE FAILURE POINTS

- Termite and boring insect damage causing breakdown of structural integrity.
- Decay (rot) due to fungi, mildew, dry rot causing surface deterioration.
- Fire damage or charred surfaces causing flaking or surface breakdown.
- Loose connections caused by vibration, temperature changes, or improper tightness.
- Splitting or checking caused by stress, bending, or twisting.
- Cracking caused by stress, settlement/movement, poor materials, or improper construction
- Impact damage caused by objects striking or impacting the surface.

SYSTEM ASSEMBLIES/DEFICIENCIES

Out-of-Alignment:	Bowing, deflection, or other movement that brings the surface out-of-plumb or not level in one or more directions.
Cracking:	Cracking, usually structural in nature, that results in tearing, ripping, or shearing. Cracks can be random, horizontal, vertical, or diagonal.
Surface Deterioration:	Crazing, small surface cracks, corrosion, and surface breakdown due to weather, pressure, or other actions.
Staining:	Surface discoloration from a foreign substance or material.
Insufficient Anchors/Connections:	Broken, damaged, loose, corroded, or missing anchorage or fasteners caused by vibration, excessive deflection, or improper tightness.
Dry Rot/Decay:	Breakdown of structural integrity from mold/mildew or dry rot.
Loss of Protective Coating/Paint:	Chalking, peeling, chipping, blistering, or deterioration.
Splitting:	Surface splitting or tearing.
Insect Damage:	Holes, cracks, or punctures from burrowing insects.
Burned or Charred Surface:	Damage from fire or excessive heat on surface.
Missing Sections:	Due to rotting, missing, or deteriorated supports.

DEFICIENCY FACTORS
0.04.02.02 WOOD SIDING (CSI 061001

END OF SUBSECTION

0.04.03 EXTERIOR INSULATION & FINISH WALL SYSTEM (CSI 07241)

DESCRIPTION

Exterior Insulation and Finish System (EIFS) represent a variety of assemblies functioning as an exterior insulating envelope. These assemblies consist of an inner layer of thermal insulation in board form and an outer layer in the form of a finish coating. Graphic assembly details that follow illustrate general assembly/component types only and are not meant as a definitive, exhaustive, in-depth system breakdown. Field conditions will vary and are subject to project type, local requirements, and facility design.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Exterior Insulation 8 Finish System (CSI 07241)

Exterior Insulation Manufacturers (EIMA) has retained the use of PB and PM in its class designations: “PB” is always be applied to systems with polymer-based protective coatings and “PM” to those with polymer-modified protective coatings. The latest definitions of class PB and PM systems by EIMA are listed below:

Class PB Svstems:

- The base coat varies in thickness depending upon the number of layers or reinforcing thickness. The thickness can range from a nominal 1/16 inch to 1/4 inch. The reinforcing material is typically glass fiber mesh embedded in the base coat at the time of installation.
- Finish coats of various thickness in a variety of textures and colors are applied over the base coat.

Class PM Systems:

- The base coat remains relatively the same thickness regardless of reinforcing. The thickness can range from a nominal 1/4 to 3/8 inch. The reinforcing material is typically glass fiber mesh laid over the insulation surface. The base coat is applied over the installation material at the time of installation.
- Finish coats of various thicknesses in a variety of textures and colors are applied over the base coat.

Coating Characteristics:

Class PB systems offer a softer, more flexible protective coating than Class PM systems: Class PB systems are nearly always combined with molded rigid cellular polystyrene thermal insulation. This form of insulation is also more flexible but less dense, more vapor permeable, and less expensive than extruded rigid cellular polystyrene thermal insulation that is typically specified for PM systems, although some manufacturers of Class PM systems offer both molded and expanded insulation. The major difference between the Class PB and Class PM, besides those related to their moisture vapor-permeability and impact resistance characteristics, is appearance. Class PM systems must be divided by control joints into rather small panels in similar manner to stucco. This prevents cracking of the protective coating because of its inherently more brittle characteristics and the greater rigidity of the insulation behind it. Class PB systems do not have that limitation and can be installed with continuous surfaces that need to be interrupted only where expansion and control joints occur in the supporting substrates.

OTHER RELATED COMPONENTS

See the following subsection for related components:

0.04.01 Walls 2.1.1-1

0.04.03 EXTERIOR INSULATION & FINISH WALL SYSTEM (CSI 07241)

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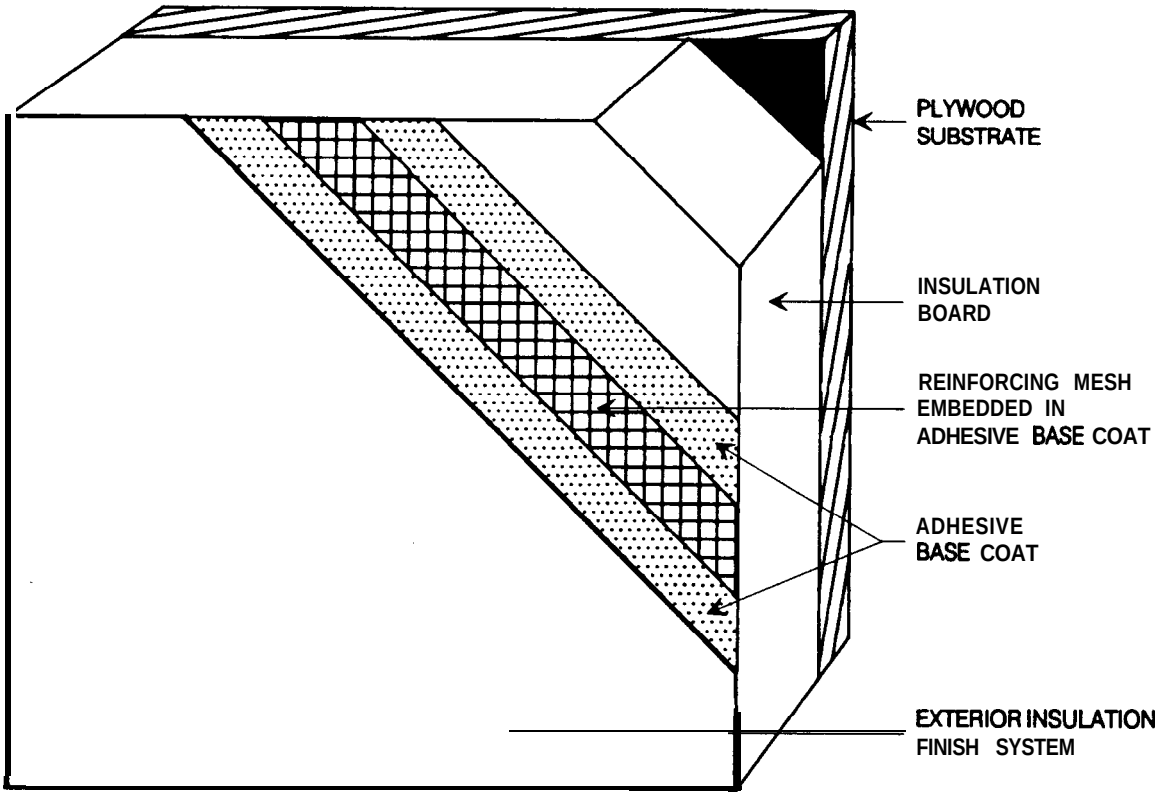
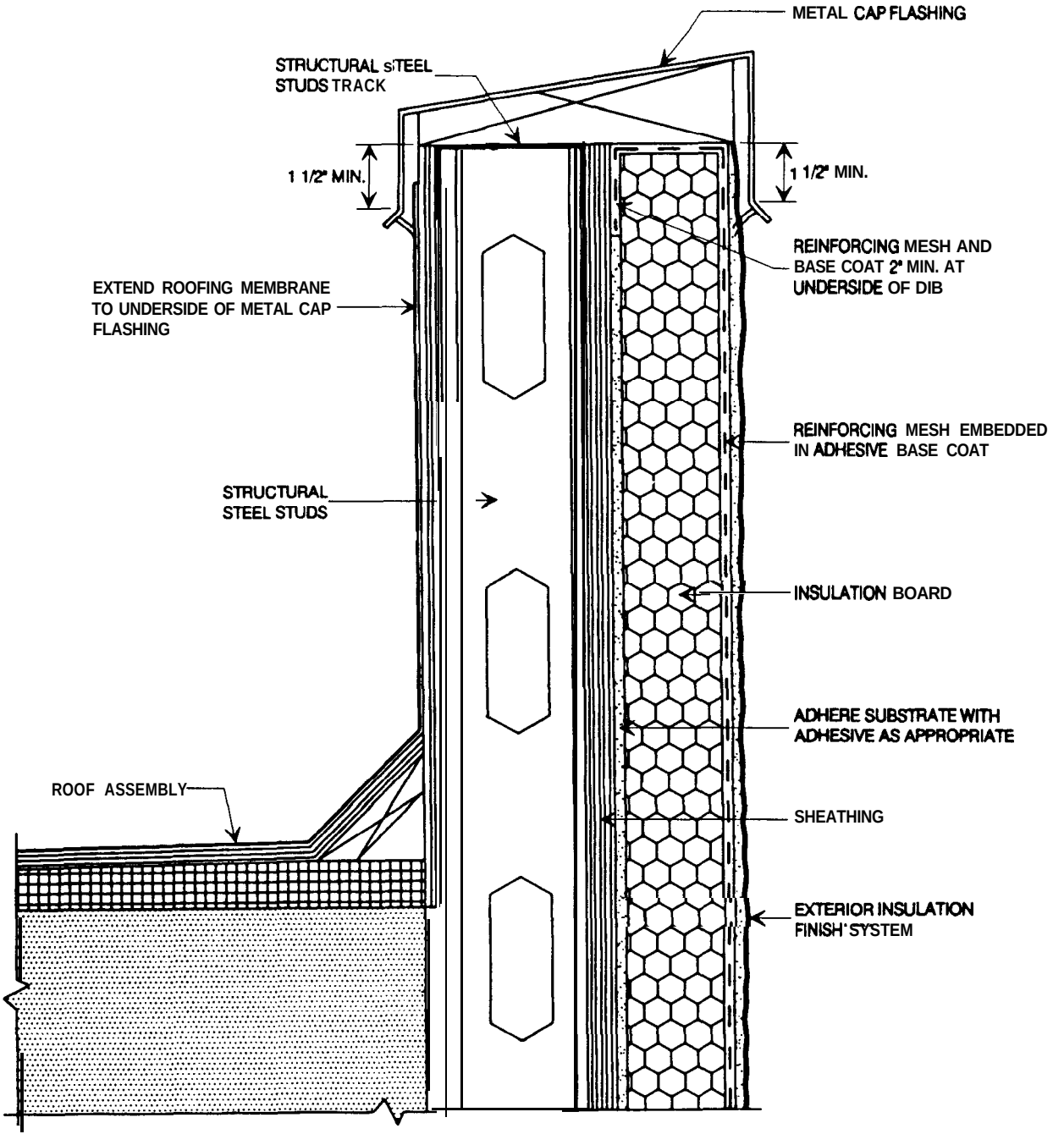


EXTERIOR INSULATION FINISH SYSTEM

SOURCE: DRYVIT SYSTEMS, INC., RESOURCE CATALOG

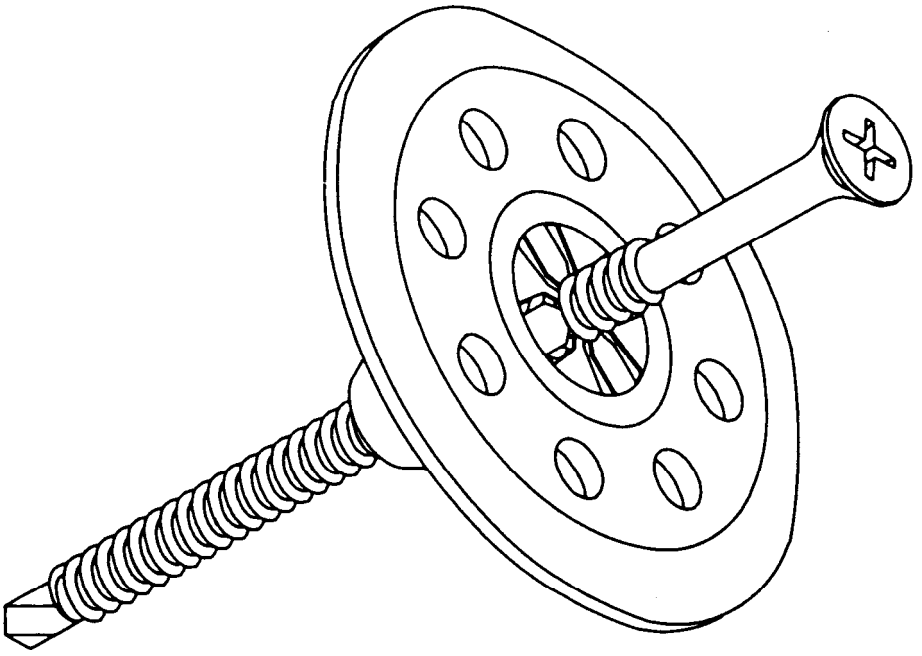
SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	INSULATION FINISH CONSTRUCTION		
EXTERIOR INSULATION & FINISH WALL SYSTEM (CSI 07240)	Revision No.	Issue Date 5/93	Drawing No. A0403-1



EXTERIOR INSULATION FINISH SYSTEM

SOURCE: DRYVIT SYSTEMS, INC., RESOURCE CATALOG

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	INSULATION FINISH CONSTRUCTION CONFIGURATION		
EXTERIOR INSULATION 8 FINISH WALL SYSTEM (CSI 07240)	Revision No.	Issue Date 5/93	Drawing No. A0403-2



MECHANICAL FASTENER

SOURCE: DRYVIT SYSTEMS, INC., RESOURCE CATALOG

SYSTEM ASSEMBLY DETAILS-EXTERIOR CLOSURE	TYPICAL INSULATION FASTNER		
EXTERIOR INSULATION & FINISH WALL SYSTEM (CSI 07240)	Revision No.	Issue Date 5/93	Drawing No. A0403-3

DEFICIENCY FACTORS
0.04.03 EXTERIOR INSULATION & FINISH WALL SYSTEM (CSI 07241)

PROBABLE FAILURE POINTS

- Loose connection caused by temperature change.
- Splitting or checking caused by stress, bending, or twisting
- Cracking caused by stress, settlement/movement, poor materials, or improper construction.
- Impact damage caused by objects striking or impacting the surface.

SYSTEM ASSEMBLIES/DEFICIENCIES

Stone

Adhesive/Delamination:	Caused by condensation behind the EIFS.
Cracks (Active & Dormant):	Construction movement, settlement. Vertical or horizontal cracking. Physical reactions such as drying/shrinkage. Surface cracking. Thermal changes (subjected to temperature extremes such as freeze/thaw cycles). Stress concentration from excessive loads. Step cracking. Accidents from overload, vibration, fatigue, and earthquake. Shear cracking.
Surface Deterioration:	Cavitation from water or liquid action over surface. Chemical reactions causing surface breakdown.
Holes (Small & Large):	Impact damage.
Spalling:	Fragment flaking from the surface due to weather, pressure, or other actions.
Out-of-Alignment:	Bowing, deflection, or other movement that brings the surface out-of-plumb or not level in one or more directions.
Staining:	Surface discoloration from a foreign substance or material.
Inadequate Expansion Joint:	Lack of expansion or control joints resulting in surface cracking from stresses.
Damaged/Missing Sections:	Broken, damaged, cracked, or missing units or sections.

DEFICIENCY FACTORS
0.04.03 EXTERIOR INSULATION & FINISH WALL SYSTEM (CSI 07241)

END OF SUBSECTION

0.04.04 DOORS (CSI 08200)

DESCRIPTION

Both metal and wood doors can serve a variety of functions. They can control passage, provide visual and sound privacy, maintain security, supply fire resistance and weather protection, control light, and serve as radiation shielding. There are three major parts or components of a door system: the door itself, the frame, and the hardware. Each must be coordinated with the other components and be appropriate for the circumstances. Graphic assembly details that follow illustrate general assembly/component types only and are not meant as a definitive, exhaustive, in-depth system breakdown. Field conditions will vary and are subject to project type, local requirements, and facility design.

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Door Hardware (CSI 08111)

Pivots or concealed hinges may be conventional butts. Door closers may be concealed instead of surfaced; panel hardware may have concealed rods; and automatic threshold seals can be recessed into door bottoms. Locations for hardware mounting can also be customized. Door edges or frames can be shaped to accommodate any type of weatherstripping. Steel doors can becustomized with almost any type of hardware.

Door Frames (CSI 08111)

Door frames may be supplied in 14, 16, or 18 gauge galvanized or plain steel in knockdown standard frames or welded customized frames that can be fabricated to satisfy most design conditions. Frames with borrowed lights, transoms, or cased openings are available in stick components from some manufacturers. Frames may be wraparound (enclosing the wall) or butt up against the opening. A wraparound frame may terminate into the enclosed wall when it is covered by a finish such as plaster, or the frame may return along the enclosed wall when it is exposed, such as in drywall construction. They are sometimes supplied in two pieces to suit varied wall thicknesses. Frames are normally reinforced at stress points and are prepared for hinges and strikes. Anchors to attach the frames to the wall are supplied to suit wall construction requirements.

Frames for wood doors are made from wood, steel (hollow metal), and aluminum. The decision concerning the type of frame to be used in a wood door depends on the appearance desired, the type of opening, the fire rating requirements, the security needed, and the durability desired. For example, wood frames may be used in 20, 30, and 45 minute fire door assemblies, but a one-hour rated door must be installed in a rated metal frame.

Function of Hardware:

- Hanging the door - hinges, pivots, and combination pivots and closers.
- Operating the door - handles, latches, push plates, and pull bars.
- Closing the door - door closers and combination pivots and closers.
- Locking the door - Locksets, dead bolts, latch bolts, electric locks, and other special devices.
- Sealing the door - weatherstripping, sound seals, smoke seals.
- Protecting the door - kick plates, corner protection, and similar materials.

Hinges & Pivots:

There are four basic types of hinges: full mortise (butt hinges), half mortise, full surface, and half surface. Within each type there are a variety of styles.

Elements or Hinges:

Swagging is a slight offset of the hinge at the barrel, that permits the leaves to come together and improves door operation and appearance. A leaf is one of the two attaching plates that form a complete hinge when fastened together by the hinge pine.

0.04.04 DOORS (CSI 08200)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Door Frames (CSI 0811)

Elements or Hinges (Continued):

Full mortise is a recess such as one cut into a door stile to receive a hinge. Full surface hinge is a hinge that is installed on the surface of a door and jamb without need of mortising.

Locks:

Locks are one of the most important categories of door hardware. The locks most commonly used in all types of construction are as follows:

- Bored locks are installed in a door having two round holes at right angles to one another: one through the face of the door to hold the lock body, and the other in the edge of the door to receive the latch mechanism. When these two are joined together in the door, they comprise a complete latching or locking mechanism. Bored type locks have the keyway (cylinder) and/or locking device, such as push or turn buttons, in the knobs.
- Preassembled locks are installed in a rectangular notch cut into the door edge. This lock has all the parts assembled as a unit at the factory, and when installed little or no disassembly is required. Preassembled type locks have the keyway (cylinder) in the knobs. Locking devices may be in the knob or on the escutcheon.
- Mortise locks are installed in a prepared recess (mortise) in a door. The working mechanism is contained in a rectangular shaped case with appropriate holes into which the required components, cylinder, knob, and turn-piece spindles are inserted to complete the working assembly.

Door Closers:

Door closers control the doors through the opening and closing swings by combining three basic components: 1) a power source to close the door (spring); 2) a checking source to control the rate at which the door closes (hydraulic mechanism); and 3) a connecting component (arm) to transmit the closing force from the frame to the door.

Fire-Rated Doors:

Underwriters Laboratories currently label steel overhead rolling doors for openings not exceeding 120 square feet in area, with no dimension exceeding 12 feet. The fire-rated classes are as follows: Class A 3 1/2 hr, B 1 1/2 hr, C 3/4 hr, and D 1/2 hr. Doors be automatic or self-closing. Motor-operated fire doors can be provided with automatic closing mechanisms, and can carry the UL label or certificate.

Smoke Detectors:

May be photoelectric or ionization types that are connected to a magnetic door holder release device which activates the closing mechanism. Door holder release devices may also be tied into a building fire alarm system in lieu of smoke detectors.

Wood Doors (CSI 08200)

Wood doors, manufactured in either flush or paneled designs, are separated into three grades: architectural/commercial, residential, and decorator. A wide variety of frames are available for exterior installations in metal, pine, or hardwood, and for various partition thicknesses. Some doors are also available prehung for quick installation. Architectural or commercial wood doors are the type most specified in building construction. The stiles are made of hardwood, and the core is dense and hot-bonded construction. They feature thick face veneers that are exterior-glued and matched in their grain patterns. Because of its durability, this grade of door often carries a lifetime warranty.

FEDERAL SPECIFICATIONS

FEDERAL SPECIFICATION	TITLE
FED-STD 66	Steel, Chemical Composition and Hardening Ability
FS FF-H-106	Hardware. Builders Locks and Door Trim
FS FF-H-1819	Hardware, Builders, Auxiliary Locks
FS HH-I-558	Insulation Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering) and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)
FS **HH-I-1972/GEN**	Insulation Board, Thermal, Faced, Polyurethane or Polyisocyanurate
FS HH-I **1972/1**	Insulation Board, Thermal, Polyurethane or Polyisocyanurate, Faced with Aluminum Foil on Both Sides of the Foam
FS HH-I-1972/5	Insulation Board, Thermal, Polyurethane or Polyisocyanurate Faced with Perlite Board to Both Sides of the Foam
FS HH-M-622	Mortar, Refractory, Heat Setting, Bonding (Wet and Dry Types)
FS L-S-125	Screening, Insect, Nonmetallic
FS MM-L-736	Lumber, Hardwood
FS MM-L-751	Lumber, Softwood
FS MMM-A-001993	Adhesive, Epoxy, Flexible, Filled (for Binding, Sealing and Grouting)
FS **QQ-C-40**	Caulking: Lead Wool and Lead Pig
FS **QQ-S-763**	Steel Bars, Wire, Shapes, and Forgings, Corrosion Resisting
FS **QQ-S-775**	Steel Sheets, Carbon, Zinc-Coated (Galvanized) by the Hot-Dip Process
FS QQ-W-461	Wire, Steel, Carbon (Round, Bare, and Coated)
FS RR-D-575	Door, Metal, Sliding and Swinging: Door Frame, Metal (Flush and Semiflush)
FS SS-C-153	Cement, Bituminous, Plastic
FS SS-C-158	Federal Specification for Cements, Hydraulic, General Specifications (methods for sampling, inspection, and testing)
FS SS-C-181	Federal Specification for Cement, Masonry
FS SS-C-192	Federal Specification for Cements, Portland (10 types)
FS **SS-C-208**	Federal Specification for Cement, Portland, Pozzolana
FS SS-P-00402	Plaster, Gypsum
FS **TT-C-490**	Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
FS **TT-C-494**	Coating Compound, Bituminous, Solvent Type, Acid Resistant
FS **TT-C-498**	Coating Compound, Bituminous, Fillers, Solvent Type, Aluminum Pigmented
FS **TT-C-535**	Coating, Epoxy, Two Component, for Interior Use on Metal, Wood, Wallboard, Painted Surfaces, Concrete and Masonry
FS I-r-C-542	Coating, Polyurethane, Oil-Free, Moisture Curing
FS **TT-C-555**	Coating, Textured (for Interior and Exterior Masonry Surfaces)
FS TT-C-00598	Caulking Compound, Oil and Resin Base Type (for Building Construction)
FS **TT-C-1796**	Caulking Compounds, Metal Seam and Wood Seam
FS I-I-E-487	Enamel: Floor and Deck
FS TT-E-489	Enamel, Alkyd, Gloss, Low Voc Content
FS I-I-E-490	Enamel, Silicone Alkyd Copolymer, Semiglass (For Exterior and Interior Nonresistant Use)
FS **TT-E-496**	Enamel: Heat-Resisting (400°F), Black
FS **TT-E-1** 593	Enamel, Silicone Alkyd Copolymer, Gloss (For Exterior and Interior use)

FEDERAL SPECIFICATIONS

FEDERAL SPECIFICATION	TITLE
FS IT-F-336	Filler, Wood, Paste
FS **TT-F-1098**	Filler, Block, Solvent-Thinned, for Porous Surfaces (Concrete Block, Cinder Block, Stucco, etc.)
FS **TT-I-735**	Isopropyl Alcohol
FS **TT-P-1** 9	Paint, Latex (Acrylic Emulsion, Exterior Wood and Masonry)
FS **TT-P-24**	Paint, Oil, Concrete and Masonry, Exterior Eggshell Finish Ready-Mixed
FS **TT-P-28**	Paint, Aluminum, Heat Resisting (1200°F)
FS **TT-P-31**	Paint, Oil: Iron-Oxide, Ready-Mixed, Red and Brown
FS IT-P-37	Paint, Alkyd Resin, Exterior Trim, Deep Colors
FS **TT-P-38**	Paint, Aluminum (Ready-Mixed)
FS **TT-P-59**	Paint, Ready Mixed, International Orange (Not for Residential Use)
FS I-T-P-85	Paint, Traffic and Airfield Marking, Solvent Base
FS **TT-P-86**	Paint, Red-Lead-Base, Ready-Mixed
FS **TT-P-95**	Paint, Rubber: for Swimming Pools and Other Concrete and Masonry Surfaces
FS **TT-P-1** 02	Paint, Oil, Alkyd Modified, Exterior, White and Tints
FS **TT-P-1** 10	Paint, Traffic Black (Nonreflectorized)
FS I-r-P-1 15	Paint, Traffic, (Highway, White, and Yellow)
FS IT-P-320	Pigment, Aluminum, Powder and Paste for Paint
FS TI-P-615	Primer Coating: Basic Lead Silico Chromate, Ready Mixed
FS I-I-P-641	Primer, Paint Coating, Zinc Dust-Zinc Oxide for Galvanized Surfaces
FS I-T-P-645	Primer, paint, Zinc-Chromate, Alkyd Type
FS **TT-P-664**	Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, Noc-Complaint
FS **TT-P-00791**	Putty,-Linseed-Oil Type, (For Wood-Sash-Glazing)
FS **TT-P-1411**	Paint, Copolymer-Resin, Cementitious (For Waterproofing Concrete and Masonry Walls)
FS T-I-P-1510	Paint, Latex, Exterior, for Wood Surfaces, White and Tints
FS I-I-P-1 952	Paint, Traffic and Airfield Marking, Water Emulsion Base
FS **TT-P-001984**	Primer Coating, Latex Base, Exterior, (Undercoat for Wood), White and Tints
FS **TT-R-266**	Resin, Alkyd, Solutions
FS **TT-S-00227**	Sealing Compound, Elastomeric Type, Multi-Component for Caulking, Sealing, and Glazing (for Buildings and Other Structures)
FS I-r-S-00230	Sealing Compound, Elastomeric Type, Single Component for Caulking, Sealing, and Glazing (for Buildings and Other Structures)
FS **TT-S-300**	Shellac, Cut
FS I-r-S-708	Stain, Oil; Semi-Transparent, Wood, Exterior
FS **TT-S-001543**	Sealing Compound: Silicone Rubber Base (for Caulking, Sealing, and Glazing in Buildings and Other Structures)
FS **TT-S-001** 657	Sealing Compound, Single Component, Butyl Rubber Based, Solvent Release Type (for Buildings and Other Types of Construction)
FS I-I-S-001 992	Stain, Latex, Exterior for Wood Surface
FS I-r-T-291	Thinner, Paint, Mineral Spirits, Regular and Odorless
FS **TT-V-51**	Varnish, Asphalt
FS **TT-V-81**	Varnish, Mixing, for Aluminum Paint
FS **TT-V-85**	Varnish, Oil, (Low Sheen, Brush or Spray Application)

FEDERAL SPECIFICATIONS

FEDERAL SPECIFICATION	TITLE
FS **TT-V-119**	Varnish, Spat, Phenolic-Resin
FS **TT-V-1** 21	Varnish, Spar, Water Resisting
FS **TT-W-00571**	Wood Preservation: Treating Practices
FS I-I-W-572	Wood Preservative: Water-Repellent
FS UU-B-790	Building Paper, Vegetable Fiber: (Kraft, Water proofed, Water Repellent and Fire Resistant)
FS UU-P-268	Paper, Kraft, Wrapping
FS UU-P-270	Paper, Wrapping, Waxed (Dry)
HH-I-524C	Insulation Board, Thermal (Polystyrene)
HH-I-526C	Insulation Board, Thermal (Mineral Fiber)
HH-I-529B	Insulation Board, Thermal (Mineral Aggregate)
HH-I-551 E	Insulation Block, Pipe Covering and Boards, Thermal (Cellular Glass)
HH-I-1972	Insulation Board, Thermal, Faced, Polyurethane or Polyisocyanurate
LLL-I-535	insulation Board, Thermal (Cellulosic Fiber) Blocks
SS-C-450A	Cloth, Impregnated (Woven Cotton Cloth, Asphalt Impregnated, Coal-Tar Impregnated)
USCE CRD-CI3	Test for Evaluation of Air-Entraining Admixtures for Concrete
USCE CRD-CI09	Field Test for Absorption by Aggregates
USCE CRD-CI19	Test for Flat and Elongated Particles in Coarse Aggregates
USCE CRD-CI29	Test for Particles of Low Specific Gravity in Coarse Aggregate (Sink-Float Test)
USCE CRD-C213	Test for the Presence of Sugar in Cement, Mortar, Concrete, and Aggregates
USCE CRD-C248	Corps of Engineers Specifications for Slag Cement
USCE **CRD-C300**	Specifications for Pigmented Membrane-Forming Compounds for Curing Concrete
USCE CRD **C400**	Requirements for Water for Use in Mixing or Curing Concrete

FEDERAL SPECIFICATIONS

END OF SUBSECTION

NATIONAL STANDARDS

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	Voluntary Specifications for Aluminum Prime Windows and Sliding Glass Doors
AAMA SFM-1	Aluminum Store Front and Entrance Manual
AAMA WSG-1	Window Selection Guide

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 211.89	Standard Practice of Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 211.2	Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 211.3	Standard Practice for Selecting Ptoportions for No-Slump Concrete
ACI 301	Specifications for Structural Concrete for Buildings
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI **305R**	Hot Weather Concreting
ACI **306R**	Cold Weather Concreting
ACI 308	Standard Practice for Curing Concrete
ACI 309	Standard Practice for Consolidation of Concrete
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
ACI **347R**	Guide to Formwork for Concrete
ACI **506R**	Shotcrete

AMERICAN HARDBOARD ASSOCIATION **(AHA)**

AHA Al 35.6	Hardboard Siding

AMERICAN PLYWOOD ASSOCIATION **(APA)**

APA AFG-01	Adhesives for Field-Gluing Plywood to Wood Framing
APA Form E30	Design/Contsruction Guide, Residential and Commercial

AMERICAN SOCIETY FOR TESTING **&** MATERIALS (ASTM)

ASTM A36	Specification for Structural Steel
ASTM A82	Steel Wire, Plain, for Concrete Reinforcement
ASTM Al 84	Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM Al85	Welded Steel Wire Fabric for Concrete Reinforcement
ASTM A416	Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A421	Uncoated Stress-Relieved Wire for Prestressed Concrete
ASTM A496	Steel Wire, Deformed, for Concrete Reinforcement
ASTM A497	Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A61 5	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A61 7	Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767	Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM **C5**	Quicklime for Structural Purposes
ASTM C6	Specification for Normal Finishing Hydrated Lime
ASTM C29	Unit Weight and Voids in Aggregate
ASTM C31	Making and Curing Concrete Test Specimens in the Field

NATIONAL STANDARDS

AMERICAN SOCIETY FOR TESTING & MATERIALS (ASTM)

ASTM **C33**	Concrete Aggregates
ASTM **C39**	Compressive Strength of Cylindrical Concrete Specimens
ASTM **C40**	Organic Impurities in Fine Aggregates for Concrete
ASTM **C70**	Surface Moisture in Fine Aggregate
ASTM C87	Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
ASTM **C88**	Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM **C91**	Masonry Cement
ASTM C94	Ready-Mixed Concrete
ASTM C 109	Compressive Strength of Hydraulic Cement Mortars
ASTM CI 14	Chemical Analysis of Portland Cement
ASTM CI15	Fineness of Portland Cement by the Turbidimeter
ASTM CI 17	Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM CI23	Lightweight Pieces in Aggregate
ASTM CI25	Concrete and Concrete Aggregates
ASTM CI27	Specific Gravity and Absorption of Coarse Aggregate
ASTM CI28	Test for Specific Gravity and Absorption of Fine Aggregate
ASTM CI31	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM CI36	Sieve Analysis of Fine and Coarse Aggregates
ASTM CI41	Hydraulic Hydrated Lime for Structural Purposes
ASTM CI 43	Slump of Hydraulic Cement Concrete
ASTM CI 50	Portland Cement
ASTM CI51	Autoclave Expansion of Portland Cement
ASTM C 156	Water Retention by Concrete Curing Materials
ASTM CI 71	Sheet Materials for Curing Concrete
ASTM CI 72	Sampling Freshly Mixed Concrete
ASTM CI83	Sampling and the Amount of Testing of Hydraulic Cement
ASTM CI 84	Test for Fineness of Hydraulic Cement by the No. 100 and No. 200 Sieves
ASTM CI86	Heat of Hydration of Hydraulic Cement
ASTM CI 87	Test for Normal Consistency fo Hydraulic Cement
ASTM CI88	Density of Hydraulic Cement
ASTM CI 90	Tensile Strength of Hydraulic Cement Mortars
ASTM CI91	Time of Setting of Hydraulic Cement by Vicat Needle
ASTM **C204**	Fineness of Portland Cement by Air Permeability Apparatus
ASTM **C206**	Finishing Hydrated Lime
ASTM **C207**	Hydrated Lime for Masonry Purposes
ASTM C219	Definitions of Terms Relating to Hydraulic Cement
ASTM C226	Specification for Air-Entraining Additions for Use in the Manufacture of Air-Entraining Portland Cement
ASTM C227	Potential Alkali Reactivity of Cement-Aggregate Combinations
ASTM **C230**	Specification for Flow Table for Use in Tests of Hydraulic Cement
ASTM C233	Air-Entraining Admixtures for Concrete
ASTM C243	Test for Bleeding of Cement Pastes and Mortars
ASTM **C260**	Air-Entraining Admixtures for Concrete
ASTM C265	Test for Calcium Sulfate in Hydrated Portland Cement Mortar
ASTM C266	Time of Setting of Hydraulic-Cement by Gillmore Needles
ASTM C267	Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings
ASTM C295	Petrographic Examination of Aggregates for Concrete
ASTM **C309**	Liquid Membrane-Forming Compounds for Curing Concrete

NATIONAL STANDARDS

AMERICAN SOCIETY FOR TESTING & MATERIALS (ASTM)

ASTM **C311**	Sampling and Testing Fly Ash and Raw or Calcined Natural Porolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM **C330**	Lightweight Aggregates for Structural Concrete
ASTM C332	Lightweight Aggregates for Insulating Concrete
ASTM C465	Specification for Processing Additions for Use in Manufacture of Hydraulic Cements
ASTM **C535**	Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM **C595**	Blended Hydraulic Cements
ASTM C851	Recommended Practice for Estimating Scratch Hardness of Coarse Aggregate Particles
ASTM C31	Standard Methods of Making and Curing Concrete Test Specimens in the Field
ASTM **C33**	Specification for Concrete Aggregate
ASTM C39	Standard Test Method for Compressive Strength fo Cylindrical Concrete Specimens
ASTM C94	Standard Test Method for Ready-Mixed Concrete
ASTM C94	Specification for Ready-Mixed Concrete
ASTM CI 43	Standard Test Method for Slump of Portland Cement Concrete
ASTM CI50	Specification for Portland Cement
ASTM CI50	Standard Specification for Portland Cement
ASTM CI72	Standard Method of Sampling Freshly Mixed Concrete
ASTM **C208**	Insulating Board (Cellulosic Fiber), Structural and Decorative
ASTM **C260**	Specification for Air-Entraining Admixtures for Concrete
ASTM C494	Specification for Chemical Admixtures for Concrete
ASTM C552	Cellular Glass Block and Pipe Thermal Insulation
ASTM C578	Preformed, Cellular Polystyrene Thermal Insulation
ASTM C726	Mineral Fiber and Mineral Fiber, Rigid Cellular Polyurethane Composite Roof Insulation Board
ASTM C728	Perlite Thermal Insulation Board
ASTM C984	Perlite Board, Rigid Cellular Polyurethane Composite Roof Insulation
ASTM CI050	Rigid Cellular Polyurethane Composite Roof Insulation
ASTM D 41	Asphalt Primer Used in Roofing, Dampproofing and Waterprodfing
ASTM D 43	Creosote Primer Used in Roofing, Dampproofing and Waterproofing
ASTM D75	Sampling Aggregates
ASTM D98	Calcium Chloride
ASTM D 224	Smooth-Surfaced Asphalt Roll Roofing (Organic Felt)
ASTM D 226	Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 227	Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 249	Asphalt Roll Roofing (Organic Felt) Surfaced with Mineral Granules
ASTM D 312	Asphalt Used in Roofing
ASTM D 450	Coal-Tar Pitch Used in Roofing, Dampproofing and Waterproofing
ASTM D 1079	Definition of Terms Relating to Roofing, Waterproofing and Bituminous Materials
ASTM D 1227	Emulsified Asphalt Used as a Protective Coating for Built-Up Roofing
ASTM D 1327	Bitumen-Saturated Woven Burlap Fabrics Used in Roofing and Waterproofing
ASTM D 1668	Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D 1863	Mineral Aggregate Used on Built-Up Roofs
ASTM D 2178	Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 2626	Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing

NATIONAL STANDARDS

AMERICAN SOCIETY FOR TESTING & MATERIALS (ASTM)

ASTM D 2822	Asphalt Roof Cement
ASTM D 2823	Asphalt Roof Coatings
ASTM D 2824	Aluminum-Pigmented Asphalt Roof Coatings
ASTM D 2829	Recommended Practice for Sampling and Analysis of Built-Up Roofs
ASTM D 3817	Practice for Sampling and Analysis of New Built-Up Roof Membranes
ASTM D 3672	Venting Asphalt-Saturated and Coated Inorganic Felt Base Sheet Used in Roofing
ASTM D 3909	Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules
ASTM D 4022	Coal-Tar Roof Cement
ASTM D 4479	Asphalt Roof Coatings - Asbestos Free
ASTM D 4586	Asphalt Roof Cement - Asbestos Free
ASTM D 4601	Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM El 1	Wire Cloth Sieves for Testing Purposes
ASTM E283	Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
ASTM E330	Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E331	Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E514	Water Penetration and Leakage Through Masonry
ASTM E515	Leaks Using Bubble Emission Techniques
ASTM E737	Installation of Storm Windows, Replacement Windows, Multi-Glazing, Storm Doors, and Replacement Doors

AMERICAN WOOD-PRESERVERS ASSOCIATION (AWPA)

AWPA CI -90	All Timber Products - Preservative Treatment by Pressure Processes
AWPA M4	The Care of Preservative-Treated Wood Products

BRICK INSTITUTE OF AMERICA (BIA)

BIA Tech Note 20	Cleaning Brick Masonry

BUILDING OFFICIALS & CODE ADMINSTRATORS INTERNATIONAL (BOCA)

BOCA-90	The BOCA National Plumbing Code

DOOR & HARDWARE INSTITUTE (DHI)

DHI 02	Installation Guide for Doors and Hardware
DHI 06	Basic Architectural Hardware
DHI Al 15	Steel Door Preparation Standards-Complete Set (Includes Al 15.1 thru A115.7 and A115.12 thru A115.17)
DHI Al 15.7	Preparation for Floor Closers - Light Duty, Center Hung, Single or Double Acting; Center Hung, Single or Double Hung; Offset Hung, Single Acting

NATIONAL STANDARDS

EXTERIOR INSULATION MANUFACTURERS ASSOCIATION (EIMA)

EIMA 01	EIMA Guideline Specification for Exterior Insulation and Finish Systems Class PB Type A

FLAT GLASS MARKETING ASSOCIATION (FGMA)

FGYA **01-90**	Glazing Manual

NATIONAL ASSN OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA 802	Manufacturing of Hollow Metal Doors and Frames
NAAMM HMMA 830	Hollow Metal Manual; Section: Hardware Preparation and Locations for Hollow Metal Doors and Frames
NAAMM HMMA 840	Hollow Metal Manual; Section: Installation and Storage of Hollow Metal Doors and Frames
NAAMM HMMA 881	Hollow Metal Manual; Section: Guide Specifications for Commercial Hollow Metal Doors and Frames
NAAMM HMMA 862	Hollow Metal Manual; Section: Guide Specifications for Commercial Security Hollow Metal Doors and Frames

NATIONAL ASSOCIATION OF GARAGE DOOR MANUFACTURERS (NAGDM)

NAGDM 102	Specifications for Sectional Overhead Type Doors

NATIONAL WOOD WINDOWS & DOOR ASSOCIATION (NWWDA)

NWWDA IS 1	Wood Flush Doors
NWWDA IS 2	Wood Windows
NWWDA IS 4	Water-Repellent Preservative Treatment for Millwork

PORTLAND CEMENT ASSOCIATION (PCA)

PCA	Specifications for Plain and Reinforced Concrete
PCA	Architectural Concrete Specifications

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI 100	Standard Steel Doors and Frames
SDOI SDI 105	Recommended Erection Instructions for Steel Frames
SDOI SDI 106	Standard Door Type Nomenclature
SDOI SDI 107	Hardware on Steel Doors
SDOI SDI 111	Recommended Standard Details, - Steel Doors and Frames

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC PA1	Shop, Field, and Maintenance Painting

NATIONAL STANDARDS

END OF SUBSECTION

INDUSTRY PUBLICATIONS

PUBLICATION	PUBLISHER
ASTM Standards in Building Codes	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
Index of Federal Specifications, Standards and Commercial Item Descriptions	General Services Administration Office of Federal Supply and Services 7th & D Streets, S W. Washington, DC 20202
UL Building Materials Directory	Underwriters Laboratories, Inc 333 Pfingsten Road Northbrook, IL 60062
FM Approval Guide and FM Loss Prevention Data Sheets	Factory Mutual Research Norwood, MA 02062
ACI Detailing Manual and Structural Concrete for Buildings	American Concrete Institute P.O. Box 19150 Detroit, Ml 48219-0150
Terminology, Design, Hardware, Engineering Specifications	Aluminum Store Front and Entrance Manual 2700 River Road Des Plaines, IL 60018

INDUSTRY PUBLICATIONS

END OF SUBSECTION

APPENDIX A

ABBREVIATIONS

A, Amp	Ampere, Area
A/E	Architect-Engineer
AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ABS	Acrylonitrile-Butadiene-Styrene
AC	Alternating Current, Air Conditioning
ACFM	Actual Cubic Feet per Minute
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ACSM	American Congress on Surveying and Mapping
ADF	Asset Determinant Factor
ADJ	Adjustable
ADM	Action Description Memorandum
ADP	Automated Data Processing
AEC	U.S. Atomic Energy Commission
AFM	U.S. Air Force Manual
AFR	U.S. Air Force Regulation
AFWL	U.S. Air Force Weapons
AGA	American Gas Association
AHU	Air Handling Unit
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALARA	As Low as Reasonably Achievable
Allow	Allowance
Amb	Ambient
AMC	U.S. Army Materiel Command
AMCA	Air Movement Contractors Association
AMC-R	Army Materiel Command Regulation
Amp	Ampere
ANS	American Nuclear Society
ANSI	American National Standards Institute
API	American Petroleum Institute
Approx.	Approximately
AR	U.S. Army Regulation
AREA	American Railway Engineering Association
ARI	American Refrigeration Institute
ARMA	Asphalt Roofing Manufacturers Association
ASBC	American Standard Building Code
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration & Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATM	Atmosphere
AVG	Average
AVLIS	Atomic Vapor Laser Isotope Separation
AWG	American Wire Gauge
AWS	American Welding Society

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AWWA	American Water Works Association
BAT	Best Available Technology
BATEA	Best Available Technology Economically Achievable
BCPCT	Best Conventional Pollutant Control Technology
BESEP	Base Electronic System Engineering Plan
BHP	Brake Horsepower
BI	Black Iron
BIA	Brick Institute of America
BIL	Basic Impulse Insulation Level
BKRS	Breakers
BLDG	Building
BOCA	Building Official Code Association
BOD	Biochemical Oxygen Demand
	Building Research Advisory Board (now Building Research Board)
B R B	Building Research Board
BRG	Bearing
BTU	British Thermal Unit
°C	Degrees Centigrade (Celsius)
C&GS	U.S. Coast and Geodetic Survey (now National Geodetic Survey)
C M	Clean Air Act
CAMS	Continuous Air Monitoring System
CAS	Condition Assessment Survey
C C N	Closed Circuit Television
CDR	Conceptual Design Report
CEM	Continuous Emissions Monitoring
CERC	U.S. Army Coastal Engineering Research Center
CERCLA	Comprehensive Environmental Response, Compensation, & Liability Act
CF	Cubic Feet
CFC	Chlorofluorocarbon
CFM	Cubic Feet per Minute
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CHW	Chilled Water
CI	Cast Iron
CIP	Cast-in-Place, Cast Iron Pipe
CISCA	Ceiling and Interior Systems Contractors Association
CISPI	Cast Iron Soil Pipe Institute
CMP	Corrugated Metal Pipe
CO_2	Carbon Dioxide
COE	U.S. Army Corps of Engineers
COMPR	Compressor
COP	Coefficient of Performance
CP	Concrete Pipe
CPLG	Coupling
CPSC	Consumer Product Safety Commission
CPVC	Chlorinated Polyvinyl Chloride
CRI	Carpet and Rug Institute
CRT	Cathode Ray Tube
C_v	Flow coefficient
c w	Cold Water
CWA	Clean Water Act
CYL	Cylinder

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DAC	Derived Air Concentration
DARCOM	U.S. Army Development, Acquisition and Readiness Command
DB	Dry Bulb, Decibel
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DBF	Design Basis Fire
DBFL	Design Basis Flood
DBG	Distance Between Guides
DBT	Design Basis Tornado
DBW	Design Basis Wind
DC	Direct Current
DCG	Derived Concentration Guide
DCPA	Defense Civil Preparedness Agency
DL	Dead Load
DM	NAVFAC Design Manual
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOP	Dioctylphthalate
DOT	U.S. Department of Transportation
DP	Differential Pressure
DP-1	Assistant Secretary for Defense Programs
DP-34	Director of Safeguards and Security Agreement
DPDT	Double-Pole Double-Throw
DSC	Differential Scanning Calorimetry
DTA	Differential Thermal Analysis
DWT	Double Wrap Traction
DWV	Drain, Waste & Vent
DX	Direct Expansion
DYN	Dyne
EA	Each
ECC	Emergency Control Center
ECP	Entry Control Point
EMCS	Energy Monitoring and Control System
ECS	Emergency Control Station
EDE	Effective Dose Equivalent
EED	Electroexplosive Device
EIA	Electronics Industries Association
EIFS	Exterior Insulation and Finish System
EIMA	Exterior Insulation Manufacturers Association
EIS	Environmental Impact Statement
Elev	Elevator
EM	U.S. Army Engineering Manual
EMS	Energy Management System
EMT	Electrical Metallic Tubing
EO	Executive Order
EOC	Emergency Operating Center
EPA	U.S. Environmental Protection Agency
EPS	Emergency Power System
Equip	Equipment
ERDA	Energy Research and Development Administration (precursor to DOE)
ESF	Engineered Safety Feature
Est	Estimated

APPENDIX A

Ext	Exterior
°F	Degrees Fahrenheit
F M	Federal Aviation Administration
FAI	Fauske and Associates, Inc.
FAR	Federal Acquisition Regulation
FCC	Federal Construction Council
FEMA	Federal Emergency Management Agency
FGA	Flat Glass Marketing Association
FGCC	Federal Geodetic Control Committee
FGD	Flue Gas Desulphurization
FHWA	Federal Highway Administration
FHDA	Fir and Hemlock Door Association
Fig	Figure
FIPS	Federal information Processing Standards
Fixt	Fixture
Flr	Floor
FM	Factory Mutual
Fndtn	Foundation
FPM	Feet Per Minute
FPT	Female Pipe Thread
FR	Federal Register
fr	Frame
FS	Federal Specifications
FSAR	Final Safety Analysis Report
Ft	Foot, feet
Ft/lb	Foot-Pound
FWPCA	Federal Water Pollution Control Act
fy	Yield strength
G	Gauss
g	Gram
GA	Gypsum Association
ga	Gauge
Gal	Gallon
Galv	Galvanized
GDC	General Design Criteria, DOE 6430.1A
GPD	Gallon Per Day
GPH	Gallon Per Hour
GPM	Gallons Per Minute
GSA	General Services Administration
HE	High Explosives
HE-Pu	High Explosives-Plutonium
HF	High Frequency, Hydrogen Fluoride
HI	Hydraulic Institute
HID	High Intensity Discharge
HLW	High-Level Waste
HOA	Hand-Off-Automatic
HP	Horsepower
HR	Hour
Htg	Heating
Htr	Heater
HTW	High Temperature Water
HVAC	Heating, Ventilating, and Air-Conditioning

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Hvy	Heavy
HW	Hot Water
Hyd	Hydraulic
HX	Heat Exchanger
HZ	Hertz, frequency
IAPMO	International Association of Plumbing and Mechanical Officials
IAS	Intrusion Alarm System
ICBO	International Conference of Building Officials
ICRP	International Commission on Radiological Protection
ID	Inside Diameter
IDA	Intrusion Detection and Assessment
IDS	Intrusion Detection System
IEEE	Institute of Electrical and Electronic Engineers
IES	Illumination Engineering Society
IFM	Irradiated Fissile Material
IFMSF	Irradiated Fissile Material Storage Facility
IHE	Insensitive High Explosives
IMC	Intermediate Metal Conduit
In	Inch
Incl	Installed, Including
Inst	Installation
Insul	Insullation
IP	Iron Pipe
IPS	Iron Pipe Size
IPT	Iron Pipe Threaded
ISDSI	Insulated Steel Door Systems Institute
IU	Inspection Unit
IUEC	International Union of Elevator Contractors
J	Joule
°K	Degrees Kelvin
K	Subgrade modulus, Thousand, heavy wall copper tubing
Kg	Kilogram
kHz	Kilohertz
Kip	1000 pounds
Km	Kilometer
kPa	kilo Pascal
KV	Kilovolt
kVA	kiloVolt Ampere
kW	kilowatt
kWh	kilowatt hour
lb	Pound
lb/hr	Pounds Per Hour
lbf	Pounds Per Foot
LCC	Life-Cycle Cost
LCD	Liquid Crystal Display
LF	Linear Feet
LL	Live load psf - pounds per square foot
LLW	Low-Level Waste
LP	Liquid Petroleum, Low Pressure
LPG	Liquified Petroleum Gas
Lt	Light
LV	Low Voltage

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MA	Management and Administration (U.S. DOE)
mA	milliAmpre
MAA	Material Access Area
Mach	Machine
Maint	Maintenance
MAWP	Maximum Allowable Working Pressure
MBA	Material Balance Area
MBH	Thousand BTUs per Hour
MBMA	Metal Building Manufacturers' Association
MC&A	Material Control and Accountability
MCF	Thousand Cubic Feet
Mfg	Manufacturing
Mfr	Manufacturer
MCC	Motor Control Center
mg	Milligram
mg/l	Milligrams per liter
MGPH	Thousand Gallons Per Hour
Mhz	Megahertz
MI	Miles, total level route
MIL-HDBK	U.S. DOD military handbook
MIN	Minute
min	Minimum
Misc	Miscellaneous
ml	Millileter
ML/SFA	Metal Lath/Steel Framing Association
mm	Millimeter
M&O	Management and Operations
MPH	Miles Per Hour
MPT	Male Pipe Thread
mr/h	milli roentgen/hour
mrad/h	milli roentgen, absorbed dose/hour
mrem	milli roentgen equivalent man
MSSA	Master Safeguards and Security Agreement
Mtng	Mounting
MVA	Million-Volt-Amps
N_2	Nitrogen
N/A	Not Applicable
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAD	North American Datum
NAEC	National Association of Elevator Contractors
NAESA	National Association of Elevator Safety Authorities
NAPHCC	National Association of Plumbing-Heating-Cooling Contractors
NASA	National Aeronautics and Space Administration
NAVFAC	Naval Facilities Engineering Command
NBC	National Building Code
NBS	National Bureau of Standards
NC	Noise Criteria
NCEL	Naval Civil Engineering Laboratory (references listed under NAVFAC)
NCMA	National Concrete Masonry Association
NDA	Non-Destructive Assay
NEC	National Electrical Code

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NEII	National Elevator Industry Incorporated
NEMA	National Electrical Manufacturers Association
NEMI	National Elevator Manufacturing Industry, Inc. (now NEII)
NEPA	National Environmental Policy Act
NFGS	Naval Facilities Guide Specification (references listed under NAVFAC)
NFPA	National Fire Protection Association
NGS	National Geodetic Survey (formerly U.S.Coast and Geodetic Survey)
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIJ	National Institute of Justice
NIST	National Institute of Standards and Technology (see NBS)
N O M	National Oceanic and Atmospheric Administration
NO	Normally Open
NO_x	Oxides of Nitrogen
NPDES	National Pollutant Discharge Elimination System
NPDWS	National Primary Drinking Water Standards
NPSH	Net Positive Suction Head
NPT	National Pipe Thread
NRC	Nuclear Regulatory Commission
NRCA	National Roofing Contractors Association
NRTA	Near-Real-Time Accountancy
NRTL	Nationally Recognized Testing Laboratory
NSA	National Security Agency
NSPC	National Standard Plumbing Code
NSPS	New Source Performance Standards
NTIA	National Telecommunications and Information Administration
NTMA	National Terrazzo and Mosaic Association
NUREG	Nuclear Regulatory Commission-produced reference document
NWWDA	National Wood Window and Door Association
OA	Outside Air
OBA	Operating Basis Accident
OBE	Operating Basis Earthquake
o c	On Center
o c s	Office of Computer Services (U.S. DOE)
OD	Outside Dimension
ODH	Oxygen Deficiency Hazards
O & M	Operations and Maintenance
OMB	Office of Management and Budget
OP AMP	Operational Amplifier
Oper	Operator
OPFM	Office of Project and Facilities Management (U.S. DOE)
OS&Y	Outside Screw and Yoke
OSHA	Occupational Safety and Health Administration
OSR	Operational Safety Requirement
o s s	Office of Safeguards and Security (U.S. DOE)
OSTI	Office of Scientific and Technical Information (U.S. DOE)
OWG	Oil, Water, or Gas
Oz	Ounce
p	Minimum reinforcing ratio
PA	Protected area
PB	Polybutylene
PCB	Polychlorinated biphenyls

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PCI	Prestressed Concrete Institute
PEL	Permissible Exposure Limit
PF	Protection Factor
Ph	Phase
PI	Point of Intersection, Proportional-plus Integral
PIV	Post Indicator Valve
PLF	Pounds per Linear Foot
P kg	Package
PMFL	Probable Maximum Flood
POL	Petroleum, Oil, and Lubricants
POTW	Publicly-Owned Treatment Works
PPHF	Plutonium Processing and Handling Facility
PPM	Parts Per Million
PRV	Pressure Regulating Valve
PSAR	Preliminary Safety Analysis Report
PSF	Plutonium Storage Facility, Pound-force per square foot
PSI	Pound-force per square inch
PSIA	Pounds per square inch absolute
PSIG	Pound-force per square inch gauge
PTI	Post Tensioning Institute
Pu	Plutonium
PUBN	Publication
PURPA	Public Utility Regulatory Policy Act
PVC	Polyvinyl Chloride
QA	Quality Assurance
Qty	Quantity
R	Resistance
R12, R22	Refigerant (12,22, etc.)
°R	Degrees Rankine
RCP	Reinforced Concrete Pipe
RCRA	Resource Conservation and Recovery Act
RDF	Refuse-Derived Fuel
REM	Roentgen Equivalent Man
Reqd	Required
RFCI	Resilient Floor Covering Institute
RG	Regulatory Guide
RLWF	Radioactive Liquid Waste Facility
RPFM	Real Property and Facilities Management (U.S. DOE)
RPIS	Real Property Inventory System (U.S. DOE)
RPM	Revolutions Per Minute
RSWF	Radioactive Solid Waste Facility
RTD	Resistance Temperature Detector
S&S	Safeguards and Security
SAR	Safety Analysis Report
SARS	Safety Analysis and Review System
SAS	Secondary Alarm Station
SC	Safety Class
SCFM	Standard Cubic Feet per Minute
SCR	Sillicon Control Rectifier
s c s	U.S. Department of Agriculture, Soil Conservation Service
SDI	Steel Deck Institute, Steel Door Institute
SDWA	Safe Drinking Water Act

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SF	Safety Factor
SGFT	Structural Glazed Facing Tile
SISL	Special Isotope Separation Laser
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SNG	Supplementary Natural Gas
SNM	Special Nuclear Materials
SO_2	Sulfur dioxide
SOP	Standard Operating Procedure
SP	Special Publication (of the American Concrete Association)
SPCC	Spill Prevention Control and Countermeasure
SPDT	Single-Pole Double-Throw
SPRI	Single Ply Roofing Institute
SPST	Single-Pole Single-Throw
ssco	Single Speed Center-Opening
SQFT	Square foot
SSE	Safe Shutdown Earthquake
SSFI	Scaffolding, Shoring, and Framing Institute
SSSP	Site Safeguards and Security Plan
SSPC	Steel Structures Painting Council.
ssss	Single Speed Side-Sliding
STC	Sound Transmission Classification
Std	Standard
STP	Standard Temperature and Pressure
Sys	System
SWI	Steel Window Institute
SWP	Safe Working Pressure
SWT	Single Wrap Traction
T	Ton, Temperature
TCA	Tile Council of America, Inc.
TCDD	Tetrachlorodibenzo-p-dioxin
TDS	Total Dissolved Solids
TEC	Total Estimated Cost
TID	Tamper Indicating Device
TIMA	Thermal Insulation Manufacturers Association
TLV	Threshold Limit Value
TM	U.S. Army technical manual
tot	Total
TR	DOD technical report
Transf	Transformer
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSD	Treatment, Storage and Disposal
Tstat	Thermostat
TYP	Typical
TV	Television
U value	Overall heat transfer coefficient value
UBC	Uniform Building Code
UCRF	Uranium Conversion and Recovery Facility
UEF	Uranium Enrichment Facility
UEU	Unirradiated Enriched Uranium

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UEUSF	Unirradiated Enriched Uranium Storage Facility
UF_4	Uranium tetrafluoride
UF_6	Uranium hexafluoride
UFAS	Uniform Federal Accessibility Standards
UHF	Ultra High Frequency
UL	Underwriters Laboratory
"MC	Uniform Mechanical Code
UO_2	Uranium dioxide
UO_3	Uranium trioxide
"PA	Unit Process Area
UPC	Uniform Plumbing Code
UPHF	Uranium Processing and Handling Facility
UPS	Uninterruptible Power Supply
"RF	Uranium Recovery Facility
USC	U.S. Code
USCE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
USPHS	U.S. Public Health Service
USPS	U.S. Postal Service
V	Volt
VA	Volt-Ampere
Vac	Vacuum
VAV	Variable Air Volume
VCT	Vinyl Composition Floor Tile
Vel	Velocity
Vent	Ventilating
VHF	Very High Frequency
Vol	Volume
W	Watt
WB	Wet Bulb
WBT	Wet Bulb Temperature
WC	Water Column
WG	Water Gauge
WB	Wet Bulb
WBS	Work Breakdown Structure
WPCF	Water Pollution Control Federation
WRC	Water Resources Council
Yd	Yard
Yr	Year

APPENDIX A

SYMBOLS

°R'	Degrees Rankine
°K	Degrees Kelvin
°F	Degrees Fahrenheit
°C	Degrees Centigrade (Celcius)
>	Greater Than
<	Less Than
≥	Greater Than or Equal To
≤	Less Than or Equal To
%	Percent
#	Pound, Number
α, A	Alpha
β, B	Beta
ϕ, Φ	Theta
λ, Λ	Lambda
μ, M	Mu
π, Π	Pi
σ, Σ	Sigma
ω, Ω	Omega

APPENDIX A

END OF SUBSECTION

APPENDIX B

GLOSSARY

Abrasion Resistance:	The ability of a coating to resist degradation due to mechanical wear.
Abrasive Media:	The material used in abrasive blasting to remove surface contaminants. Examples of abrasive media are sand, iron shot, crushed iron slag, glass beads, or ground nut shells.
Absorption (of brick):	Obtained by immersion in either cold or boiling water for stated periods of time. It is usually expressed as a percent of the weight of the dry brick.
Abutment:	That part of a structure that takes the thrust of a beam, arch, vault, truss, girder, or foundation wall.
Accelerated Weathering:	A test designed to simulate but at the same time intensify and accelerate the destructive action of natural outdoor weathering.
Accelerator:	A substance used in small proportions to increase the speed of a chemical reaction. Accelerators are often used in the paint industry to speed a coating system's curing time and to speed concrete's natural setting time.
Acrylic Latex:	An aqueous dispersion of acrylic resins
Acrylic Resin:	A clear resin attained by polymerizing various acrylic monomers either alone or in combination.
Activator:	The curing agent of a two component coating system.
Additive:	A substance added to a material to modify at enhance its characteristics.
Adhesion:	The degree of attachment between a paint film and it's underlying material.
Admixture:	Act of mixing or the compound formed by mixing different substances together.
Adobe Brick:	A large clay brick, of varying size, roughly molded and sun dried. In certain sections of this country, a brick approximating paving brick size is known by this term.
Adsorption:	Process of attraction or attachment to a surface. The retention of foreign molecules on a substance surface.
Aggregates:	Inert minerals such as sand, gravel, and crushed stone. The aggregates are divided into two sizes - fine and coarse.
Air Cap (Air Noule):	Perforated housing for directing the atomizing air through the head of an air spray gun.
Air Drying:	The most common form of curing a coating in which drying takes place by oxidation or solvent evaporation by simple exposure to air without heat or catalyst.
Air Entrapment:	The inclusion of air bubbles in liquid paint or a paint film
Airless Spray:	A spraying system in which paint is atomized using high hydraulic pressure rather than compressed air.

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Alcohols: A group of solvents of relatively high evaporation rate but with fairly low solvent strength. Methanol, ethanol, and isopropyl alcohol are common alcohols.

Aliphatic Hydrocarbons: A class of organic solvents composed of open chains of carbon atoms. Aliphatics are relatively weak solvents. Mineral spirits and VM & P Naphtha are aliphatic solvents.

Alkali: An aqueous liquid that has a pH value between 7 and 14. A base or caustic material.

Alkyd Resin: Resins prepared by reacting alcohols and fatty acids. Widely used in general purpose coatings.

Alligatoring: Coating film surface imperfections having the wrinkled appearance of alligator skin.

Ambient Temperature: Room temperature or the existing temperature of the surroundings.

Amine: Materials often used as curing agents for epoxy coatings.

Anchor Bolts: Bolts to secure a wooden sill plate to concrete or masonry floor or wall. A threaded bolt, usually embedded in a foundation or footing to secure a column base.

Anchor Pattern: The surface profile generated by abrasive blasting. The distance between peaks and valleys of the blast profile.

Anchor: A piece or connected pieces of metal used for tying together two or more pieces of masonry materials.

Arch: A curved structural member used to span an opening or recess; also built flat. Structurally, an arch is a piece or assemblage of pieces so arranged over an opening that the supported load is resolved into pressures on the side supports, and practically normal to their faces.

Area Wall: The masonry or concrete surrounding or partly surrounding an area. It also serves as a retaining wall.

Areaway: An open subsurface space adjacent to a building used to admit light or air, or as a means of access to a basement.

Aromatic Hydrocarbons: A class of relatively strong organic solvents that contain an unsaturated ring of carbon atoms. Examples.are benzene, toluene, and xylene.

Arris: A sharp edge forming an external corner at the junction of two surfaces.

Ashlar: A flat-faced surface, generally square or rectangular, having sawed or dressed beds and joints.

Coursed Ashlar:
Ashlar set to form continuous horizontal joints.

Stacked Ashlar:
Ashlar set to form continuous vertical joints.

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Ashlar (Continued):	Random Ashlar: Ashlar set with stones of varying length and height so that neither vertical not horizontal joints ate continuous.
Asphalt:	Black resinous material of petroleum origin.
Backfill:	The replacement of excavated earth into a trench around and against a basement foundation.
Backfilling:	(1) Earth, soil, or other material used to replace excavated materials around a newly constructed wall, (2) Rough masonry lard behind a facing, or between two faces; (3) brickwork laid in the space between structural timbers.
Barge Course:	A course of brick, forming the coping of a wall, set on edge and transversely to the wall.
Barrier Coat:	A coating used to isolate a paint system either from the surface it is applied to or a previous coating for the purpose of increasing adhesion or ensuring compatibility.
Base:	The lowest part, or the lowest main division, of a building, column, pier, or wall.
Base Course:	The lowest course of masonry of a wall or pier. A footing course.
Base Plate:	See Bearing Plate.
Bat:	A piece of broken brick.
Beam:	A structural member transversely supporting a load
Bearing:	That part of a lintel, beam, girder, or truss that rests upon a column, pier, or wall.
Bearing Partition:	A partition that supports any vertical load in addition to its own weight.
Bearing Plate:	A piece of steel, iron, or other material that receives the load concentration and transmits it to the masonry or concrete.
Bearing Wall:	A wall that supports any vertical load in addition to its own weight.
Bed:	The prepared soil, or layer of mortar, on or in which a piece of masonry material is laid.
Bed Joint:	A horizontal joint between stones, usually filled with mortar, lead, or sealant.
Belt Course:	Same as a string course.
Bevel:	The angle that one surface or line makes with another when they are not at right angles.
Binder:	The nonvolatile portion of the vehicle of a coating that holds together the pigment particles.
Bituminous Coating:	A coal tar or asphalt based coating material usually used in thick films.
Blank Wall:	One having no door, window, or other opening.

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Blast Cleaning:	The cleaning and roughing of a surface by the use of sand, artificial grit, or fine metal shot that is projected at a surface by compressed air or mechanical means.
Blast Profile:	A cross sectional view of an abrasive blasted surface. (See anchor pattern.)
Bleaching:	The fading of a color toward white generally caused by exposure to chemicals or ultraviolet radiation.
Bleeding:	The diffusion of color matter through a coating from underlying surfaces causing a color change.
Blistering:	The formation of blisters in paint films by the local loss of adhesion and lifting of the film from the underlying substrate.
Block:	A unit in terra cotta or cement block, differing from a brick in being larger and hollow or solid.
Block (Hollow):	A shape made of clay, terra cotta, or other material fashioned with one or more openings in 'its body for lightness, whose net sectional area does not exceed 75 percent of its gross sectional area.
Blocking:	A method of bonding two adjoining or intersecting walls, not built at the same time, by means of offsets and overhanging blocks consisting of several courses of brick each.
Blooming:	A haziness that develops on paint surfaces caused by the exudation of a component of the paint film.
Blushing:	A film defect that manifests as a milky appearance which is generally caused by rapid solvent evaporation or the presence of excessive moisture during the curing process.
Bond:	The tying or bonding of the various pieces and parts of a masonry wall by laying one piece across two or more pieces; the entire system of bonding or breaking joints as used in masonry construction. The mortar between brick is sometimes termed a bond.
Bond (Course):	The header course.
Bond Beam:	A horizontally reinforced concrete or concrete masonry beam built to strengthen and tie a masonry wall together. A bond beam is often placed at the top of a masonry wall with continuous reinforcing around the entire perimeter.
Bond Stone:	Stones projecting laterally into the backup wall used to tie the wall together.
Bonding:	The attachment between a coating film and the underlying material it is applied to.
Bounce Back:	The rebound of atomized paint, especially when applied by conventional air spray methods.
Boxlng:	Mixing of coatings by pouring from one container to another.

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Brick:	A structural unit of burnt clay or shale, formed while plastic into a rectangular prism, usually solid, the net sectional area of which is not less than 75 percent of the gross sectional area.
Brick and Brick:	A method of laying brick whereby the brick are laid touching each other with only mortar enough to fill the irregularities of the surface.
Brick Veneer:	A facing of brick laid against and fastened to sheathing of a frame wall of tile wall construction.
Brickwork:	Any structure or structural part made of brick and mortar
Bridging:	The formation of a paint film over a depression
Brittleness:	The lack of resistance to cracking or breaking of a paint film when bent or flexed.
Brushability:	The ease of applying a coating by brush.
Bubbling:	A temporary or permanent film defect in which bubbles of air or solvent vapor are present in the applied film.
Bugged Finish:	A smooth finish produced by grinding with power sanders
Build:	The wet or dry thickness of a coating film.
Bull Nose:	Convex rounding of a member, such as the front edge of a stair tread or window sill.
Bull-Header:	A rowlok brick laid with its longest dimension perpendicular to the face of the wall.
Bull-Stretcher:	A rowlok brick laid with its longest dimension parallel to the face of the wall.
Buttering:	Placing mortar on a brick with a trowel before brick is laid.
Buttress:	A piece of masonry, like a pier, built against and bonded into a wall to strengthen the wall against side thrust.
Buttress (Flying):	A detached buttress or pier of masonry, at some distance from the wall, and connected thereto by an arch or portion of an arch, to assist in resisting side thrust.
C/B Ratio:	The ratio of the weight of water absorbed by cold immersion (usually 24 hours) to the weight absorbed by immersion in boiling water (usually 5 hours). This ratio is also known as the saturation coefficient.
Calcite Streaks:	Description of a white or milky streak occurring in stone. It is a joint plane usually wider than a glass seam that has been recemented by deposition of calcite in the crack. It is structurally sound.
Camber:	A slight upward curve of a structural member so that it becomes horizontal, or nearly so, when loaded.
Cap:	The upper member of a column, pilaster, pile, caisson molding, and the like.
Capital:	Column cap.

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Catalyst:	An accelerator, activator, or curing agent that chemically increases the rate of reaction in a coating.
Cathode:	The negative terminal of an electrolytic cell which, in the corrosion process, is protected and not attacked.
Cathodic Protection:	The reduction or prevention of corrosion of a metal surface caused by making it cathodic. This is accomplished by using a sacrificial anode (such as in zinc rich coatings or galvanizing) or by using impressed current.
Caulking:	The operation or method of rendering a joint tight against water by means of some plastic substances such as oakum, pitch, elastic cement, and the like.
Caustic:	A strong base or alkaline material.
Caustic Soda:	A common name for sodium hydroxide, a strong base or alkali.
Cellosolve:	Proprietary name for ethylene glycol monoethyl ether. A slow evaporating, water miscible, relatively strong solvent often used in epoxy coatings.
Cementitious Coatings:	A coating containing Portland cement as one of its components held on the surface by a binder.
Centipoise:	One hundredth of a poise which is a unit of measurement for viscosity. Water at room temperature has a viscosity of 1.0 centipoise.
Chalking:	The formation of a friable powdery coating on the surface of a paint film, generally caused by exposure to ultraviolet radiation resulting in a loss of gloss.
Chat Sawed:	Description of a textured stone finish, obtained by using chat sand in the gang sawing process.
Check Cracks:	Shrinkage cracks in concrete still bonded to its base.
Checking:	Cracks in the surface of a paint film.
Chip Cracks:	Similar to check cracks, except that the bond has been partially destroyed, causing eggshelling. Sometimes referred to as fire cracks, map cracks, crazing, fire checks, or hair cracks.
Chlorinated Hydrocarbon:	A class of strong, fast evaporating, nonflammable solvents such as carbon tetrochloride, methylene chloride or trichloroethylene.
Chlorinated Rubber:	A coating resin formed by the reaction of rubber with chlorine gas. Often used for chemical or water resistant properties.
Cleaners:	A detergent, alkali, acid, or similar contamination removing material; usually water borne.
Coal Tar:	A dark brown to black bituminous material produced by the destructive distillation of coal.

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Coal Tar Epoxy:	A coating in which the binder or vehicle is a combination of coal tar and epoxy resins.
Coalescence:	The formation of resinous or polymeric material when water evaporates from an emulsion or a latex system, permitting contact and fusion of adjacent particles.
Coat:	The paint applied to a surface in a single application to form a film when dry.
Coating System:	A number of coats separately applied, in a predetermined order, at suitable intervals to allow for drying and curing, resulting in a completed job.
Cobwebbing:	Premature drying of a coating during spraying causing a spider web effect.
Cohesion:	The forces that bind paint film particles together into a continuous film.
Cold Rolled Steel:	Low carbon, cold-reduced, sheet steel. Differs from hot, rolled steel by the absence of mill scale.
Color Fast:	Nonfading.
Color Retention:	The ability to retain its original color during weathering or chemical exposure.
Column:	A pillar or pier of rather slender proportions that carries a load and acts as an upright support.
Combustible Liquid:	Any liquid having a flash point at or above 100°F (37.8°C)
Compatibility:	The ability to mix with or adhere properly to other coatings without detriment.
Concrete:	A mixture of two components, cement' paste and aggregates.
Concrete Plain:	Concrete either without reinforcement, or reinforced only for shrinkage or temperature changes.
Conical Mandrel:	An instrument used to evaluate a coating's resistance to cracking when bent over a specified radius.
Connectors:	A device that holds two or more structural members intact
Construction Joint:	The interface/meeting surface between two successive concrete pours.
Coping:	The material or member used to form a capping or finish on top of a wall, pier, or the like to protect the masonry below by throwing off the water to one or more sides.
Copolymer:	Large molecules obtained by simultaneous polymerization of different monomers, as in vinyl copolymers.
Corbel:	That part of the masonry built outward from the face of masonry by projecting successive courses of the masonry.
Corbel Out:	To build out one or more courses of brick or stone from the face of a wall to form a support for timbers.

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Cornice:	A molded projecting stone at the top of an entablature
Corrosion:	The decay, oxidation, or deterioration of a substance due to interaction with the environment.
Counterfort:	A buttress or portion projecting from a wall and upward from the foundation to provide additional resistance to thrusts.
Course:	One of the continuous horizontal layers (or rows) of masonry units which, bonded together, form a masonry structure.
Cracking:	Splitting of a paint film usually as a result of aging.
Cramp:	An anchor for masonry, made of a short, flat bar of metal, with both ends turned down at right angles, and used for tying the masonry together by bedding the bent ends in holes provided in the masonry units.
Craters:	The formation of small bowl shape depressions in paint films.
Creep:	The time-dependent deformation of steel or concrete due to sustained load.
Cross Spraying:	Spraying the first pass in one direction and the second at a right angle to the first, providing more even film distribution.
Crosslinking:	The setting up of chemical links between molecular chains to form a three dimensional network of connected molecules.
Crowfoot:	(Stylofite.) A dark gray to black zig-zag marking occurring in stone. Usually structurally sound.
Crown:	The top or high point of a horizontal surface.
Curing Agent:	A hardener or activator added to a synthetic resin to develop the proper film forming properties.
Curtains:	Long horizontal runs in a coating film that occur on vertical surfaces when a coating is applied too heavily.
Cut Stone:	Finished, dimensioned stone, ready to set in place.
Cutting:	Handwork required to finish a stone that cannot be done by machine.
Damp Course:	A course or layer of impervious material in a wall or floor to prevent the entrance of moisture from the ground or from a lower course.
Deformed Bars:	Reinforcing bars with closely spaced shoulders, lugs, or projections formed integrally with the bar during rolling to firmly engage the surrounding mortar. Wire mesh with welded intersections not farther apart than 12 inches (30 cm.) in the direction of the principal reinforcement and with cross wires not smaller than No. 10 may be rated as a deformed bar.
Degreaser:	A chemical solution or compound designed to remove grease, oils, and similar contaminants.
Deionized Water:	Water that has been purified to remove mineral salts

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Delamination:	The separation between layers of coats due to very poor adhesion.
Density:	Mass per unit volume, usually expressed as grams per milliliter or pounds per gallon.
Dentil:	Block projections on an entablature.
Dentil Course:	Mold course immediately below the cornice, having on one of its members, small uniformly spaced blocks, referred to as dentils.
Descaling:	The removal of mill scale or rust from steel by mechanical means, sometimes assisted by flame cleaning.
Dew Point:	The temperature of a surface, at a given ambient temperature and relative humidity, at which condensation of moisture will occur.
DFT:	Dry film thickness.
Diamond Sawed:	Finish produced by sawing with diamond toothed saws (either circular or gang).
Diluent:	A portion of the volatile components of a coating that is not a true solvent and has minimal affect on the viscosity.
Dimensioned Stone:	Stone precut and shaped to specified sizes.
Dispersion:	The suspension of tiny particles, usually pigments, in a liquid, usually resin.
Distilled Water:	Water that has been purified by vaporizing the liquid and collecting the vapor which is then condensed back to a liquid having, in the process, removed all salts, metals, etc.
Dope:	Term for additives used either to accelerate or retard the set of any type of mortar.
Drip:	Any projecting piece of material, member, or part of a member so shaped and placed as to throw off water and prevent its running down the face of a wall or other surface of which it is a part.
Dry Fall:	A coating designed to dry rapidly so that the overspray can be easily removed from the surfaces below.
Dry Seam:	Unhealed fracture that is a plane of weakness.
Dry Spray:	Overspray or bounce back producing a sandy finish due to the sprayed particles having partially dried before reaching the surface.
Dry Time:	Time allotted for an applied coating film to reach a set stage of cure or hardness.
Dry-Out:	Soft, chalky mortar caused by water evaporating before setting.
Dry-to-Handle:	The degree of cure at which a film will resist deformation due to handling.

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Dry-to-Recoat:	The time required for a cured film to dry prior to the application of a second coat.
Dry-to-Tack Free:	The stage at which a coating film will form a skin that dust will not adhere to.
Dry-to-Touch:	The state of dry at which a coating film will not transfer onto an item touched lightly against it.
Dryer:	A chemical thaat promotes oxidation and subsequent drying of a paint film. Primarily used in oil base paints.
Drying Oil:	An oil having the property of hardening by oxidation to a tough film when exposed to air in the form of a thin film.
Dulling:	A loss of gloss or sheen.
Dusting:	The development of dust on the surface of concrete. Dusting can be the result of trowelling too soon, too much water in the mix, improper mix design, or other reasons.
Effective Area of Brick Masonry:	The area of a section that lies between the centroid of the tensile reinforcement and the compression face of the structural member.
Effective Area of Reinforcement:	The area obtained by multiplying the right cross-sectional area of the metal reinforcement by the cosine of the angle between its direction and that for which the effectiveness of the reinforcement is to be determined.
Effective Depth:	The distance from the center of gravity of tensile reinforcement to the compression surface of a structural member.
Effervescence:	An effect in the film caused by rapid solvent release. This "boiling" of solvent causes a pinholed or cratered appearance reducing gloss.
Eff lorescence:	Mortars or cements that contain an excess of soluble salts contribute to masonry efflorescence. Efflorescence can only occur when water penetrates the masonry or concrete, dissolves the salts, and upon evaporation deposits them on the face of the wall. The surest efflorescence preventative is to keep water out of masonry or concrete.
Eggrhelling:	Refers to the condition of chip-cracked concrete, mortar, or plaster. The form taken is concave to the surface and the bond is partially destroyed.
Elastic:	The ability of a substance to return to its original shape or volume after a distorting force on the substance has been removed.
Elcometer:	A trademark and brand name for a magnetic instrument for measuring dry film thicknesses of coatings applied to ferrous surfaces such as steel.
Electrical Potential:	A minute voltage produced by the separation of molecules into their ionic state.

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Electrolyte:	A substance that dissociates into ions in solution thereby becoming electrically conductive.
Electromotive Series:	A listing of elements arranged according to their standard electrical potentials otherwise known as galvanic series.
Electrostatic Spray:	The spray application of paint where the particles are charged causing them to be electrically attracted to the grounded surface.
Emulsion:	A two phase liquid system in which small droplets of one liquid are immiscible in and dispersed uniformly throughout a second continuous liquid phase.
Enamel:	A term used to characterize a coating that has a glossy smooth finish. A common term for alkyd coatings.
Enclosure Wall:	An exterior non-bearing wall in skeleton construction, anchored to columns, piers, or floors, but not necessarily built between columns or piers nor wholly supported at each story.
Entablature:	Consists of an architrave, frieze, and cornice.
Entasis:	The curve resulting from the gradual diminishing of the diameter of the upper two-thirds of a column.
Epoxy:	A synthetic resin, derived from petroleum products, that can be cured by a catalyst or used to upgrade other synthetic resins to form a harder, more chemical resistant film.
Epoxy Resin:	A flexible usually thermal setting resin made by polymerization of an epoxide and used as an adhesive.
Etching:	The treatment of a surface with an acid in order to dissolve loose particles or provide a profile.
Expanded Metal:	Sheets of metal that are slit and drawn out to form diamond-shaped openings. This is used as a metal reinforcing for plaster and is termed metal *lath.*
Expansion Anchor:	A metal expandable unit inserted into a drilled hole that grips stone by expansion.
Expansion Joint:	A bituminous fiber strip used to separate blocks or units of concrete to prevent cracking due to expansion as a result of temperature changes. Also used in concrete slabs.
Exterior Wall:	Any outside wall or vertical enclosure of a building other than a party wall.
External Atomization:	Using air to break up a coating material after it has exited the spray gun nozzle.
Face:	The front or exposed surface of a wall.
Facing:	Any material, forming a part of the wall, used on the exterior as a finishing surface.
Fading:	Loss of gloss or sheen.
Fan Pattern:	The geometry of a spray pattern.

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Fat:	Material accumulated on the trowel during the finishing operation and used to fill in small imperfections. Also a term to describe working characteristics of any type mortar.
Feather Edge:	Reduced film thickness at the edge of a dry paint film in order to produce a smooth, continuous appearance.
Filler:	A compound used to extend or bulk a coating to provide extra body or hiding power.
Film Build:	The dry film thickness characteristics of a coat.
Film Integrity:	The continuity of a coating free of defects.
Film Thickness Gauge:	A device for measuring either wet or dry film thickness.
Film:	A layer of coating or paint.
Fineness of Grind:	The degree of dispersion of particles within a liquid.
Fingering:	A broken spray pattern delivering heavier paint to one area than another.
Fire Division Wall:	Any wall that subdivides a building to resist the spread of fire, but is not necessarily continuous through all stories to and above the roof.
Fire Resistance:	The property of a material or assembly to withstand fire, characterized by the ability to confine a fire and/or to continue to perform a given structural function.
Fire stop:	Any piece or mass of fire resistant material used for filling in open spaces or close openings in order to prevent the passage of fire.
Fire Wall:	Any wall that subdivides a building to resist the spread of fire, by starting at the foundation and extending continuously through all stories to and above the roof.
Fireproofing:	Any material or combination of materials used to enclose structure members to make them fire resistant.
Flammable:	Any substance easily ignited in the presence of a flame; any liquid having a flash point below 100°F (37.8°C).
Flash Point:	The lowest temperature of a liquid at which sufficient vapor is provided to form an ignitable mixture when mixed with air.
Flash-Off lime:	Time that must be allowed after the application of a paint film before baking so that the initial solvents are released, which prevents bubbling.
Flashing:	The material used and the process of making watertight the roof intersections and other exposed places on the outside of the house.
Flexibility:	The degree at which a coating is able to conform to movement or deformation of its supporting surface without cracking or flaking.
Floating (Flooding):	A concentration of one of the ingredients of the pigmented portion of a paint at its surface giving rise to a color change.

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Flow: The degree to which a wet paint film can level out after application so as to eliminate brush marks and produce a smooth uniform finish.

Fluid lip: The orifice in a spray gun to which the needle is seated.

fluorescent: A class of pigments that when exposed to visible light, emit light of a different wave length producing a bright appearance.

Footing: A masonry section, usually concrete, in a rectangular form wider than the bottom of the foundation 'wall or pier supports.

Footing Form: A wooden or steel structure, placed around the footing that will hold the concrete to the desired shape and size.

Force Drying: The acceleration of drying by increasing the ambient temperature.

Foreign Thinner: Any thinner not recommended on the label or in published literature of the manufacturer, that can affect the coating's performance.

Formwork: The total system of support for freshly placed concrete including the mold or sheathing that contacts the concrete, all supporting members, hardware, and necessary bracing.

Fouling: Marine growth such as weeds or barnacles adhering to the surface.

Foundation: The supporting portion of a structure below the first-floor construction, or below grade, including the footings.

Foundation Wall: That portion of a load-bearing wall below the level of the adjacent grade, or below the first tier of floor beams or joists, that transmits the superimposed load to the footing.

Frostline: The depth of frost penetration in soil. This depth varies in different parts of the country. Footings should be placed below this depth to prevent movement.

Fungicide: A substance poisonous to fungi that retards or kills mold and mildew growth.

Galvanic Anode: A metal that when properly connected to metallic structures of different composition, will generate an electric current.

Galvanized Steel: Cold rolled steel that has been coated with a thin layer of metallic zinc by hot dipping or electroplating.

Gang Saw: A machine with multiple blades used to saw rough quarry blocks into slabs.

Gelled: A coating that has thickened to a jelly-like consistency making it unusable.

Generic: Belonging to a particular family.

Glass Seam: Vein fillings of coarsely crystalline calcite, that do not necessarily decrease the strength of stone.

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Gloss:	The sheen or ability to reflect light.
Gloss Retention:	The ability to retain the original sheen during weathering.
Glycol Ether:	A group of relatively slow evaporating, strong solvents commonly utilized in epoxy coatings.
Granular Base:	Evenly graded mixture of fine and course aggregates to provide, when compacted, a smooth and even surface below footings.
Grit Blasting:	Abrasive blasting using grit as the blasting media.
Grit:	An abrasive blasting media obtained from slag and various other materials.
Grout:	A mixture of cementitious material (cement, lime), sand, and sufficient water to make a consistency that will flow without separation of ingredients.
Hardener:	An activator curing agent, catalyst, or cross-linking agent.
Hardness:	The degree to which a material will withstand pressure without deformation or scratching.
Header:	A brick laid lengthwise across a wall and serving as a bond. A masonry unit laid flat with its largest dimension perpendicular to the face of the wall. It is generally used to tie two wythes of masonry together.
Hiding:	The ability of a coating to obscure the surface it is applied to.
High Build:	A term referring to a paint film that can produce a thick film in a single coat.
High-Strength Adhesive:	A bonding agent of high ultimate strength used to join individual pieces of stone into preassembled units.
Holiday:	Any discontinuity, bare, or thin spot in a painted area.
Hollow Wall:	A wall built of solid masonry units laid in and so constructed as to provide an air space within the wall.
Hot Rolled Steel:	Steel that has been formed while still hot, generally characterized by the presence of bluish-black mill scale.
Hydrocarbon:	Extracts from petroleum such as gasoline, lubricating oils, solvents, etc.
Hydrophilic:	A substance that absorbs or has an affinity for water, water loving.
Hydrophobic:	A substance that does not absorb or exhibit an affinity for water.
I-Beam:	A structural member of rolled steel whose cross section resembles the capital letter I.
Immersion:	Referring to an environment that is continuously submerged in a liquid, often water.
Impact Resistance:	The ability to resist deformation or cracking due to a forceful blow.

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Incise:	To cut inwardly or engrave - as in an inscription.
Incombustible (Building Material):	Any building material that does not contain matter subject to rapid oxidation within the temperature limits of a standard fire test of not less than 2.5 hours duration. NOTE: Materials that continue burning after this time period are combustible.
Incompatibility:	Unsuitable for use together because of undesirable chemical or physical effects.
Induction Time:	The period of time between mixing of two component products and the moment they can be used.
Inert Pigment:	A nonreactive pigment, filler, or extender.
Inhibitive Pigment:	A pigment that assists in corrosion prevention.
Inorganic:	The designation of compounds that do not contain carbon.
Inorganic Zinc:	A coating based on a silicate resin and pigmented with metallic zinc that has excellent resistance to organic solvents and general weathering.
Inscription:	Lettering cut in stone.
Intercoat Adhesion:	The adhesion between successive coats of paint.
Intercoat Contamination:	The presence of foreign matter such as dust or dirt between successive coats of paint.
Internal Mix:	A spray gun in which the fluid and air are combined before leaving the gun.
Interior Wall:	Any wall entirely surrounded by the exterior walls of a building.
Intumescent Coating:	A fire retardant coating that, when heated, produces nonflammable gasses trapped by the film, converting it to a foam, thereby insulating the substrate.
Ion:	An atom or group of atoms possessing a positive or negative electric charge as a result of having lost or gained an electron.
Iron Oxide:	An oxide of iron. The natural occurring state of steel.
Isopropyl Alcohol **(IPA):**	A volatile, flammable liquid used as a solvent commonly known as rubbing alcohol.
Joint:	The space between the adjacent surfaces of two members or components joined and held together by nails, glue, cement, mortar, or other means.
Joist:	One of a series of parallel beams, usually 2 inches (5 cm.) thick, used to support floor and ceiling loads, and supported in turn by larger beams, girders, or bearing walls.
Ketone:	An organic compound with a carbonyl group attached to two carbon atoms. Usually indicates a strong, fast evaporating solvent.

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Key:	A section of concrete formed to lock into another pour to stop water penetration or provide easier joining of pieces. A wedge section of masonry placed at the crown of an arch, acting as a key.
Keystone:	The wedge-shaped stone placed at the top center of an arch.
Lacing Course:	A course of brick, or several adjacent courses considered collectively, inserted at frequent intervals, as in a stone wall as a bond course.
Lacquer:	A coating comprised of a synthetic film forming material that is dissolved in organic solvents and dries by solvent evaporation.
Lacquer Thinner:	Term commonly used to describe a solvent blend of ethyl alcohol, ethyl acetate, and toluene.
Laitance:	An accumulation of fine particles, loosely bonded, on the surface of fresh concrete, caused by the upward movement of water.
Latex:	A stable dispersion of a polymer substance in an aqueous medium; a common term for water reducible coatings.
Lead-Free:	Contains, by weight, less than 0.5% lead for industrial products and less than 0.6% lead in consumer products.
Leafing:	The orientation of pigment flakes in a horizontal plane, usually aluminum.
Lewis Bolt:	A tapered head wedged in a tapered recess in stone for hanging soffitt stones.
	Box Lewis: A tapered metal box wedged in the top of columns or other heavy stones for hoisting.
	Lewis Holes: Sinkages **in** the top beds of stone to engage Lewis pins for hoisting.
Lifting:	Softening and raising or wrinkling of a previous coat by the application of an additional coat; often caused by coatings containing strong solvents.
Lintel:	A horizontal structural member that supports the load over an opening such as a door or window.
Lintel (Safety):	A lintel of wood or other suitable material placed behind the main lintel or behind an arch; generally used in conjunction with a relieving arch.
Masonry:	Stone, brick, concrete, hollow-tile, concrete-block, gypsum-block, or other similar building units or materials or a combination of the same, bonded together with mortar to form a wall, pier, buttress, or similar mass.

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Mastic:	A pasty material used as a cement (as for setting tile) or a protective coating (as for thermal insulation or waterproofing) or a term used to describe a heavy bodied coating.
Metallzing:	A method of applying atomized, molten metal such as zinc and aluminum to a surface.
Methyl Ethyl Ketone (MEK):	A low boiling, highly volatile, flammable solvent with extremely good solubility for most vinyls, urethanes, and other coatings.
Methyl **Isobutyl** Ketone (MIBK):	A medium boiling solvent commonly used in vinyls.
Micron:	A micrometer or one millionth of a meter.
Mil:	One one-thousandth of an inch; 0.001 inches. Commonly used to denote coating thickness.
Mildew:	A superficial growth of living organic matter produced by fungi in the presence of moisture; results in discoloration and decomposition of the surface.
Mill Scale:	A layer of iron oxide formed on the surface of steel plates during hot rolling; bluish in appearance.
Mineral Fiber:	Fibers formed from mineral slag, the most common being glass wool used in loose or batt form for thermal and/or fireproofing.
Mineral Spirits:	A refined petroleum distillate having a low aromatic hydrocarbon content and low solubility; suitable for thinning of alkyd coatings.
Miscible:	Capable of mixing or blending uniformly.
Mist Coat:	A thin tack coat usually applied to fill porous surfaces such as zinc rich primers.
Miter:	The junction of two units at an angle. The junction line usually bisects on a 45 degree angle.
Monomer:	A substance of low molecular weight molecules capable of reacting to form longer molecules called polymers.
Mortar:	A mixture of cementitious materials and aggregate, with or without the addition of plasticizers or other admixtures, reduced to a plastic state by the addition of water and suitable for use to bind masonry units together.
Mottled:	Spots of different tones and colors next to each other resulting in a blotchy effect on the coating film.
Mudcracking:	A paint film defect characterized by a broken network of cracks in the film.
Muriatic Acid:	Concentrated hydrochloric acid often diluted and used for etching concrete.
Natural Bed:	The horizontal stratification of stone as it was formed in the deposit.

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Neat:	Generally, basecoat plaster, mortar, or grout to which sand is added at the job.
Neutral:	A liquid that is neither acid nor alkali such as water; pH7
Non-Bearing Wall:	Any wall that carries no load other than its own weight,
Non-Drying Oil:	An oil that undergoes little or no oxidation when exposed to air and therefore has no film forming properties.
Nonferrous:	A term used to designate metals or alloys that do not contain iron; eg., brass, aluminum, magnesium.
Nonflammable:	A compound that does not burn in the presence of a flame.
Nonvolatile:	The portion of the paint left after the solvent evaporates, solids.
Oil Length:	The ratio of oil to resin expressed as a percentage of oil by weight in the resin. Used to determine the physical properties of a resin.
Opacity:	The ability of a paint film to obliterate or hide the color of the surface it is applied to.
Orange Peel:	The dimpled appearance of a dried paint film resembling the peel of an orange.
Organic:	Designation of any chemical compound containing carbon.
Organic Zinc:	A zinc rich coating utilizing an organic resin such as an epoxy.
Osmosis:	The diffusion of liquid through a paint film or other such membrane.
Overspray:	Sprayed coating that is dry when it hits the surface resulting in dusty, granular, adhering particles, reducing gloss and presenting a poor appearance.
Oxidation:	The formation of an oxide; the curing mechanisms for alkyds.
Paint:	(v.) To apply a thin layer of coating to a substrate by brush, roller, spray, or other suitable method. (n.) A pigmented liquid designed for application to a substrate, in a thin layer, which is then converted to an opaque solid film.
Panel Wall:	A non-bearing wall in skeleton construction, built between columns or piers, and wholly supported at each story.
Parging:	To coat or plaster with mortar or grout.
Partition:	A wall that subdivides spaces within any story of a building
Party Wall:	A wall used, or adapted for use for joint service by adjoining buildings.
Pass:	The motion of a spray gun in one direction only.
Pasdvate:	To make a surface such as steel inert or unreactive, usually by chemical means.

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Paste:	The product of the dispersion process. It is usually very high viscosity and requires dilution prior to application; a concentrated pigment dispersion used for shading or a composition of Portland cement, water, and air
Pattern:	The shape or stream of material coming from a spray gun.
Peeling:	A paint or coating lifting from the surface due to poor adhesion.
Perm:	A measure of water vapor movement through a material (grains per square foot, per hour, per inch of mercury difference in vapor pressure).
Permeability:	The degree to which a membrane or coating film will allow the passage or penetration of a liquid or gas.
pH:	A measure of acidity and alkalinity; pH l-7 is acid and pH 7-14 is alkaline.
Phenolic:	A synthetic resin used for heat or water resistance.
Phorphatizing:	A pretreatment of steel by a chemical solution containing metal phosphates and phosphoric acid to temporarily inhibit corrosion.
Pickling:	The treatment of steel for the removal of rust and mill scale by immersion in a hot acid solution containing an inhibitor.
Pier:	A column of masonry, usually rectangular in horizontal cross section, used to support other structural members.
Piers:	Masonry or concrete supports, set independently of the main foundation.
Pigment:	A finely ground natural or synthetic, insoluble particle adding color and opacity or corrosion inhibition to a coating film.
Pigment Grind:	The action of dispersing a pigment in a liquid vehicle.
Pigment Volume Concentration (PVC):	The percent by volume occupied by pigment in the dried film of paint generally expressed as a percentage.
Pigment/Binder Ratio:	A ratio of total pigment to binder solids in paint.
Pilaster:	A pier, built as an integral part of a wall, and projecting slightly from either vertical surface thereof.
Pinholing:	A film defect characterized by small, pore-like flaws in a coating that extend entirely through the film.
Pipe Column:	A column made of steel pipe and often filled with concrete.
Plasticizer:	An agent added to the resin to aid in flexibility.
Plumb:	Exactly perpendicular; vertical.
Pointing:	Pushing mortar into a joint after masonry is laid.
Polyester Resin:	A group of synthetic resins that contain repeating ester groups. A special type of modified alkyd resin.

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Polymer:	A substance of molecules that consist of one or more structural units repeated any number of times.
Polymerization:	A chemical reaction in which two or more small molecules combine to form large molecules containing repeated structural units.
Polyurethane:	Reaction product of isocyanate with any of a wide variety of other compounds containing an active hydrogen group. Polyurethane is used to formulate tough, abrasion-resistant coatings.
Polyvinyl Chloride (PVC):	A hard, tough plastic solid used for plastics and coatings, commonly known as vinyl.
Porosity:	The presence of numerous minute voids in a cured material.
Post:	A timber set on end to support a wall, girder, or other member of the structure.
Pot Life:	The length of time a paint material is useful after its original package is opened or a catalyst or other curing agent is added.
Practical Coverage:	The spreading rate of a paint calculated at the recommended dry film thickness and assuming 15% material loss.
Preassembled Units:	Two or more stones combined into a single unit by the use of epoxy resins, steel framing, or concrete backing.
Precast Concrete:	A concrete member that is cast and cured in other than its final position.
Primer:	The first coat of paint applied to a surface, formulated to have good bonding, wetting, and inhibiting properties.
Profile:	The term used to describe the anchor pattern of a surface produced by sandblasting, acid etching, or similar method.
Pyrometer:	An instrument used to measure the temperature of a surface.
Quarry:	The location of an operation where a natural deposit of stone is removed from the ground.
QUV:	An accelerated testing device designed to evaluate the fading properties of a coating by exposure to high intensity, ultraviolet light.
Raggle:	A groove or channel made in a mortar joint, or in the solid masonry material, to receive roofing, metal flashing, or other material that is to be sealed in the masonry.
Recess:	A sinkage.
Reducer:	Commonly known as thinner.
Reflectance:	The intensity ratio of reflected light to that of incidental light.
Reglet:	A recess to receive and secure metal flashing.

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Reinforced Brick Masonry (R-B-M):	Brick masonry in which metal is embedded in such a manner that the two materials act together in resisting forces.
Reinforcement:	Structural steel shapes, steel bars, rods, wire mesh, or expanded metal embedded or encased in brick or other masonry or concrete to increase its strength.
Reinforcing:	Steel rods or metal fabric placed in concrete slabs, beams, or columns to increase their strength.
Relative Humidity:	The ratio, expressed as a percent, of the quantity of water vapor actually present in the air to the greatest amount possible at a given temperature.
Relief or Relieve:	Projection of ornamentation
Reprise:	Inside corner of a stone member with a profile other than a flat plane.
Resin:	A group of organic materials, either natural or synthetic, that can be molded or dissolved.
Retarder:	Any material added to concrete, mortar, or grout that slows up its natural set.
Reveal:	The exposed portion of a stone between its outer face and a window or door set in an opening.
Rheology:	The science characterizing fluid deformation or flow.
Roller:	A cylinder covered with lamb's wool, felt, foamed plastics or other materials used for applying paint.
Rowlok:	A brick laid on its edge. Frequently spelled rolok.
Rubble Masonry:	Uncut stone, used for rough work, foundations, backing, and the like.
Runs:	Sogging and curtaining of a coating or paint film, usually caused by improper thinning, excessive film build or poor application techniques.
Rust:	The reaction product of steel, oxygen, and water.
Rustication:	A recessed surface cut around or across the face of a stone to produce shadow accent.
Sag Resistance:	The ability of a paint to be applied at proper film thicknesses without sagging.
Sagging:	The downward movement of a paint film on a vertical surface, between the time of application and drying, resulting in an uneven coating having a thick lower edge.
Salt Atmosphere:	A moist, heavily ladened air with a high chloride concentration; used as a test for accelerated corrosion evaluations and also present near sea coast areas.

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Salt Fog Test:	A cabinet designed to accelerate the corrosion process in evaluating coatings; combines 100% humidity with a 5% salt concentration at 100°F in an enclosed cabinet.
Sand Float Finish:	Lime mixed with sand, resulting in a textured finish.
Saponification:	The alkaline hydrolysis of fats whereby a soap is formed; typical reaction between alkyds and galvanized metals resulting in peeling.
Satin Finish:	A descriptive term generally referenced to paints with a 60° gloss reading between 10 and 40.
Scaffold or Staging:	A temporary structure or platform enabling workmen to reach high places.
Sealant:	A resilient compound used as the final weatherface in stone joints. (This term is sometimes misused to indicate clear water-repellent treatments that are sometimes sprayed or otherwise applied to masonry.)
Sealer:	A coating used on absorbent surfaces prior to paint.
Settling:	The sinking of pigments, extenders or other solid matter in a paint, on standing in a container, with a consequent accumulation on the bottom of the can.
Shade:	A term employed to describe a particular hue or tone.
Shelf Life:	The maximum time interval that a material may be kept in a usable condition during storage.
Shop Primer:	An inexpensive, rust inhibiting primer designed to protect steel from general weathering immediately after fabrication and before final coating.
Shot Blasting:	Abrasive blasting with round iron shot, or any material that retains its spherical shape, for peening purposes.
Shot Sawed:	Description of a finish obtained by using steel shot in the gang sawing process to produce random markings for a rough surface texture.
Shrinkage:	The volume change in concrete caused by drying normally occurring during the hardening process.
Silica Sand:	Clean sand made up of sharp silica particles, not containing dirt or clay, used for abrasive blast cleaning.
Silicone Resins:	Resins based on silicone instead of carbon, generally used for their outstanding heat resistance and water repellency.
Sill Course:	(See String Course.)
Sills:	The horizontal timbers of a house that either rest on the masonry foundation or form the foundation.
Skeleton Construction:	A type of building construction in which all loads are transmitted to the foundation by a rigidly connected framework of suitable material, with the enclosing walls supported by girders or by the floor at each floor level.

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Skew:	Inclination in any direction.
Skinning:	The formation of a solid membrane on the top of a liquid, caused by partial curing or drying of the coating during storage.
Slab-on-Grade:	A concrete slab placed on grade, sometimes having insulation board or an impervious membrane beneath it, on a granular base.
Slip Joint:	A connection that permits vertical or horizontal movement of the cladding with respect to the structural frame.
Smooth Finish:	A finish of minimum textural quality, presenting the least interruption of surface. Smooth finish may be applied to any surface, flat or molded and is produced by a variety of machines.
Soffitt:	The finished underside of a lintel, arch, or portico.
Soldier:	A brick laid on its end so that its longest dimension is parallel to the vertical axis of the wall face.
Solid Wall:	A wall built of solid masonry units (or solid concrete), laid contiguously, with the spaces between the units completely filled with mortar.
Solids by Volume:	The total volume percentage occupied by nonvolatile compounds.
Solids by Weight:	The total weight percentage occupied by nonvolatile compounds.
Solvent Entrapment:	Solvent encapsulation within a cured paint film due to improper drying conditions resulting in a noncontinuous film.
Solvent:	A liquid in which another substance may be dissolved.
Sound Rusted Substrate:	A rusted substrate cleaned of all loose rust and other loose materials, but not cleaned to bare metal.
Spall:	A small fragment removed from the face of stone, brick, masonry, or concrete material by a blow or due to weather.
Span:	The distance between structural supports such as walls, columns, piers, beams, girders, and trusses.
Spandrel Wall:	(1) That part of a panel wall above a window in one story and below the window-sill in the story above. (2) The space included between the extrados of two adjoining arches and a line approximately connecting their crowns.
Specification:	(1) Instructions detailing the plan for coating a project; (2) a list of criteria for a coating.
Splay:	A beveled or slanted surface.
Spray Head:	The combination of needle, tip, and air cap.
Spray Pattern:	The configuration of coating sprayed on the surface.
Spread Rate:	Coverage, usually at the specified dry film thickness.

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Springing Line:	A line marking the level from which the curve of an arch or vault rises from the upright or impost.
Stress Corrosion Cracking:	Spontaneous cracking produced by the combined action of corrosion and static stress.
Stretcher:	A masonry unit laid flat with its longest dimension parallel to the face of the wall.
String Course:	A narrow, vertically faced and slightly projecting course in an elevation, such as window-sills which are made continuous. Also, horizontal moldings running under windows, separating the walls from the plain part of the parapets, dividing towers into stories, stages, and the like.
Stringing Mortar:	The name applied to the method by which a brick-layer picks up sufficient mortar for a number of bricks and spreads it before laying the brick.
Strong Solvent:	Any solvent capable of dissolving large quantities of a specified subject.
Structural Tube Columns:	Structural column shaped as a square or rectangle.
stucco:	Most commonly refers to an outside plaster made with portland cement as its base.
Stud:	One of a series of slender wood or metal vertical structural members placed as supporting elements in walls and partitions.
Substrate:	The surface to be painted.
support:	An angle, plate, or other stone that carries a gravity load.
Surfacer:	Pigmented composition for filling depressions in order to obtain a smooth, uniform surface before applying the finish coat.
Surfactant:	An additive that reduces surface tension thereby improving wetting, aiding pigment dispersal, or inhibiting foam.
Surround:	An enframement.
Suspension:	A relatively coarse, noncolloidal dispersion of solid particles in a liquid.
Sweat-Out:	Soft, damp mortar caused by poor drying conditions.
Swedge Anchor:	An anchor bolt, threaded at one end and swedged or flattened in spots along the shank to produce greater holding power.
Synthetic:	Manufactured, as opposed to naturally occurring.
labor Abraser:	An instrument used to measure abrasion resistance.
Tail Beam:	A relatively short beam or joist supported in a wall on one end and by a header at the other.
Tails:	Finger-like spray pattern produced by improper gun or coating material adjustment.

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Tape Time:	The drying time of a coating required prior to masking sections for lettering or striping after which masking tape will not distort the finish.
Tapping:	Setting a brick down on its bed of mortar with a light blow of the trowel blade or end of handle.
Temper:	To moisten and mix clay, plaster, mortar, and similar materials to the proper consistency for working.
Template:	A pattern used in the fabrication operation.
Termite Shield:	A shield, usually of noncorroding metal, placed in or on a foundation wall or other mass of masonry or around pipes to prevent passage of termites.
Texture:	Any finish other than a smooth finish.
Thermocouple:	A temperature measuring device.
Thermoplastic:	Resins having the property of becoming soft upon the application of heat but which regain hardness after cooling.
Thermosetting:	Resins having the property of becoming insoluble or hard upon the application of heat.
Thinners:	A liquid (solvent) added to a coating to adjust viscosity.
Thixotropic:	An adjective describing full bodied materials that undergo a reduction in viscosity when shaken, stirred, or otherwise mechanically disturbed, but readily recover their original full bodied condition upon standing.
Throat:	The undercut of a projected molding to form a drip.
Tie:	Any unit of material used to resist the spreading of a wall, or the separation of the two solid parts of a hollow wall.
Tolerance:	Acceptable dimensional allowance, under or over ideal net sizes.
Toluene:	An aromatic solvent with a high boiling range and low flash point classified as a strong solvent.
Tooling:	Compressing and shaping the face of a mortar joint, usually with a special tool, other than a trowel.
Tooth:	The profile, mechanical anchor pattern, or surface roughness.
Toothing:	The temporary end of a wall built so that the end stretcher of every alternate course projects.
Trim:	Stone used as sills, copings, enframements, etc., with the facing of another material.
Tuck Pointing:	A method of refinishing old mortar joints, the loose mortar is dugout and the tuck is filled with fine mortar that is left projecting slightly or tooled.
Two-Pack:	A coating that is supplied in two parts and must be mixed in the correct portions before use in order to cure.

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Undercoat:	The coat applied to the surface after preparation and before the application of a finish coat.
Undercut:	Cut or molded so as to present an overhanging part, as a drip mold.
Underfilm Corrosion:	Corrosion that occurs under films in the form of randomly distributed hair lines.
Vapor Barrier:	Material used to retard the movement of water vapor into walls, and prevent condensation in them. Usually considered as having a perm value of less than 1 .0. Applied separately over the warm side of exposed walls or as part of a batt or blanket insulation.
Vapor Transmission Rate:	The rate at which moisture passes through a material or coating.
Vehicle:	The liquid portion of a paint in which the pigment is dispersed; comprised of binder and thinner.
Veneer:	A facing of masonry material attached but not bonded to the backing.
Vinyl Copolymer:	A resin produced by copolymerizing vinyl acetate and vinyl chloride.
Viscometer:	One of several types of instruments for measuring a liquid's viscosity.
Viscosity:	A measure of a liquid's fluidity.
Viscosity Cup:	An efflux viscometer utilizing a measured volume of liquid flowing through a precise orifice.
Voids:	Holidays or holes in a coating or material.
Volatile Content:	The percentage of materials that evaporate from a coating.
Volatile Organic Compounds **(VOC):**	A measure of the total amount of organic compounds evaporating from a coating film, excluding water.
Volume Solids:	The volume of the nonvolatile portion of a composition divided by the total volume expressed as a percent used to calculate coverage rate.
Wall Plate Anchor:	A machine bolt anchor with a head at one end and threaded at the other fitted with plate or punched washer to securely engage the brickwork or concrete and hold the wall plate or other member in place.
Wall lie:	Strip of metal used for tying a facing veneer to the body of a wall.
Walls, Bearing:	A wall supporting a vertical load in addition to its own weight.
Walls, Cavity:	A wall in which the inner and outer wyths are separated by an air space, but tied together with metal ties.
Walls, Composite:	A wall in which the facing and backing materials are bonded together.

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Wash Primer:	A thin paint, usually a chromate, designed to promote adhesion or to be used as a barrier coat.
Water Blasting:	Blast cleaning of metal using high velocity water
Water Repellent:	Any of several types of clear liquids used to render masonry walls less absorptive. These treatments are said to maintain a material's ability to breathe away moisture, as distinct from "sealers" that form impervious, non-breathing coatings.
Water Retentivity:	Flow and resistance to segregation are factors affecting workability, and are affected by the properties of both the cementitious materials and the aggregate.
Water Spotting:	A surface defect caused by water droplets depositing a circular ring of contaminants.
Water Table:	A slight projection of the lower masonry or brickwork on the outside of a wall and slightly above the ground as a protection against water.
Waterproofing:	(See Dampproofing.)
Weatherometer:	A machine designed for the accelerated testing of coatings.
Weep Hole:	A drainage opening usually inserted at the base of a stone unit to release moisture accumulating between the stone and backup.
Weld Slag:	Amorphous deposit formed during welding.
Weld Splatter:	Beads of metal left adjoining the weld.
Welded Wire Mesh:	A series of longitudinal and transverse wires arranged substantially at right angles to each other and welded together at all points of intersection.
Wet on Wet:	The technique of painting whereby the second coat is applied before the first coat has dried and the composite film then dries as a whole.
Wet Sandblasting:	The incorporation of water into the sandblasting operation in order to minimize dust.
Wetting:	The ability of a vehicle to flow onto the surface in order to achieve a good bond.
White Rust:	The zinc oxide formed on galvanized metal.
With(e) or **Wyth(e):**	A continuous vertical 4 inch (10 cm.) or greater section or thickness of masonry.
Wooden Brick:	Piece of seasoned wood, made the size of a brick, and laid where necessary to provide a nailing space in masonry walls.
Workability:	That property of freshly mixed concrete or mortar that determines the ease and homogeneity with which it can be mixed, placed, compacted, and finished.
Xylene:	A flammable, aromatic hydrocarbon solvent used in epoxies and fast drying alkyds.

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Zinc Dust:	Finely divided zinc metal used as a pigment in protective coatings.
Zinc Oxide:	A rust inhibitive pigment used in paints also, provides color retention and surface hardness.
Zinc Rich Primer:	An anti-corrosive primer for iron and steel incorporating zinc dust in a concentration sufficient to provide cathodic protection.

END OF SUBSECTION

APPENDIX C

TECHNICAL BULLETINS/UPDATES/ADVISORIES

Index of Bulletins/Advisories
followed by Bulletins/Advisories
as developed

APPENDIX C

TECHNICAL ADVISORY TO501 • 1

DATE: 1 0/91
SYSTEM: Roofing (CSI 07000)
ASSEMBLY: Built-Up (CSI 07510)
SUBJECT: Roof Top Lighting and Insect Damage

"In March, 1988 a professional roofing magazine article described a bizarre but apparently avoidable, phenomenon. In about a dozen documented cases ranging from Washington State to Florida, beetles have bored through roof membranes, causing leaks. It was determined that the beetles are attracted to lights (especially mercury vapor) mounted on, over, or near roof surfaces, including nearby billboard lighting. Falling to the roof, they burrow into the roof substrate, seeking protection from the sun during the day. The types of roof membrane affected were asphaltic BUR, modified bitumen, and single-ply roofing. Evidently, no instance has yet been found among coal tar BUR. It is advisable to exercise care in the selection of roof membranes where billboards may exist adjacent to a planned roof installation, or when rooftop lighting is required. The roof specifier should discuss the types of luminaire to be used with project electrical engineers before mercury vapor fixtures are specified."

Source: Roofing Design Criteria Options. **R.D.** Herbert II

EXAMPLE: TECHNICAL ADVISORY BULLETIN

END OF SUBSECTION

APPENDIX D

REVISIONS SUMMARY

AT A GLANCE SUMMARY OF ALL

REVISIONS UP TO LATEST REVISION DATE

APPENDIX D

END OF SUBSECTION