Department of Energy

Condition Assessment Survey (CAS) Program

Deficiency Standards & Inspections Methods Manual

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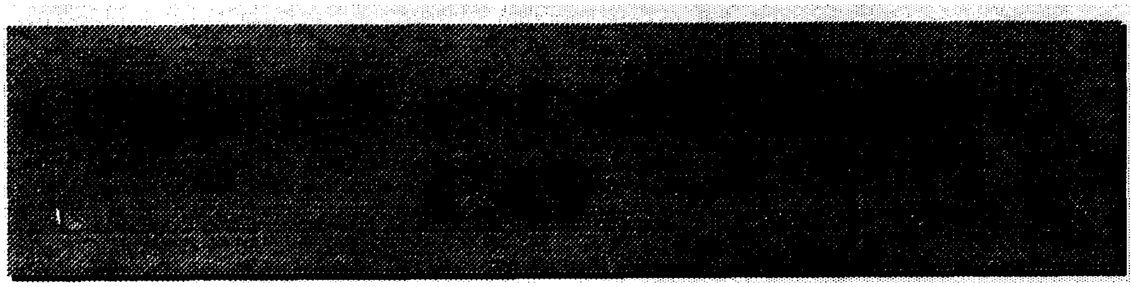


INTRODUCTION

CAS PROGRAM OVERVIEW

WHAT IS CAS?

WHY CAS?

HOW IS CAS IMPLEMENTED?

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 familiar 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

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.

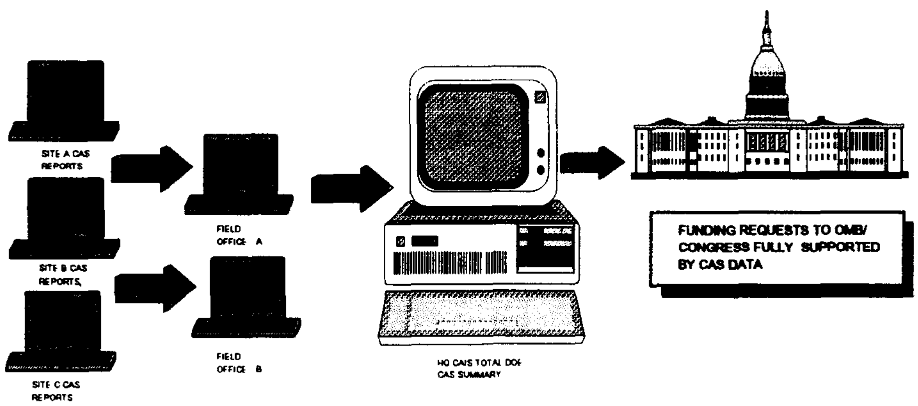
The current state of condition assessment across all DOE assets is mixed. While DOE regulations dictate facility assessments be made, no one methodology is mandated to conduct them. As a result, DOE surveys have varied from site to site, with some locations providing exhaustive in-depth analysis while 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 INSPECTION PROGRAM FOR ALL SITES
- IDENTIFY REPAIR/REPLACEMENT NEEDS TO FACILITATE KEY BUDGET DECISION MAKING
- DEVELOP SUPPORTABLE FUNDING REQUESTS 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:

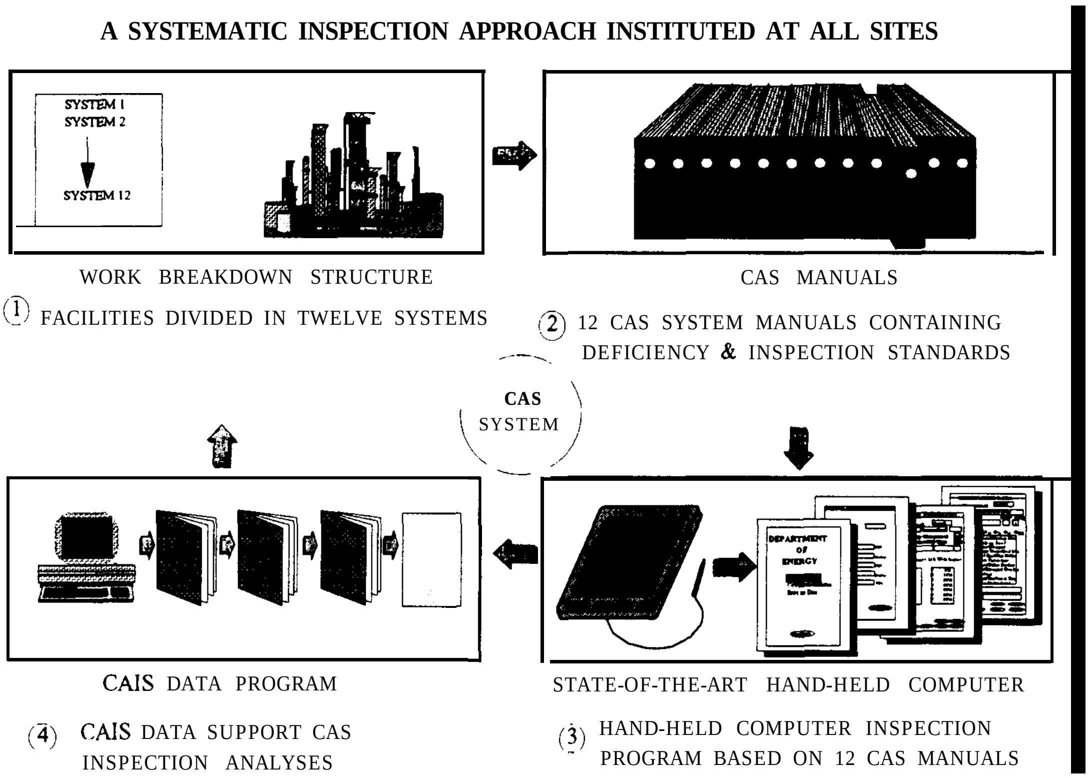
Using inspection data from all sites, a general picture across all DOE assets and programs can be used to direct limited resources to crucial areas. Standardized reports form "a level playing field" to ensure that all programs and missions will receive a fair analysis.

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?



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 premier research 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 component in the CAS Manuals as follows:

EXAMPLE: Roofing (CSI 07000)

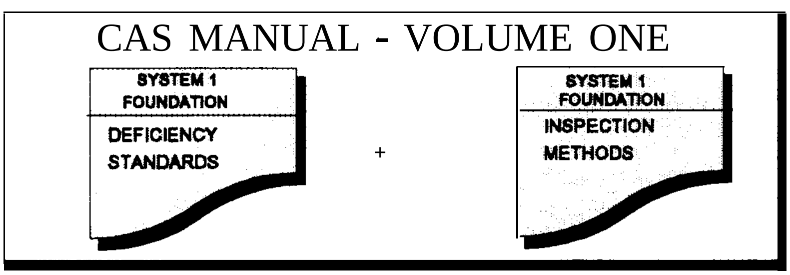
*NOTE. This section supersedes Means 0.10 category and includes FIS 700 Series Asset Codes.

INTRODUCTION

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 OR SYSTEM DEFICIENCY ILLUSTRATED



INTRODUCTION

WHAT IS CAS? - DOE CAS Manual Format

Using these 12 systems as the basic organrzing 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 Determrnant 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 **&** 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

I.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 defined 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 points, 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 inspecting 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.

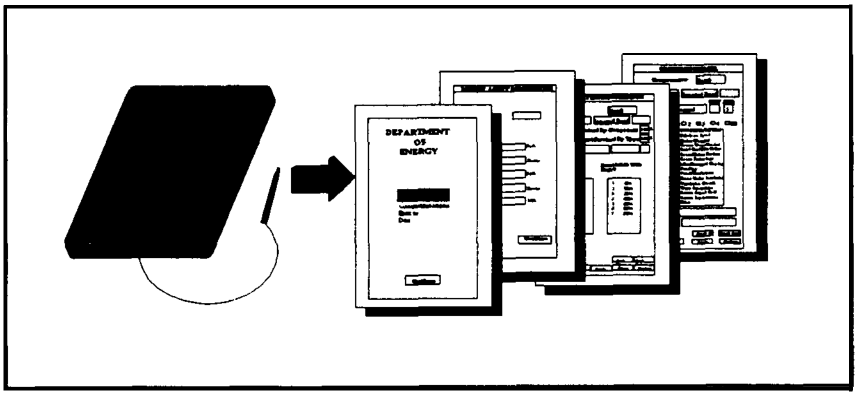
Appendix D **Revisions** Summary - All revisions listed in chronological sequence. The last revision listed will be the most current modification.

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 coverage. 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.

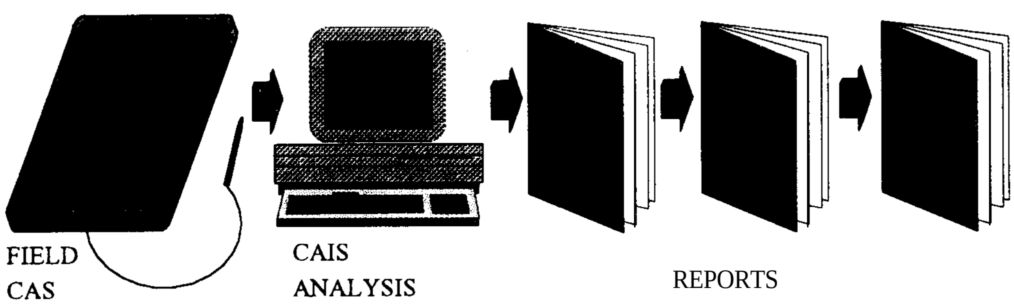
In short, the CAS process will be conducted in a carefully structured, "standardized" manner to ensure that the quality of raw inspection data is consistent throughout all DOE installations.

INTRODUCTION

WHAT IS CAS?

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 ears" 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 noting 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 are defined and processed by the CAIS database.

Project Costs:

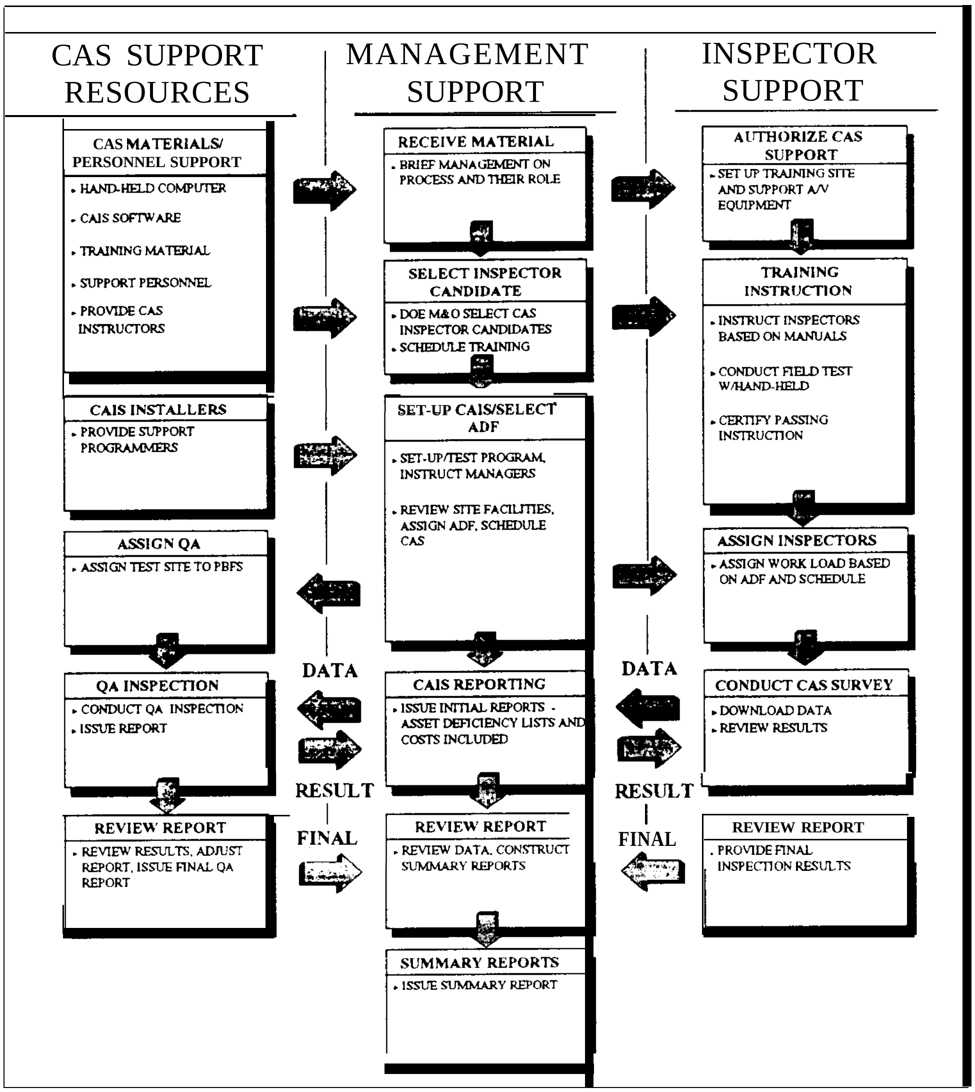
Costs to accomplish repairs and replacements are generated by the manipulation of field data in the CAIS program, which employs several methods including determining cost as a percentage of total replacement and/or direct entry of costs. (See Section 1, Subsection 1.1 for discussion of cost development.)

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 are the main building blocks of the CAS Program, CAS support personnel will form the standing framework. 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 & Operations (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.

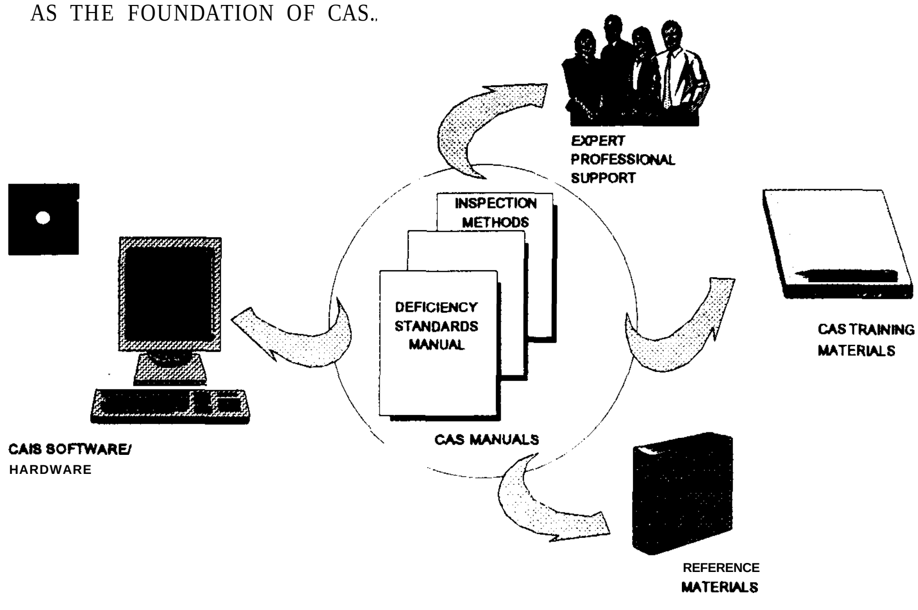
CAS Inspectors:

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.

INTRODUCTION

HOW IS CAS IMPLEMENTED?

MANAGEMENT KEY ROLES

1. Coordinates CAS program implementation
2. Sets up training location & equipment support
3. Selects CAS inspector candidates
4. With CAS/CAIS contractor, coordinates CAIS installation and testing
5. Analyzes site assets and assigns Asset Determinant Factor (ADF)
6. Schedules inspection
7. Reviews CAIS reports, provides analysis, and issues summary reports

INTRODUCTION

HOW IS CAS IMPLEMENTED? - The Management Role

The critical role DOE M&O managers will play in the CAS process cannot be overstated. Their understanding and direct input will guide the construction of the CAS Program. Their chief 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 & CAS Schedule:

A vital element of the CAS Program is the development of a CAS "strategy." DOE M&O managers will 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:

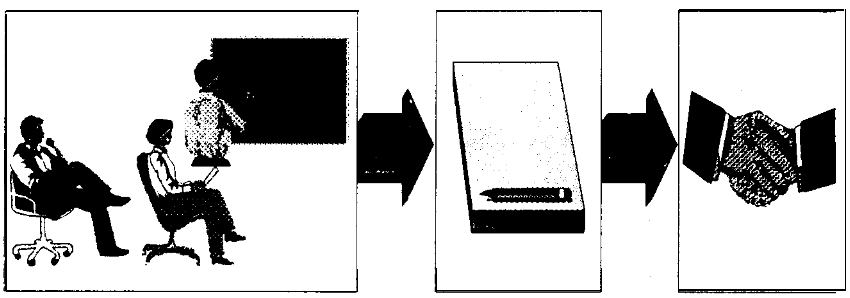
The process of up-loading CAS field data to the PC-based CAIS program will be demonstrated to the M&O CAS managers. Analysis processes will be examined using predetermined, formatted reports. Final management project "sorts" and prioritization schemes, and construction of summary reports for higher authorities,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

INTRODUCTION

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 pr-ocess. 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 separate 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:**

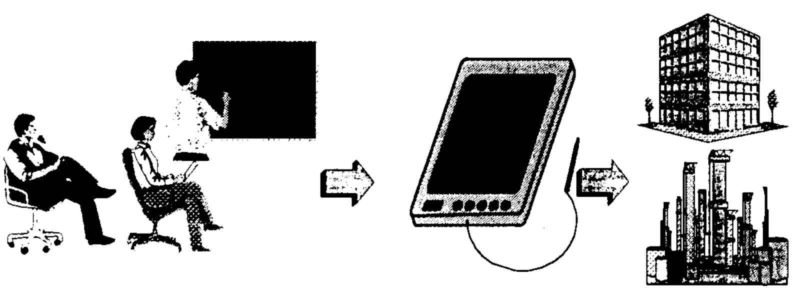
At the completion of the CAS training, each candidate is required to take and pass a written examination based on the material covered in the class. It is the goal of the training team to pass 100% of the candidates. Those having difficulty will receive additional instructor attention during the class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

INTRODUCTION

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



INTRODUCTION

HOW IS CAS **IMPLEMENTED?** - The Survey Process

At the completion ot 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:**

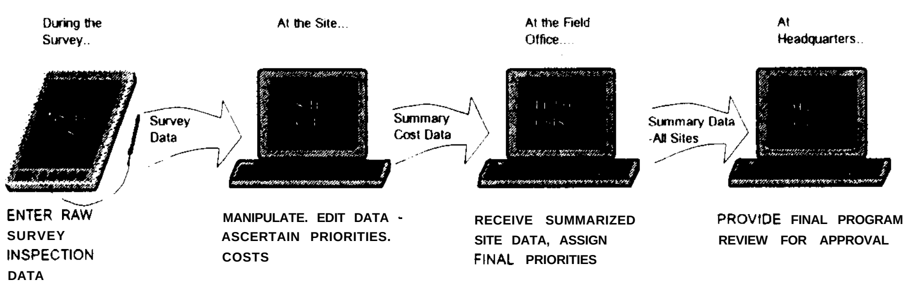
After completing the CAS Inspection, information is uploaded to the PC-based CAIS system. "Universal" reports showing all asset deficiencies, observations, associated cost, scheduling priorities, and repair purposes will be produced. As part of the QA, the Inspector will review this information with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

INTRODUCTION

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 "PRIORITIZE" REPAIWREPLACEMENT REQUIREMENTS FROM ASSET TO ASSET
- ISSUE SUMMARY RESULTS WITH FULL BACK-UP 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 program is analyzed to provide the survey reports. The primary preformatted 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.

INTRODUCTION

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 creating 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 fund; 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.

INTRODUCTION

END OF SUBSECTION

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 comoonent level)[1]	ALL
2	Existing temporary asset (>3 years) program projected to last - <5 years	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 comoonent 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	Asset ELECTRICAL only	ELECTRICAL inspection (base CAS - assembly level or optional comoonent level)[1]	0.09
9	Asset SITE inspection only	SITE inspection (base CAS - assembly or optional component level)'	0.12
10	As developed by each site	As constructed by site[2]	As Reauired

GENERAL NOTES:

1. Survey may combine 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.

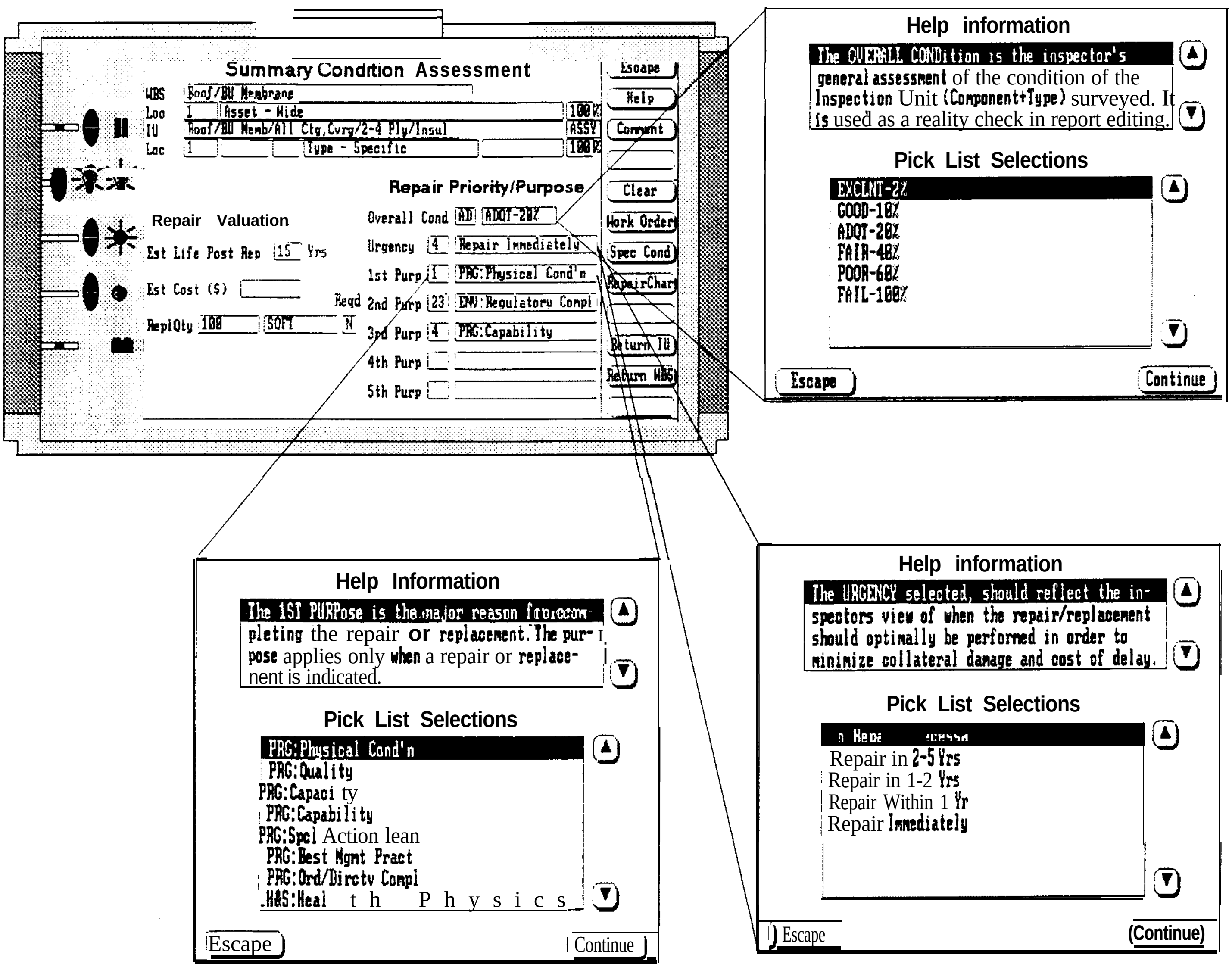
ASSET DETERMINANT **FACTOR/CAS** REPAIR CODES/CAS COST FACTORS

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 systems 0.05 Roofing, 0.07 Conveying, 0.08 Mechanical, and 0.09 Electrical is recommended.
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 replacement 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 replacement 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	Fall: Non-operational or significantly substandard performance. Replacement required because repair cost is >60% of replacement cost.

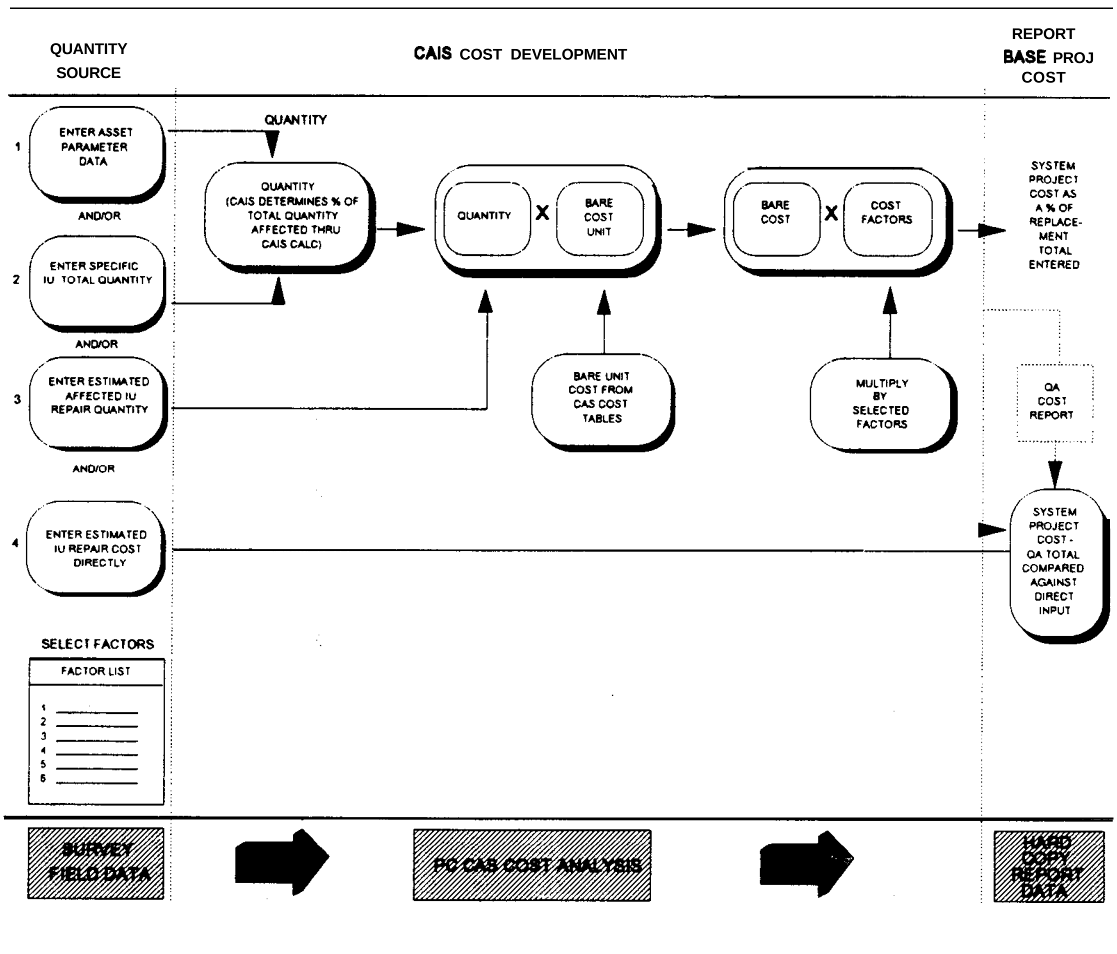
PURPOSE CODE*	**DEFINITION**
P2	PRG: Capacity
H2	H&S: Industrial Safety
E2	ENV: Solid Waste Management
S4	S&S: Security
•	Partial list based on CAMP Order DOE 4330.4A dated 1 O-l 7-90.

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	Repair in 1 to 2 Years: Asset condition degraded; initiate repair in 1- 2 years.
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 pertaining to 0.05 Roofing in addition to the Basic Tool Group outlined below.

Accomplishing the activities identified in the inspection guide sheets require 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 and are identified in the guides.

All crafts involved in a roof inspection 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

- 3 x 5 inch card stock to indicate photograph locations
- 50 foot measuring tape
- Aersol can of brightly colored paint or crayons
- Extension cord and inspection lights
- Flashlight
- Pocket knife
- Rags
- Standard and Phillips head screw drivers - various sizes

STANDARD TOOL GROUP

- Pipe wrenches to 14 inches
- Pliers-vise grip (2), slipjoint, needlenose, diagonal, cutting pliers, side cutters

NON-STANDARD TOOL GROUP

- Infrared measuring device (optional)
- Other tools or instruments as required for test
- Slope measuring device (optional)
- Small and large level, and square
- Various cleaning tools - brushes, brooms, scrapers, etc.
- Wire brush and stiff bristle brush

The basic tool set must be augmented to accomplish maintenance and inspection actions on a specific item of equipment. The guides sheets located in Section 3 identify this augmentation. Also, test methods for roofing assemblies are defined in subsection 1.3.

NOTE: It is not the intent of this manual to have sites perform non-standard tests. These guidelines may be used in the event standard inspection is not sufficient to determine system condition Such non-standard inspections will be provided by others (eg., consultants, outside labs).

GUIDE SHEET TOOL & MATERIAL LISTING

END OF SUBSECTION

TESTING METHODS

GENERAL

During the course of the Condition Assessment Survey, various tests will be employed to better ascertain the condition of 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.

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).

Standard vs Non-Standard

Inspection Methods are classified as Standard versus Non-Standard based on the 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 Standard Guide Sheets. Where tests are indicated, they are non-invasive (eg., Flood Testing).

Non-Standard Methods are generally those that require specialized equipment and analysis as well as destructive testing. Examples include Infrared, Capacitance Tests and Core Sampling.

Some tests can 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, and a test requiring specialized services will be listed under Non-Standard Test Methods.

STANDARD TEST METHODS

- Flood Test

STANDARD TEST DESCRIPTION

Flood Test

Roof areas are flooded to investigate potential leak sources. For flat roof assemblies, the drainage system is usually plugged and water retained for a period of time (within structural tolerance) to certify water tightness.

NON-STANDARD TEST METHODS

- Capacitance Testing
- Core Sampling
- Infrared Testing
- Nuclear Analysis
- Radiography (X-Ray Testing)
- Test Cuts
- Ultrasonic Testing

NON-STANDARD TEST DESCRIPTION

Capacitance Test

Capacitance or dielectric analysis is accomplished by imposing an electric field on the roof. When water is present, the field is distorted. This test should be performed on a dry roof surface for best results. A grid pattern is also used.

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

TESTING METHODS

NON-STANDARD TEST DESCRIPTION (Continued)

Core Sampling

Core sampling involves taking core samples at various controlled roof sections to ascertain the condition of membrane plies by laboratory chemical analysis. Sample holes must be patched immediately.

Infrared Testing

Infrared Testing measures heat loss or gain. Areas of roof 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. Infrared is done either by aerial survey or by walking the roof with a hand-held instrument.

Nuclear Analysis

Nuclear analysis is accomplished using a mechanism that imposes neutrons on the roof. Where water is present, radiation is taken back into the unit. The roof is squared off in a grid pattern, and readings are taken from 5-point intersections."

Radiography (X-Ray) Testing

Radiography testing involves passing radiation in the form of X-Rays or gamma rays through an object to expose photographic film on the opposite side to detect cracking.

lest Cuts

Test cuts involve cutting and removing sections of the roof membrane to inspect the condition of the insulation or deck. Test cuts must be patched immediately.

Ultrasonic 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.

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

END OF SUBSECTION

NOTE	It is not the intent of this manual to have sites perform non-standard tests. These guidelines may be used in the event standard inspection is not sufficient to determine system condition. Such non-standard inspections will be provided by others (eg , consultants, outside labs)

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 Condition Assessment Survey (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 utilizes the standard guide sheets as a reference. All Non-Standard inspections are optional tor Roofing System Assemblies and Components.

TABLE ONE

Assembly/Component	Year One	Year Two	Year Three	Year Five
Built-Up Membrane	S			
Single-Ply Membrane	S			
Metal Roofing System		S		
Coated Foam	S			
Shingles	S			
Tiles	S			
Parapets			S	
Roof Drainage System	S			
Roof Specialties	S			
Skylights	S			

S - STANDARD INSPECTIONS — NS - NON-STANDARD INSPECTIONS

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

INSPECTION FREQUENCY

END OF SUBSECTION

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 follows lists design life and replacement cost parameters for Work Breakdown Structure (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

ITEM DESCRIPTION	Replacement Life, Years	Percent Replaced
0.05 ROOFING		
Asphalt & gravel built-up membrane roofing, 4 ply- 15# felt	20	100
Prepared roll roofing, 15# felt	12	100
SINGLE-PLY/IRMAS		
Inverted insulated roof membrane	20	100
Butyl rubber sheet roofing, self-flashing	20	100
Neoprene sheet roofing	30	100
Hypalon sheet roofing	30	100
METAL ROOF SYSTEM		
Copper roofing: flat, standing, or batten seam	50	100
Galvanized steel sheet metal	30	100
COATED FOAM MEMBRANE	15	100
SHINGLES	20	100
Asphalt, fiberglass, and wood	30	100
Slate/Cement	50	100
TILES - Metal, clay, and concrete	40	100
PARAPETS, MASONRY, CONCRETE, METAL, WOOD	See System .04 for appropriate replacement life	
ROOF DRAINAGE SYSTEMS		
a. Gutters and downspouts	20	100
b. Scuppers, drains	20	100
ROOF SPECIALTIES		
Roof hatches, painted steel	24	100
Roof hatches, galvanized	40	100
Roof hatches, stainless	40	100
Relief Vents	40	100
SKYLIGHTS	40	100
Skylights, single-and double glazed	40	100

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

0.05 SYSTEM - ROOFING

0.05.01	BUILT-UP MEMBRANE
0.0502	SINGLE-PLY MEMBRANE
0.05.03	METAL ROOFING SYSTEMS
0.05.04	COATED FOAM MEMBRANE
0.05.05	SHINGLES ,
0.05.06	TILES
0.05.07	PARAPETS
0.05.08	ROOF DRAINAGE SYSTEMS
0.05.09	ROOF SPECIALTIES
0.05.10	SKYLIGHTS

SYSTEM WORK BREAKDOWN STRUCTURE

WBS LEVEL TABLE

0.05	*LEVEL I*	0.08
ROOFING	*SYSTEM*	MECHANICAL
0.05.01	*LEVEL 2*	0.08.0 I
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	*LEVELS*	0.08.01.01.01.01
NOT USED	***TYPE***	3/4" DIA. COPPER

WBS ORGANIZATION HIERARCHY

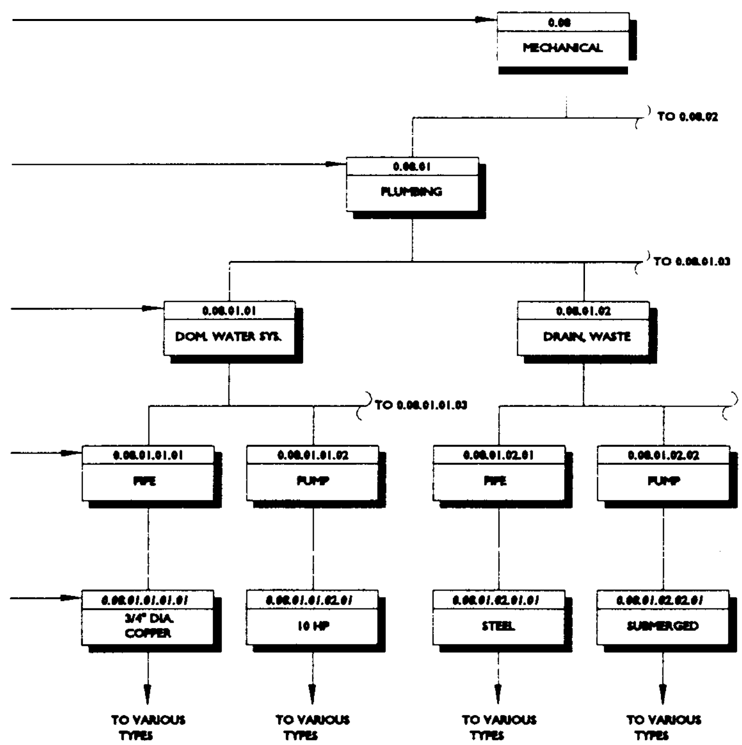


FIG. I

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	*LEVELS*	0.08.01.01.01.01
NOT USED	*TYPE*	3/4" DIA. COPPER

WBS COST DEVELOPMENT HIERARCHY

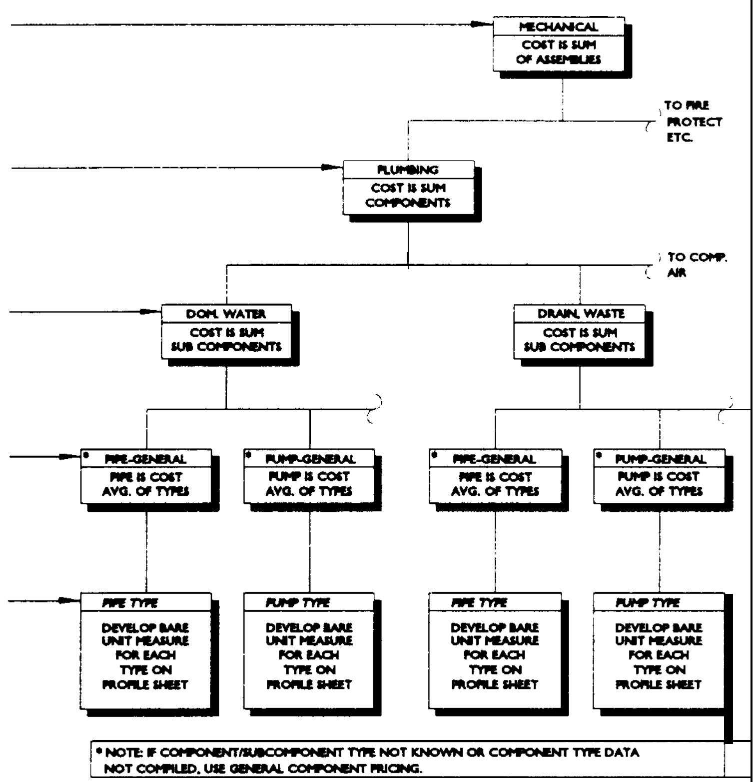


FIG. *2*

END OF SUBSECTION

0.05.01 BUILT-UP MEMBRANE (CSI 07510)

DESCRIPTION

This narrative and the following details describe built-up roofing asphalt-impregnated glass fiber felts applied to rigid insulation over steel decking. These details are similar for other types of built-up roofs. Although this description and the following details show generally accepted roofing practices, the exact field conditions will depend on the specific requirements of the project, local trade practices, decking material, and the exact type of roofing membrane used. 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 Deck (CSI 05310)

Minimum 22 gauge with minimum spans as recommended by Factory Mutual, Underwriters Laboratories and the requirements of the local building code. Depth and configuration as required by the structural roof requirements. Maximum deck deflection should be limited to the following values:

Span	Deflection
4 feet	0.20 inch
5 feet	0.25 inch
6 feet	0.30 inch

Roof Deck Insulation (CSI 07220)

Glass fiber, cellular glass, perlite, or wood fiberboard may be used without an additional layer of protection prior to applying the roofing felts. Composite board, polyurethane foam board, and polyisocyanurate foam board require protection or a vented base sheet. Thickness varies as required by thermal resistance needed. Insulation must have sufficient strength to span the flutes of metal decking and must have adequate strength to support the applied design load.

Bltumlnous Roofing (CSI 07510)

Asphalt: Type II, III, or IV as required
Asphalt primer
No. 40 asphalt-saturated base sheet
No. 15 asphalt-saturated organic felts
Asphalt-impregnated glass fiber mat: Type III or IV

A vented base sheet can be substituted for the No. 40 base sheet based on particular building requirements.

Roofing Asphalt (CSI 07519)

Type II for roof slopes up to 1/2 inch per foot
Type III or IV for slopes up to 3 inches per foot

Ballast (CSI 07580)

3/8 inch nominal diameter gravel, slag, or other approved material

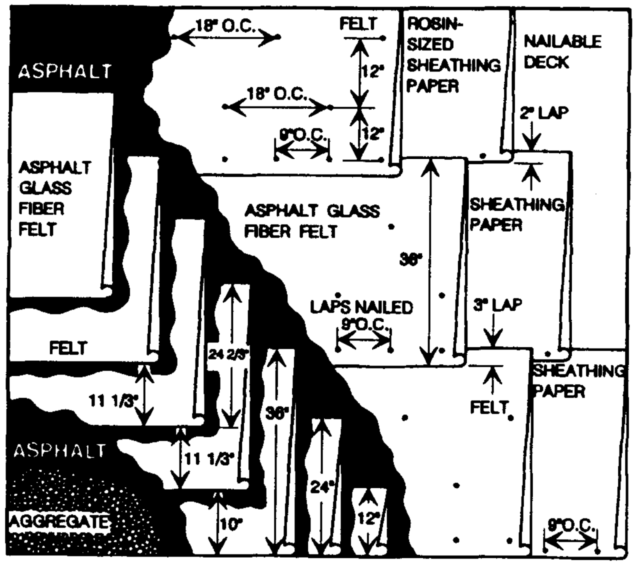
Flashing (CSI 07800)

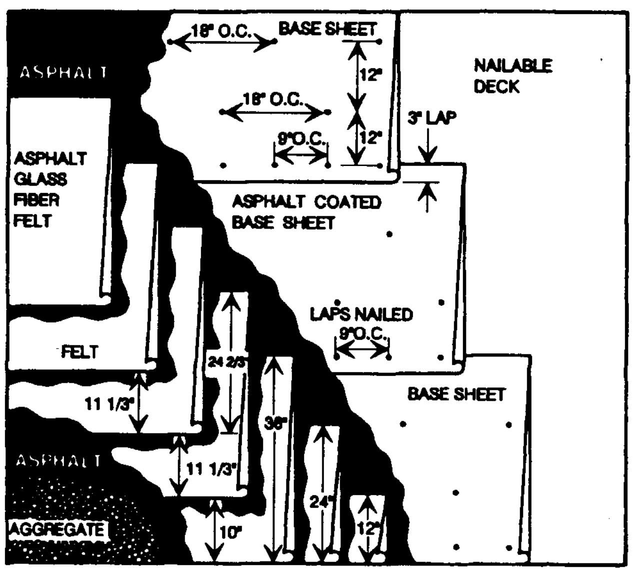
Roof flashing may include curb flashing, base and counter flashing, expansion flashing (joints, etc.). Material varies and may include copper, aluminum, galvanized steel, painted, etc..

0.05.01 BUILT-UP MEMBRANE (CSI 07510)

OTHER RELATED COMPONENTS

See the following subsections for related components:

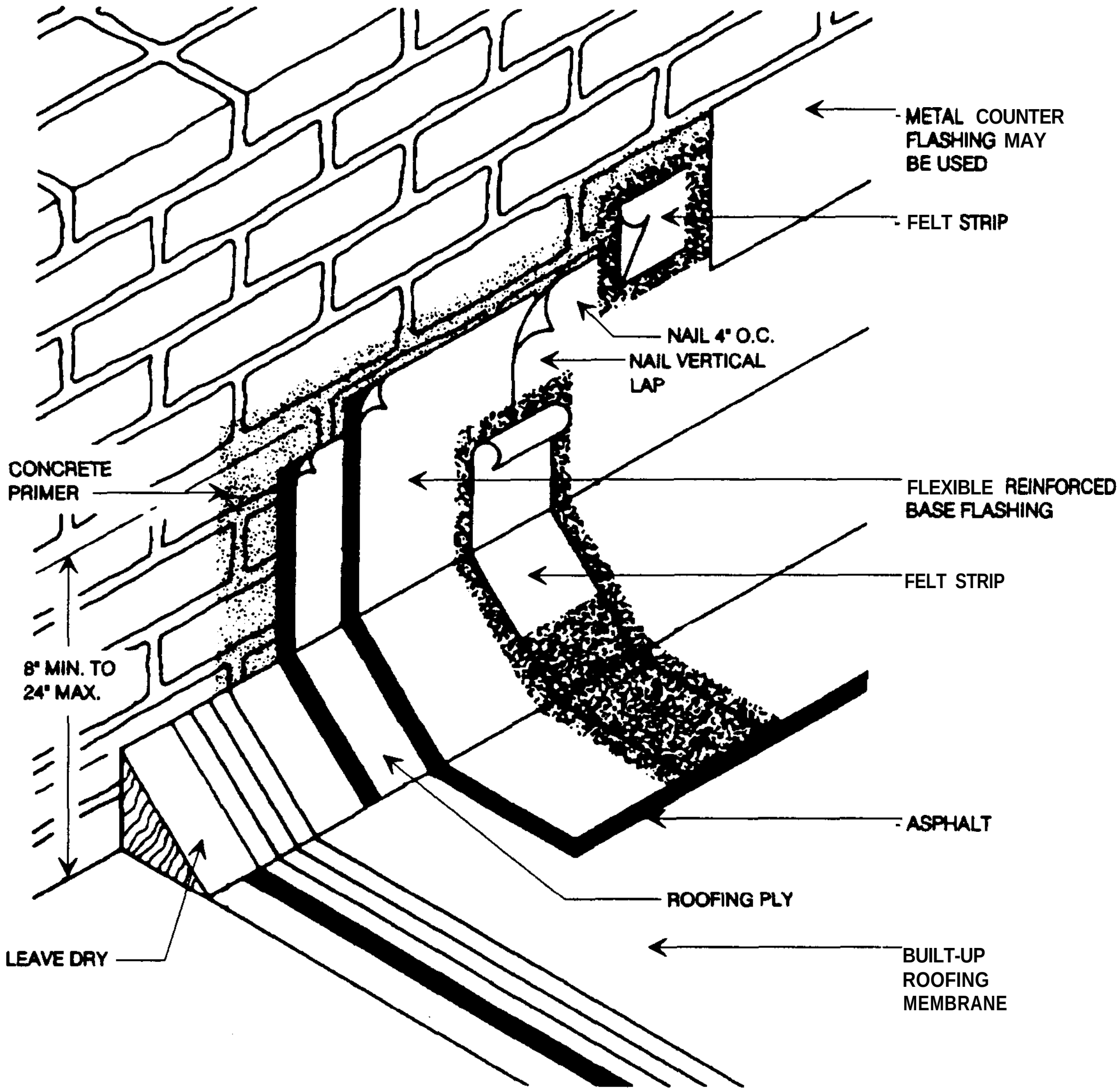




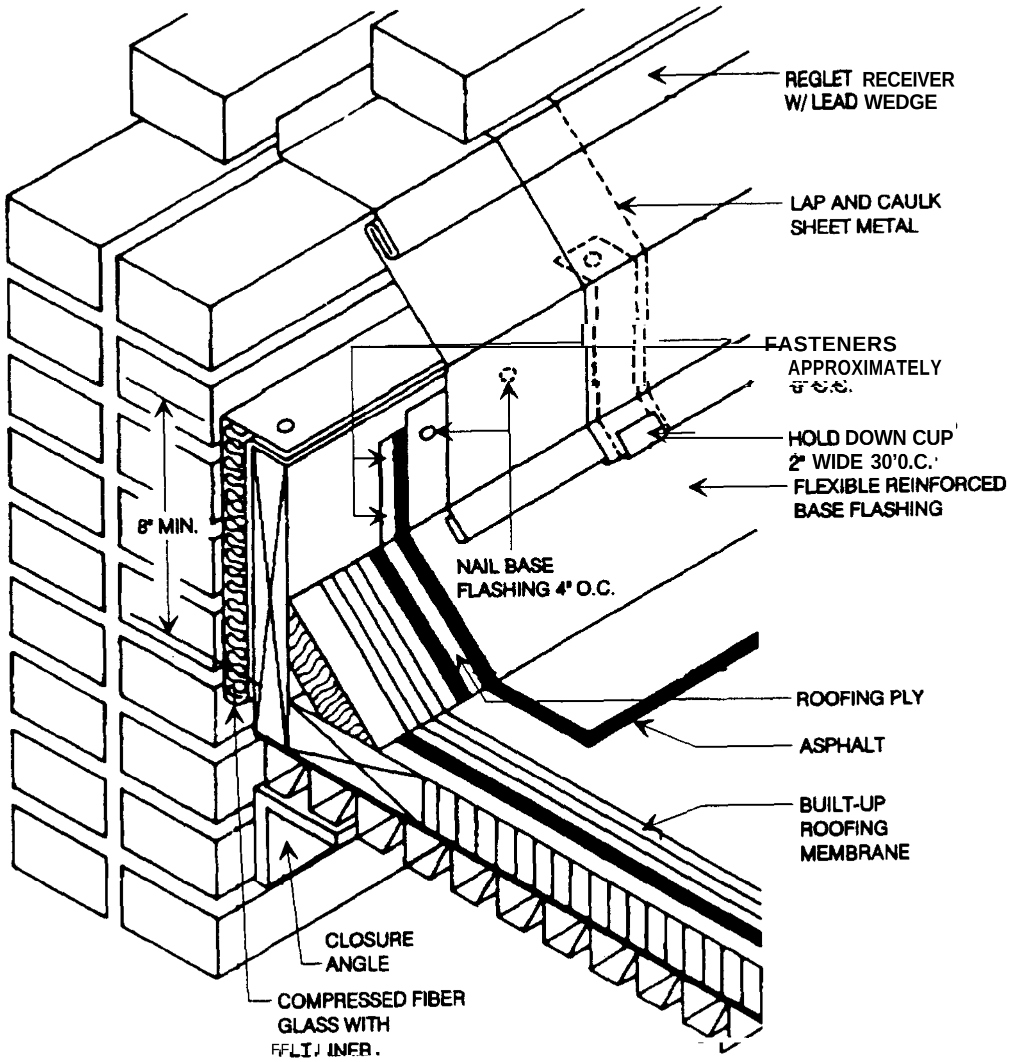
ALTERNATE PROCEDURE

SOURCE: THE NRCA ROOFING AND WATERPROOFING MANUAL, THIRD EDITION

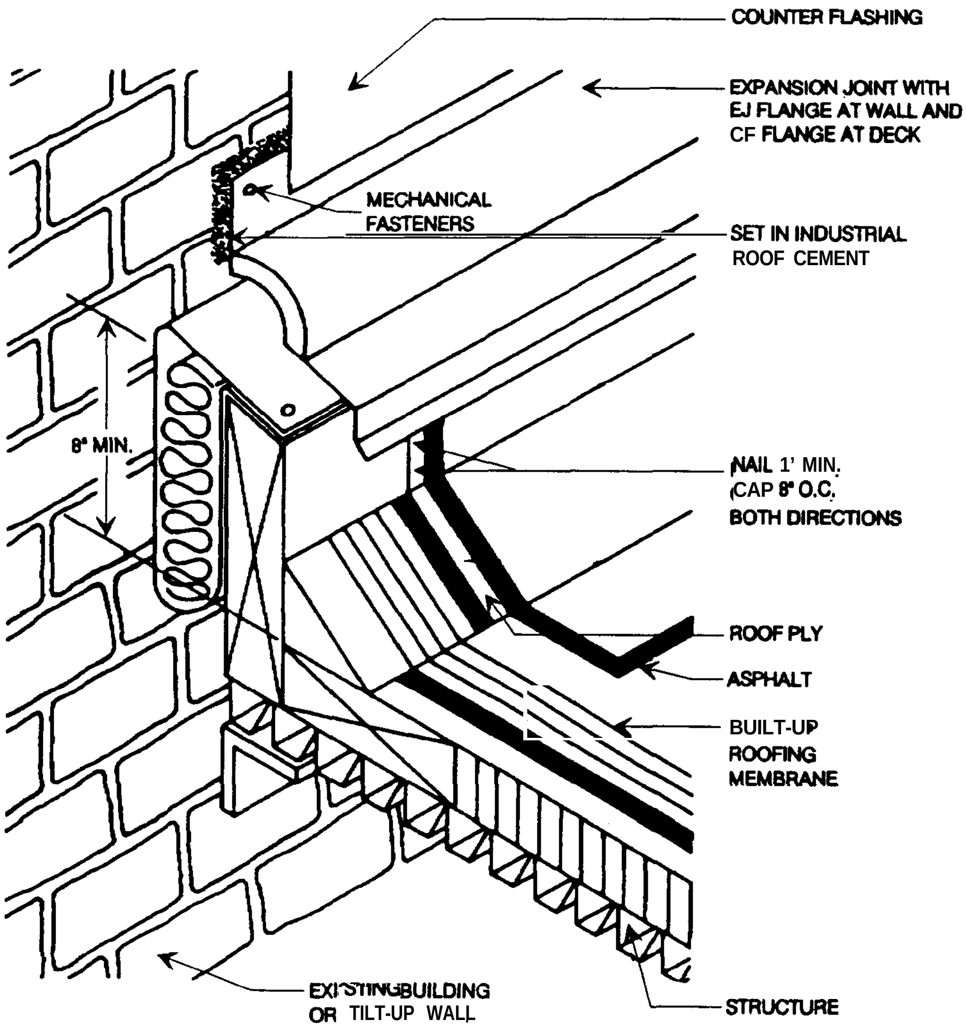
SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF MEMBRANE		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-1



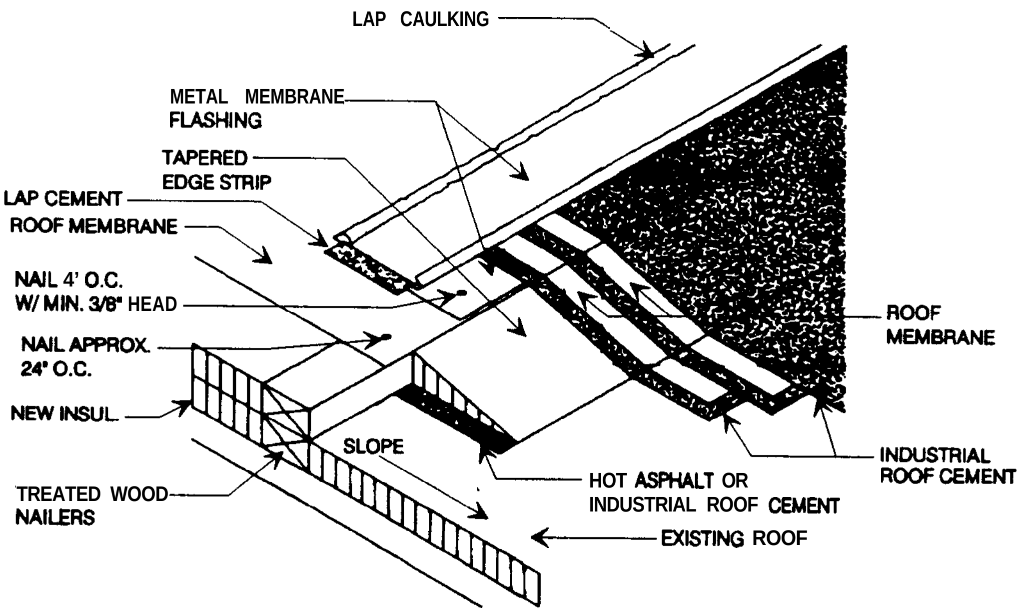
SYSTEM ASSEMBLY DETAILS-ROOFING	FLASHING AT PARAPET/WALL		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-2



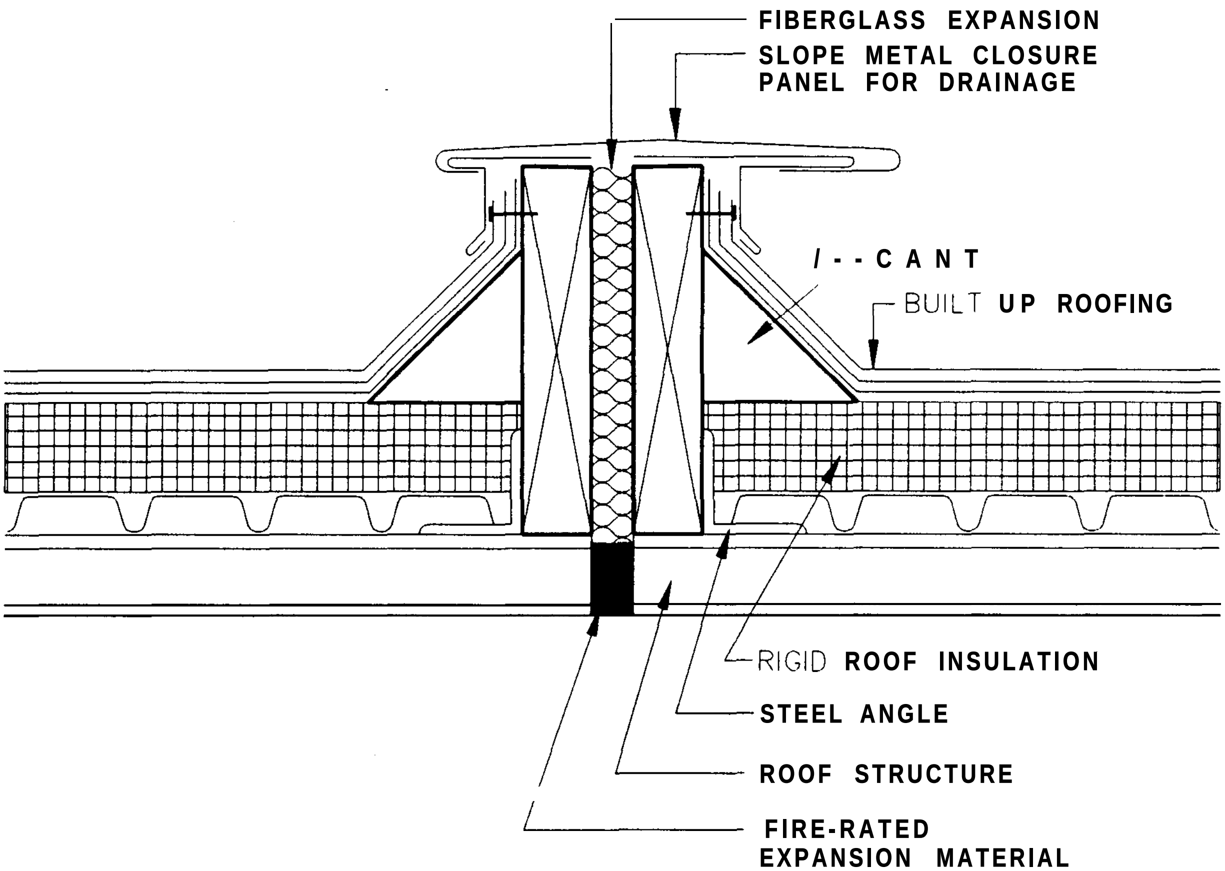
SYSTEM ASSEMBLY DETAILS-ROOFING	**FLASHING AT WALL**		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-3



SYSTEM ASSEMBLY DETAILS-ROOFING	FLASHING AT EXPANSION JOINT(WALL)		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-4

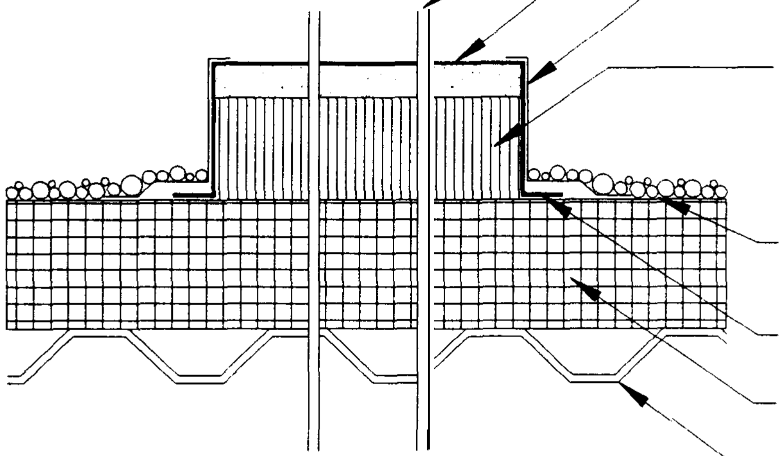


SYSTEM ASSEMBLY DETAILS-ROOFING	FLASHING AT CHANGE OF LEVEL OR ROOF TYPE		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-5



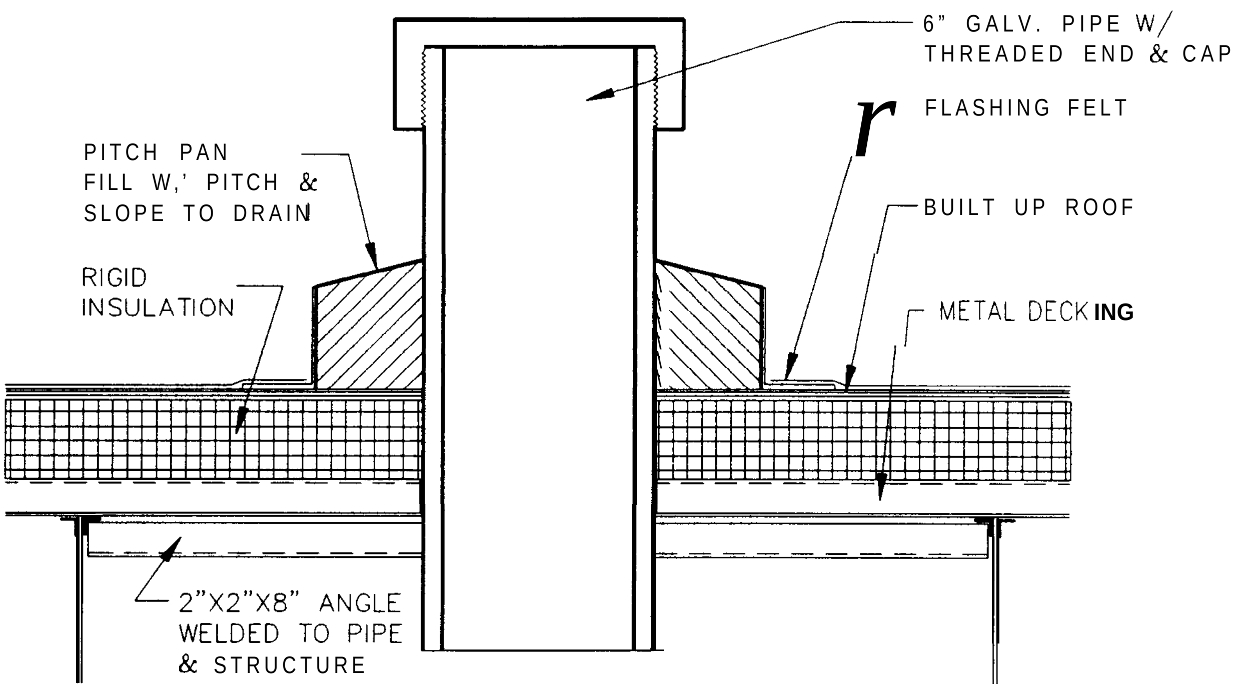
ROOF EXPANSION JOINT

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF EXPANSION JOINT DETAIL		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-6



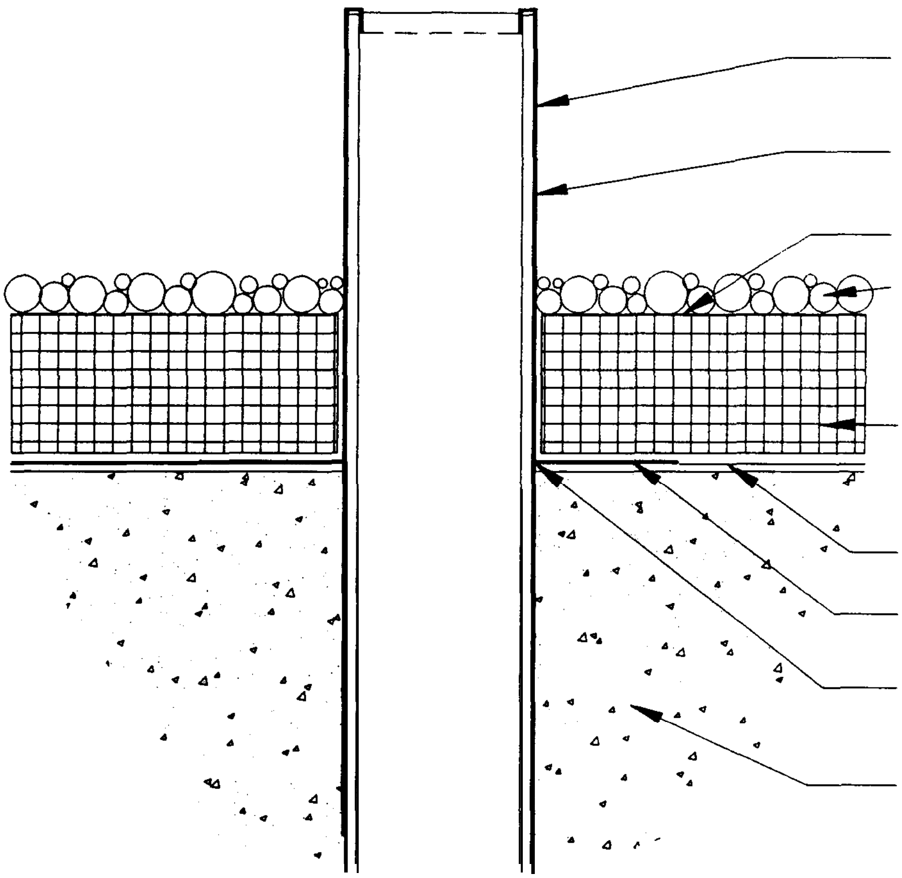
PITCH POCKET

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF PITCH POCKET DETAIL		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-7



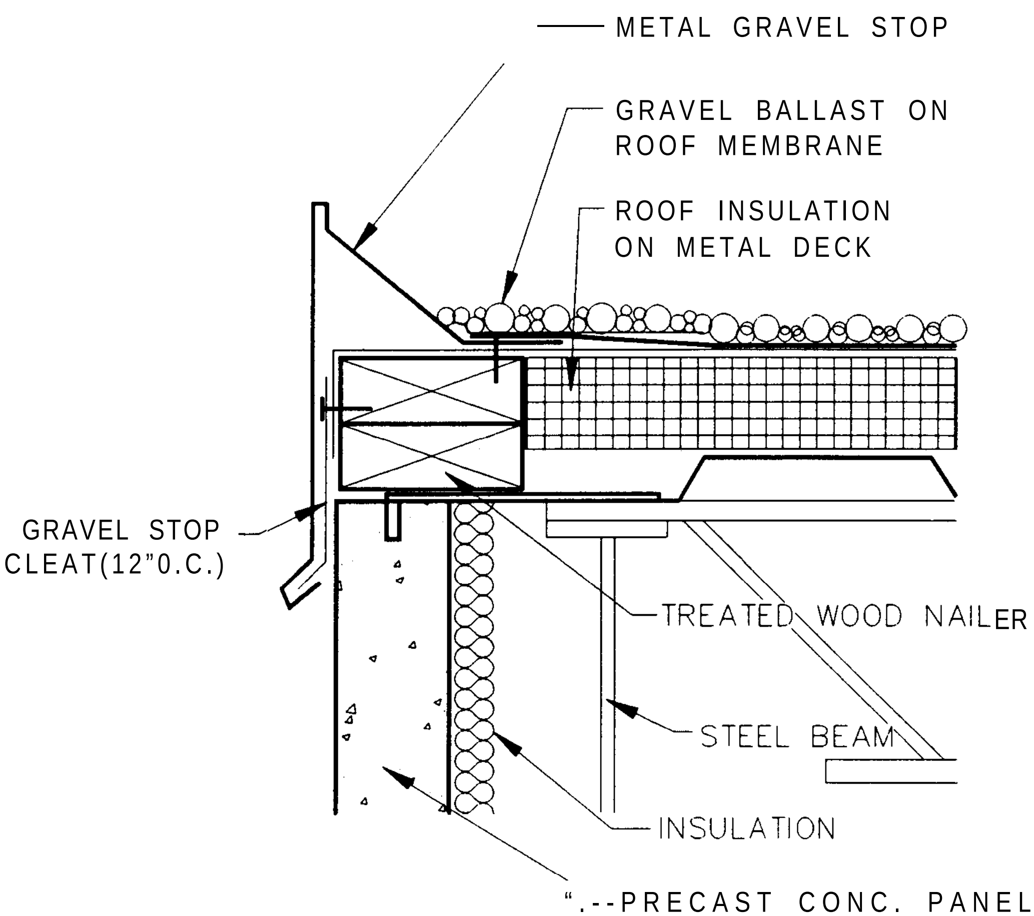
ROOF PENETRATION

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF PENETRATION DETAIL		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-8



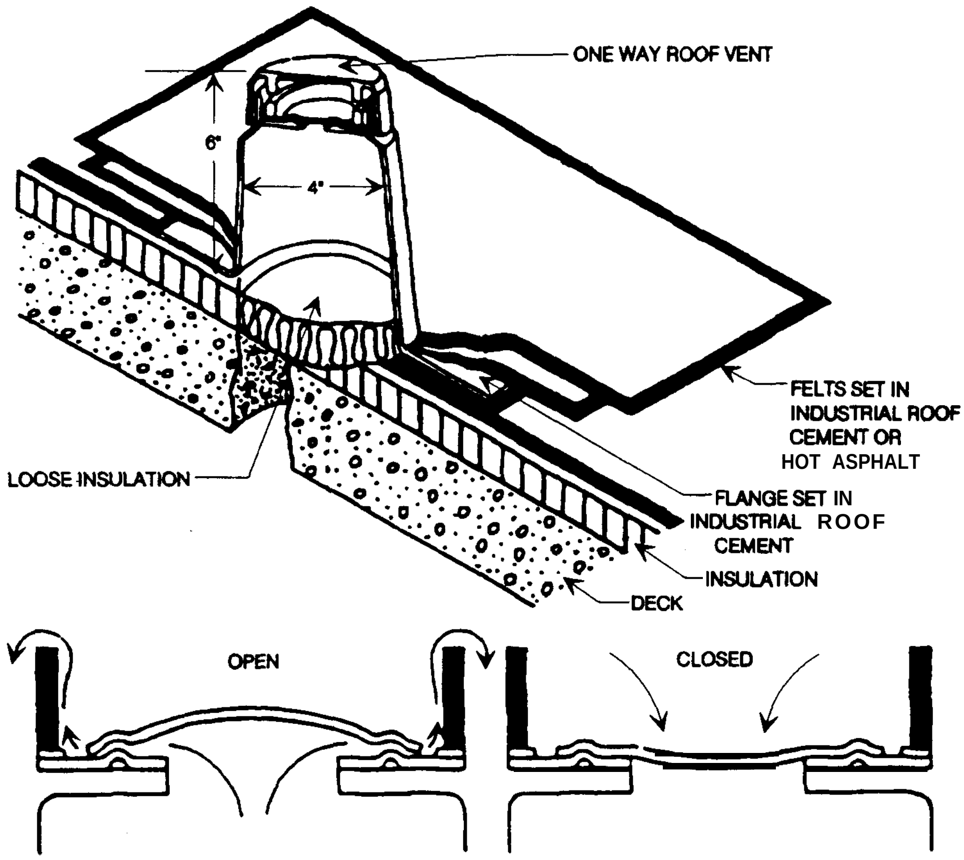
VENT THROUGH ROOF

SYSTEM ASSEMBLY DETAILS-ROOFING	VENT PENETRATION DETAIL		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawhg No. A0501-9

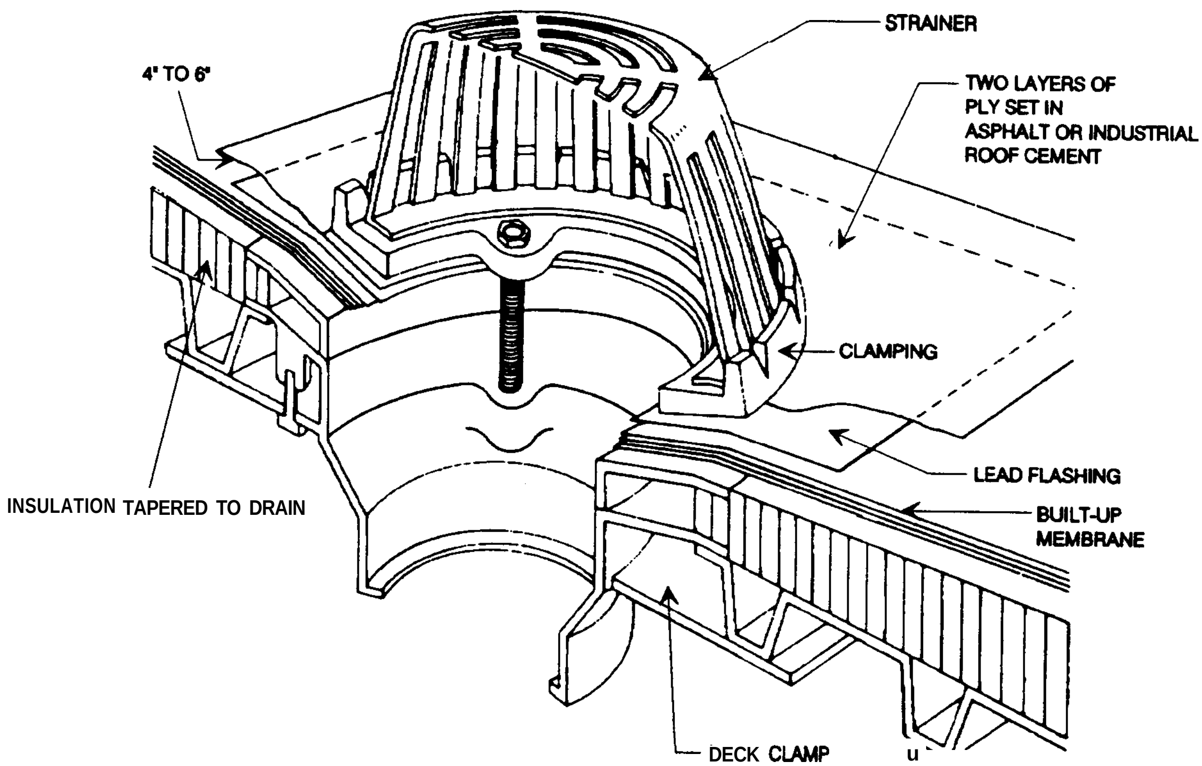


GRAVEL STOP

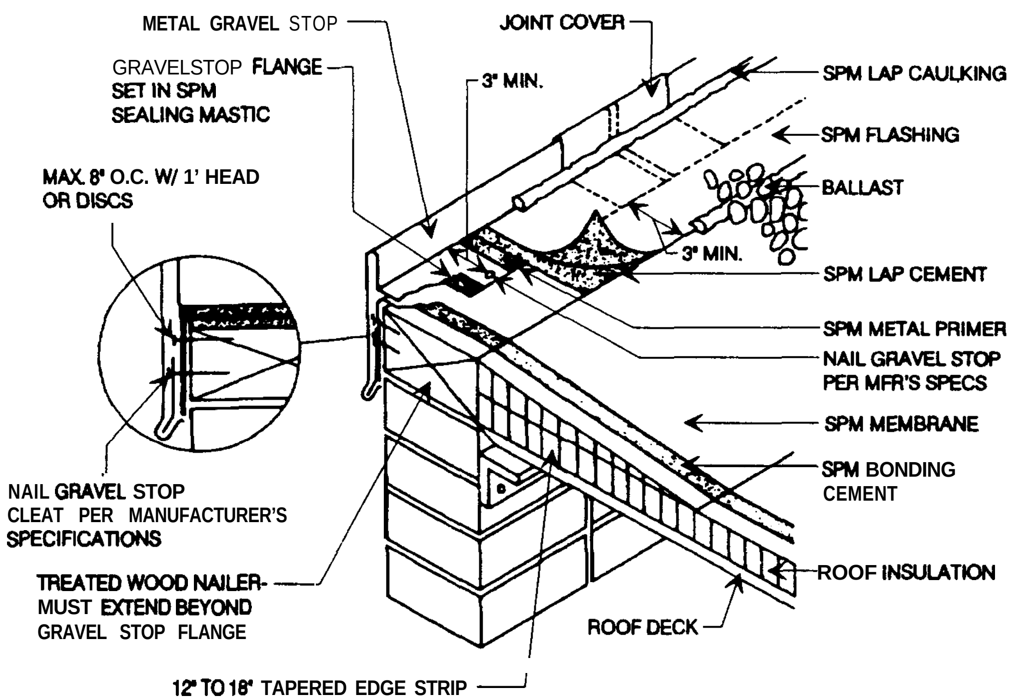
SYSTEM ASSEMBLY DETAILS-ROOFING	GRAVEL STOP DETAIL		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-10



SYSTEM ASSEMBLY DETAILS-ROOFING	ONE WAY VENT DETAIL		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-11



SYSTEM ASSEMBLY DETAIL-ROOFING	ROOF DRAIN DETAIL		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. A0501-12



SYSTEM ASSEMBLY DETAIL-ROOFING	GRAVEL STOP AND EDGE FLASHING DETAIL		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date	Drawing No.
		5/93	A0501-13

DEFICIENCY FACTORS
0.05.01 BUILT-UP MEMBRANE (CSI 07510)

PROBABLE FAILURE POINTS

- Roofing deterioration or structural collapse due to ponding water if sufficient slope for drainage is not provided.
- Insulation uplift caused by insufficient fastening of the insulation base layer.
- Blistered or delaminated roofing membrane or insulation failure caused by vapor migration through the insulation.
- Increase roofing blistering caused by directly applying the membrane to polyisocyanurate, polyurethane, and felt-skinned foam-type insulation.
- Split roofing or base flashing caused by direct mechanical attachment of the metal flashing to the roof or roof penetrations.
- Membrane tearing or splitting caused by differential movement between the wall and the roof or lap joint failure.
- Roof or felt overspaced during installation.
- Flashing deterioration or failure.
- Asphalt membrane degradation due to UV exposure because the membrane was not completely covered by ballast.
- Membrane punctured from ballast (foot traffic on ballast stone and damaged membrane).

SYSTEM ASSEMBLIES/DEFICIENCIES

Membrane

Roof Membrane, Exposed Felts, & Small Deteriorated Areas:	Caused usually by weathering, excessive traffic, and/or improperly installed materials.
Roof Membrane Split:	Caused usually by differential roof deck movement and/or improper installation.
Large Blisters or Buckles:	Caused primarily by trapped moisture beneath the built-up membrane, and gases from asphalt or insulation. Moisture usually results from improperly cured concrete (when used as deck), moisture migration through assembly (no vapor barrier when required by conditions), or extensive water penetration of membrane.
Fishmouths:	These half-conical (or cylindrical) openings occur at felt edges and are caused by differential roof movement, weathering, and/or improper installation.
Exposed & Badly Deteriorated Felts/Alligatoring:	Lack of adequate ballast cover;. ballast movement due to excessive wind and weathering.
Punctures in Membrane:	Almost exclusively caused by foot traffic and/or falling objects. Weather can cause puncture damage, either by large hail and/or object projectiles created by severe wind conditions.
Standing Water (Ponding):	Attributed to clogged roof drains, low points on a roof, or a combination of both.

DEFICIENCY FACTORS
0.05.01 BUILT-UP MEMBRANE (CSI 07510)

SYSTEM ASSEMBLIES/DEFICIENCIES

Membrane (Continued)

Slippage:	Condition due to weakened adhesives or membrane bond to the substrate causing the membrane to creep or slide; leading to other deficiencies such as splits and buckling.

Flashings

Punctures in Base Flashing:	Cant strips are absent or undersized. Caused by foot traffic and/or by falling objects.
Open Vertical Laps in Bituminous Base Flashing:	Caused by inadequate flashing cement in combination with weathering, and is usually compounded by differential roof movement.
Deteriorated Bituminous Base Flashing Coating:	Caused by weathering, but can be amplified by improper installation.
Deteriorated Gravel Stop Metal Base and/or Counterflashing:	Caused by weathering, paint coat failure (ferrous metals), differential roof movement, and/or improper fastening.
Bituminous Base Flash Separation from Wall or Curb:	Caused by excessive roof/wall differential movement and/or improper installation.
Exposed Embedded Flashing:	Embedded flashing exposure caused by weathering and/or lack of maintenance.

Insulation

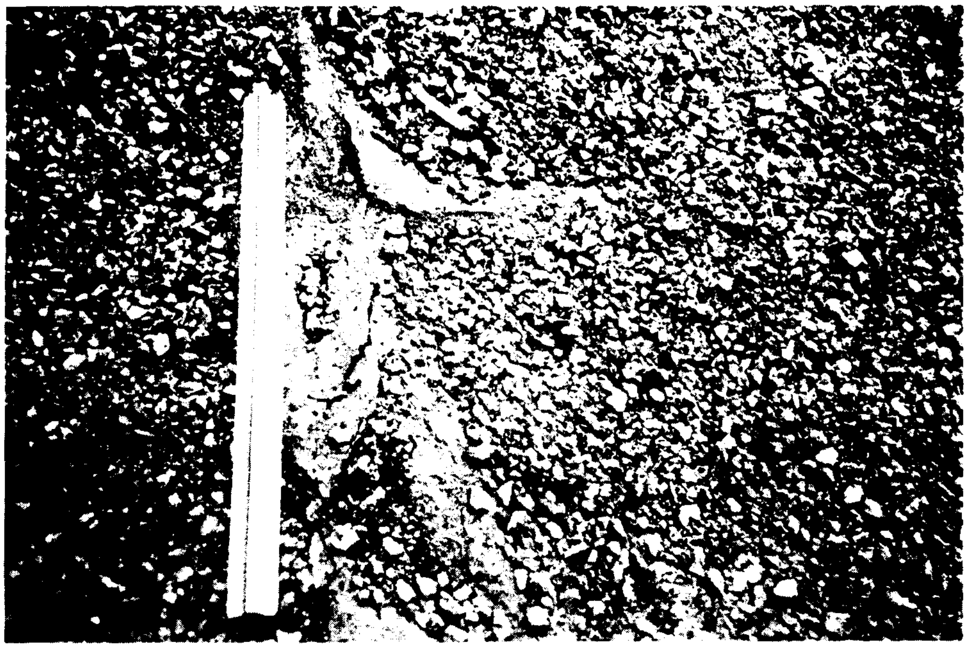
Exposed, Damaged Insulation:	Caused by insulation exposed to direct sunlight and inclement weather conditions; deteriorates rapidly.
Missing Insulation:	Caused by wind, improper installation, or other external adverse conditions.
Wet Insulation:	Membrane failure allows water penetration into the roof assembly.

EXPOSED FELTS

ROOF MEMBRANE SPLIT

PHOTO ILLUSTRATION

- SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	EXPOSED FELTS, ROOF MEMBRANE SPLIT		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. D0501-1



FISHMOUTHS

LARGE BLISTERS AND BUCKLES

PHOTO ILLUSTRATION

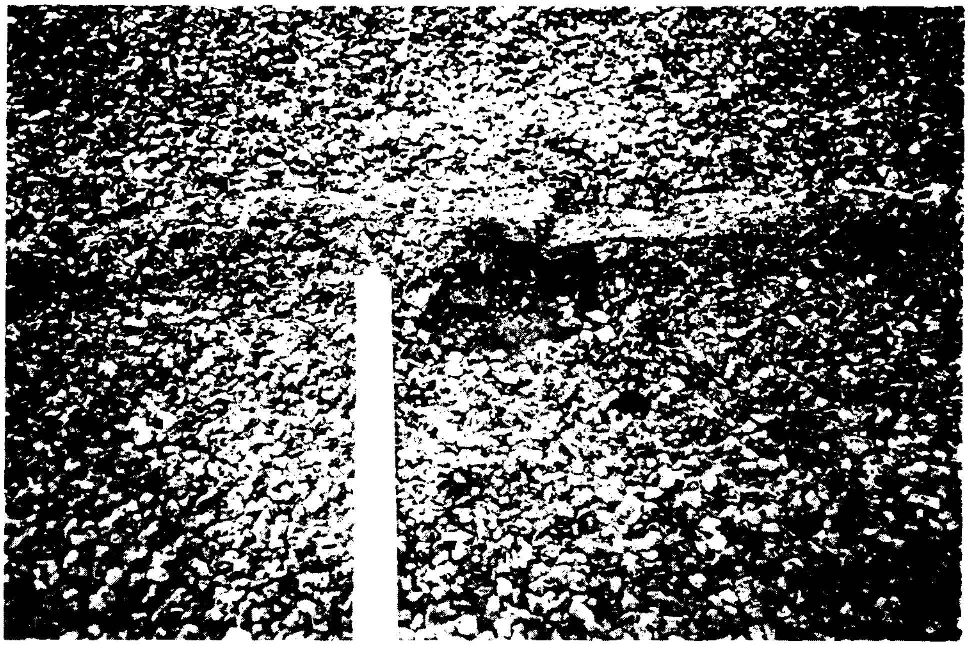
SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	FISHMOUTHS, LARGE BLISTERS		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. D0501-2

FLASHING SEPERATION

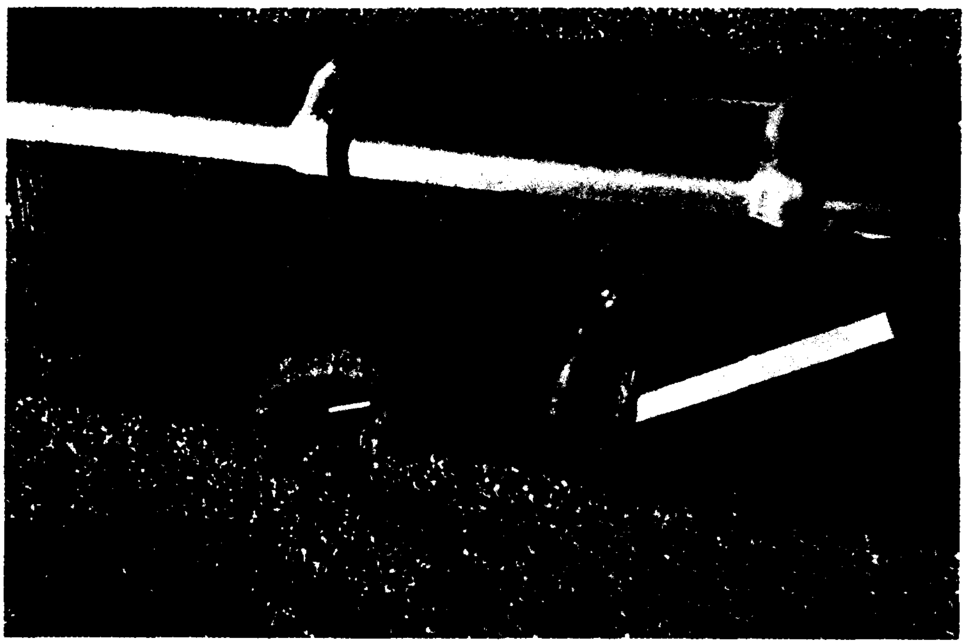
BADLY EXPOSED AND DETERIORATED FELTS/ALLIGATORING

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	FLASHING, DETERIORATED FELTS		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. D0501-3



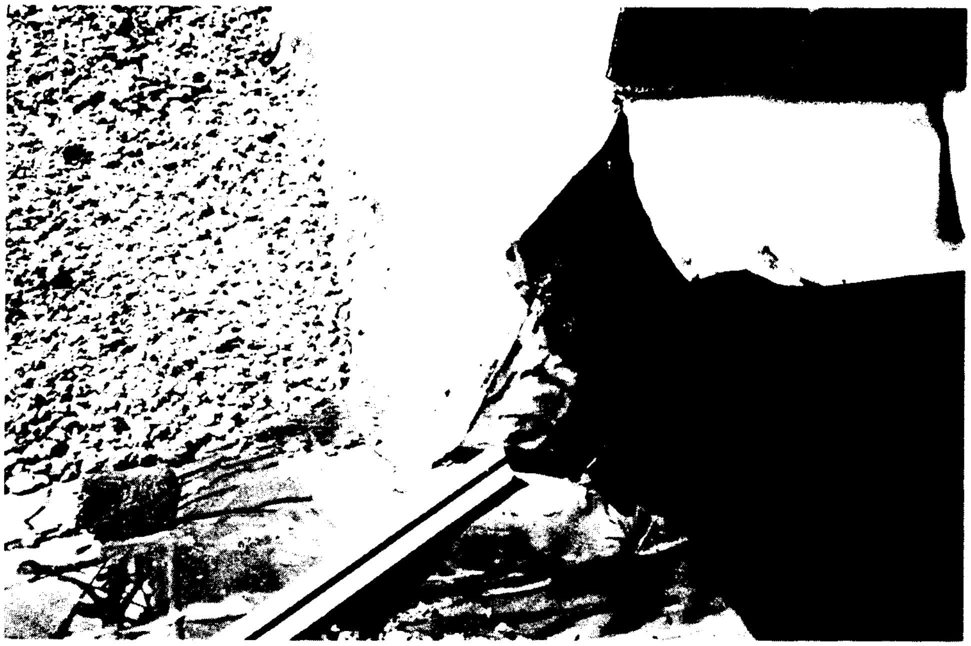
PUNCTURES IN MEMBRANE



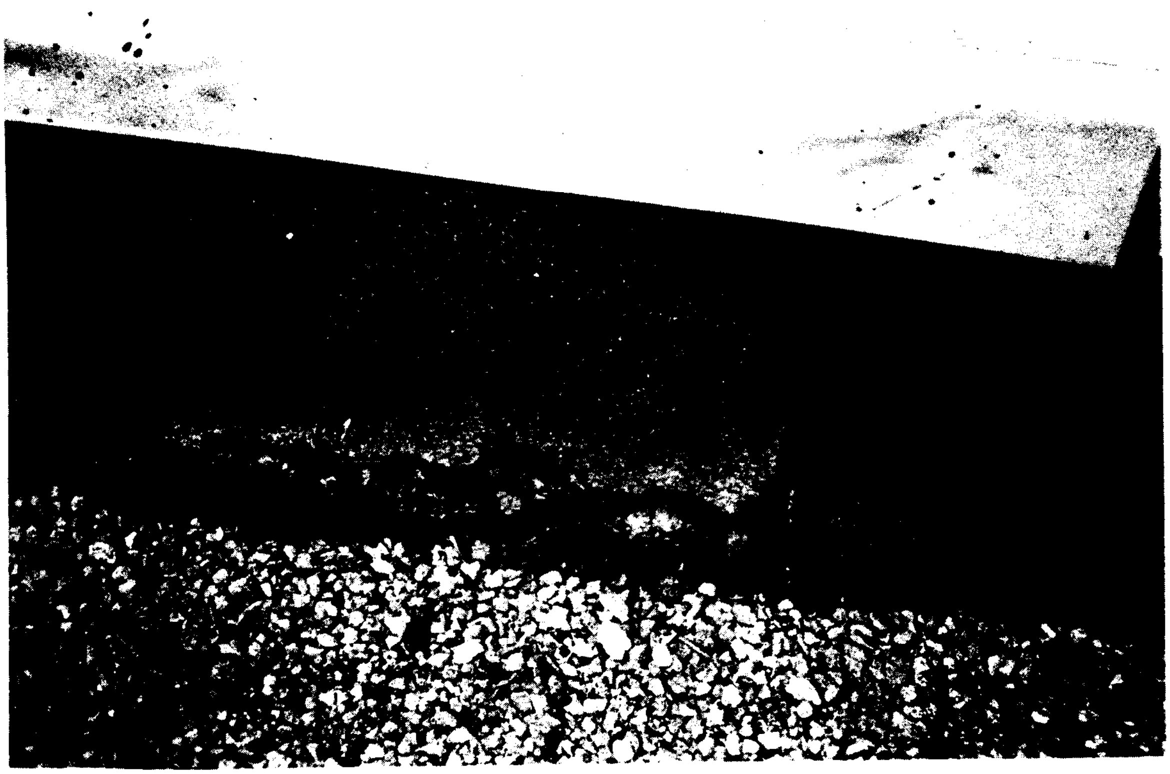
OPEN VERTICAL LAPS IN BITUMINOUS BASE FLASHING

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	PUNCTURES, OPEN VERTICAL LAPS		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. D0501-4



DETERIORATED COUNTERFLASHING



DETERIORATED BITUMINOUS BASE FLASHING

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	DETERIORATED BASE AND COUNTERFLASHING		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. D0501-5

PONDING

PONDING

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	PONDING		
BUILT-UP MEMBRANE (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. D0501-6

DEFICIENCY FACTORS
0.05.01 BUILT-UP MEMBRANE (CSI 07510)

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DEFICIENCY FACTORS
0.05.01 BUILT-UP MEMBRANE (CSI 07510)

END OF SUBSECTION

0.05.02 SINGLE-PLY MEMBRANE (CSI 07530)

DESCRIPTION

This narrative describes single-ply membrane roofing systems and the fastening systems used to tie membrane to the substrate or deck. There are four fastening systems: Mechanically Fastened, Fully Adhered, Partially Adhered with spot or lines of adhesive, and Loose Laid with a ballast cover. Fully adhering the membrane to the deck and covering with insulation and ballast is the fifth method in use and is called IRMA (Inverted Roof Membrane Assembly).

The following details also describe a generic single-ply membrane roof system. Single-ply membranes are isotropic or have equal strength in both directions, and are more resistant to moisture and sub-zero temperatures than built-up roofing membranes. 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 Deck (CSI 05310)

Metal deck is usually a minimum 22 gauge with spans as recommended by Factory Mutual, Underwriters Laboratories and the requirement of the local building code. The depth and configuration of deck and flutes are determined by the structural requirements of the roof. Maximum deck deflection should be limited to the following values:

Span	Deflection
4 feet	0.20 inch
5 feet	0.25 inch
6 feet	0.30 inch

High-quality fasteners must be used in steel decks of less than 22-gauge thickness, lightweight concrete decks, and cementitious decks due to greater deflection.

Roof Deck Insulation (CSI 07220)

Glass fiber, cellular glass, perlite, or wood fiberboard may be used without an additional layer of protection prior to applying the roofing felts. Composite board, polyurethane foam board, and polyisocyanurate foam board require protection or a vented base sheet. Thickness varies as required by thermal resistance needed. Insulation must have sufficient strength to span the flutes of metal decking and must have adequate strength to support the applied design load.

Roofing Membrane (CSI 07530)

Types of Single-Ply Membrane:

Thermosetting (vulcanized or "cured" elastomers)

- EPDM (ethylene propylene diene monomer)
- Neoprene (chloroprene rubber)

Thermoplastic (non-vulcanized or "uncured" elastomers)

- CPA (copolymer alloy)
- CPE (chlorinated polyethylene)
- EIP (ethylene interpolymer alloy)
- NBP (acrylonitrile butadiene copolymer)
- PIB (polyisobutylene)
- PVC (polyvinyl chloride)

0.05.02 SINGLE-PLY MEMBRANE **(CSI 07530)**

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Roofing Membrane (CSI 07530)

Tvpes of Single-Plv Membrane (Continued):

CSPE (chlorosulfonated polyethylene)

- This is neither a thermosetting nor thermoplastic material

The most widely used type of single-ply roofing is EPDM. It is available in rolls of up to 50 feet wide and 200 feet long, and requires fewer field seams, the weakest parts of the system. These large sheets can only be used in a ballasted system because mechanical fasteners and adhesives are normally placed at seams. Ballasted systems add 10 pounds per square foot of dead load to a structure.

There are four basic methods of attaching the SPR membrane to the substrate or deck: using stone ballast, mechanically fastening, partially adhering using “spots” or “lines” of adhesive, and fully adhering. Many of the SPR products may use any of the attachment methods.

Mechanical attachment can present certain problems, the most common of which are fastener corrosion and thermal bridging. Fasteners are normally required to provide a minimum of 300 pounds of pull-out resistance.

Cold-Applied Roofing System (CSI 07500)

Cold-applied systems are generally lightweight and always substantially reduce the dead load on the roof structure. A cold-applied roofing system is easier to maintain than ballasted roofing. Leaks and damage to the roof are much easier to locate and repair on a smooth surface. Cold-applied roofing is easily adaptable to many different slopes and roof structure configurations.

Coatings and adhesive are used separately or in combination with reinforcing felts and fabrics to comprise the cold-applied roofing system. Coatings and adhesives are grouped into the following categories: Asphalt Cutbacks, Asphalt Emulsions, Refined Coal Tar Coatings, Non-Asphaltic Emulsions and Colored Coatings, Aluminum Pigmented Asphalt, and Particulate Toppings.

Asphalt Cutbacks:

Non-filled asphalt cutbacks are a mixture of asphalt and a suitable approved solvent mixed in a ratio to obtain a brush or spray grade material at normal room temperature. They are usually used as a primer for other coatings or as foundation coatings.

Filled asphalt cutbacks are a mixture of asphalt, approved solvent, and possibly thixotropes, with or without filler. They may be modified with polymers or plasticizers. They are made in brush or spray grade at room temperature and are used in single or multiple applications with or without reinforcements to provide a weather-resistant protection for the roof area or to hold granules in place.

Mastic and granule asphalt cutbacks are a mixture of asphalt, approved solvent, and fillers to give brush grade material at room temperature. This material is usually used as the tack coat to hold mineral granule surfacing in place for a decorative or fire-resistant surface. Adhesives based on asphalt cutback are used primarily to adhere roofing plies to each other or to substrates, or as surface adhesives to receive granules or other surfaces.

Asphalt Emulsions:

Non-filled asphalt emulsion is a mixture of asphalt in water in a colloidal using an agent such as bentonite clay. This results in a thixotrophic mixture that is brush or spray grade at room temperature.

0.05.02 SINGLE-PLY MEMBRANE (CSI 075301

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Cold-Applied Roofing System (CSI 07500)

Asphalt Emulsions (Continued):

Filled asphalt emulsion is a mixture of asphalt in water with fillers in a colloidal suspension using an agent such as bentonite clay. This results in a thixotrophic mixture that is brush or spray grade at room temperature.

Asphalt emulsions are used extensively in roofing and many other types of waterproofing and dampproofing systems.

Refined Coal Tar Coatinus:

Non-filled coal tar coatings are a mixture of refined coal tar and a suitable solvent, resulting in a brush or spray grade coating at room temperature. This class of coatings includes non-fibrated tar roof coatings and primers.

Filled coal tar coatings are a mixture of refined coal tar, a suitable solvent, and fillers. These products are tar roof cements for flashings and repairs and fibrated tar coatings for use on aged tar and gravel roofs.

Non-Asphalt Emulsions & Colored Coatings:

Solvent base colored coatings are a mixture of resins, approved solvents, pigments, and bodying agents to develop suitable pigmentation properties.

Colored coating emulsions contain resin and emulsion mixed with suitable pigments and fillers to provide excellent pigmentation properties. These coatings are used as a finish coat or reflective coating over existing roofs.

Asphalt-Based Aluminum Coating:

Filled aluminum, pigmented asphalt coatings are a mixture of oxidized asphalt, suitable approved solvents, aluminum paste, and fillers. They are commonly used as a reflective coating for roofs or flashing areas.

Non-filled aluminum pigmented asphalt coatings are a mixture of oxidized asphalt, suitable approved solvents, and aluminum paste. These materials are used as a reflective coating over metal surfaces such as metal roofing, storage tanks, and vessels.

Particulate Toppings:

Granules, gravel, or aluminum chips are placed in the last coat while it is still wet so that they are exposed and immobilized when the coating cures. Not only do they offer decorative options, but they can block ultraviolet light and control energy transfer, thus extending the life of the membrane.

Mechanical Fasteners (CSI 07530)

A problem of mechanically attached membranes is wind-induced flutter around the fasteners, which may lead to fastener or membrane failure. On high-rise buildings or in very windy locations, it is prudent to use fully-adhered systems. Many manufacturers are currently developing dependable mechanical fastener systems and adhered systems in response to a trend away from ballasted systems.

Ballast (CSI 07580)

3/8 inch nominal diameter gravel, slag, riverwashed stone, or other approved material.

0.05.02 SINGLE-PLY MEMBRANE (CSI 07530)

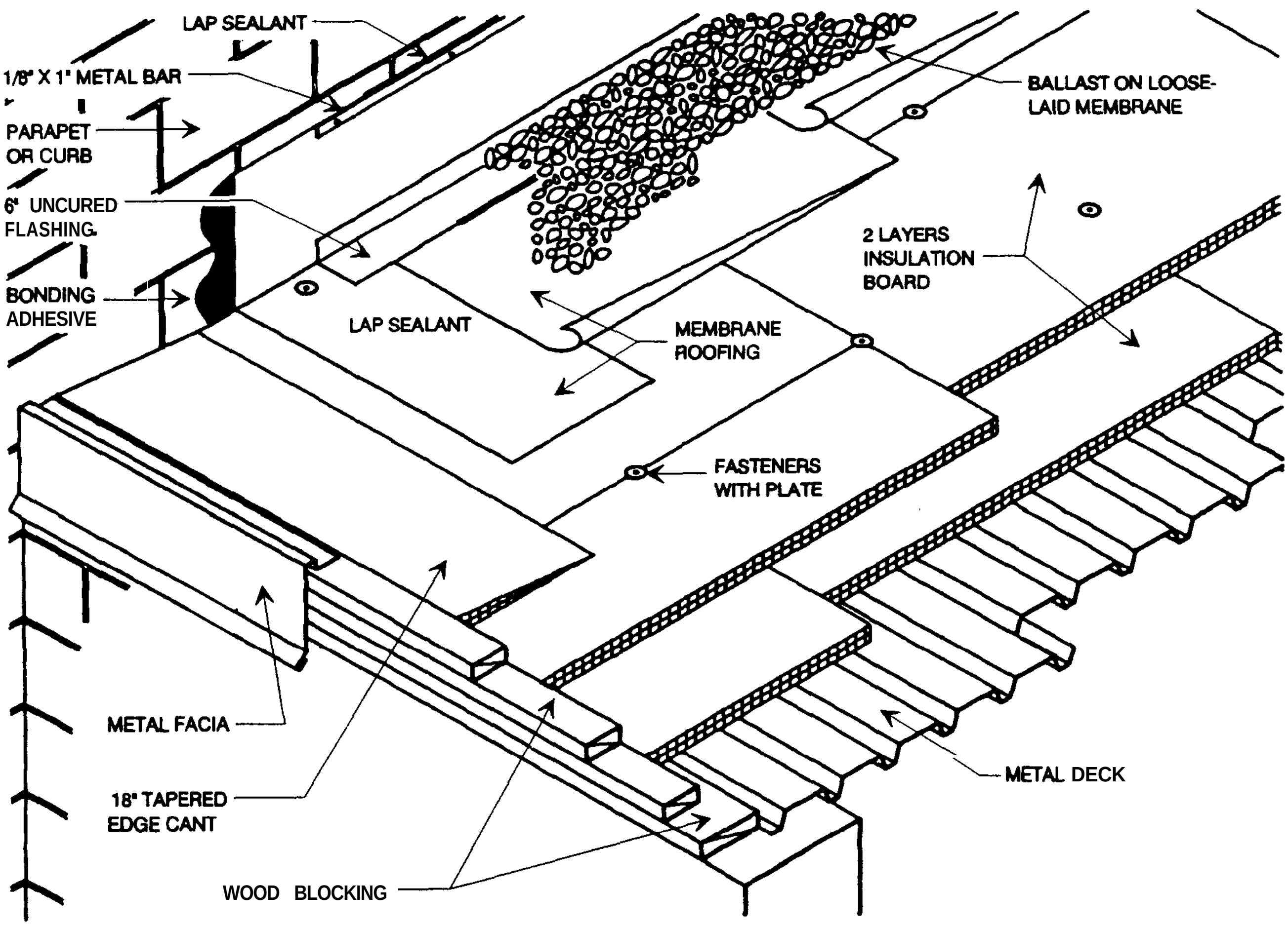
ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

Flashing (CSI 07600)

Roof flashing may include curb flashing, base and counterflashing, and expansion flashing (Joints, etc.). Material varies and may include copper, aluminum, galvanized steel, single-ply membrane.

OTHER RELATED COMPONENTS

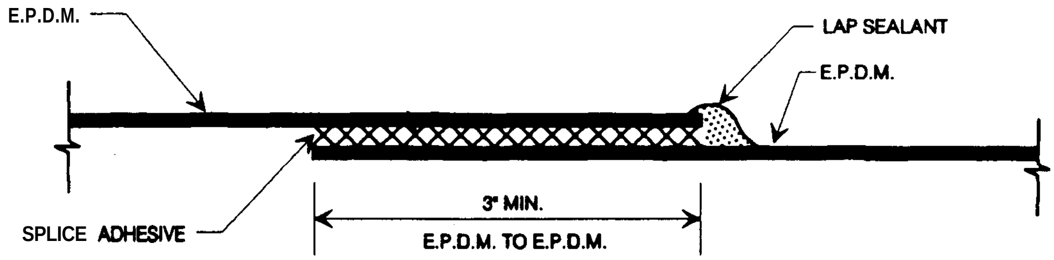
See the following subsections for related components

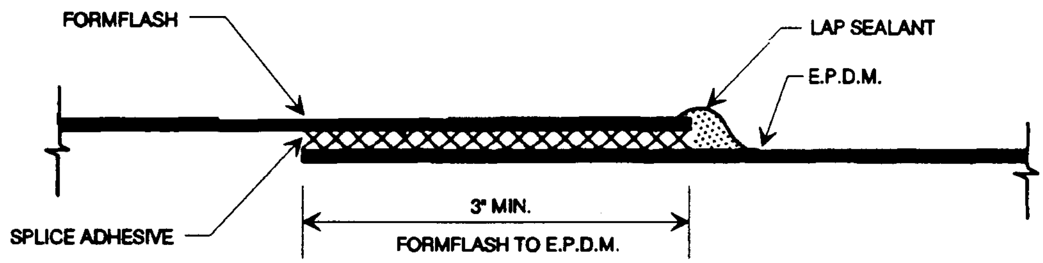


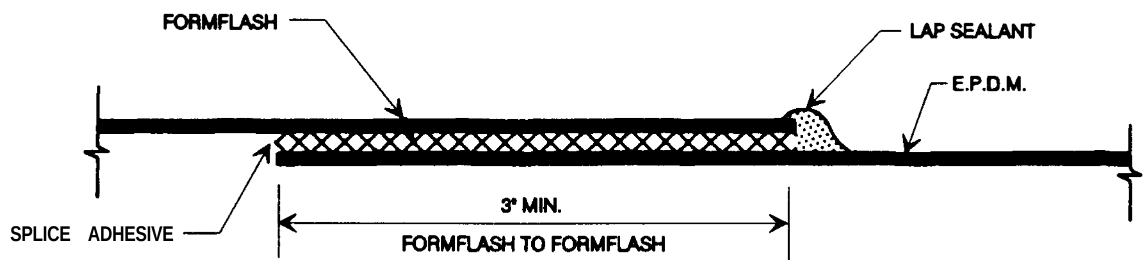
BALLASTED MEMBRANE ROOFING

SOURCE: MEANS ROOFING DESIGN CRITERIA, OPTIONS, SELECTION, "R.S. Means Co., Inc., Kingston, Massachusetts"

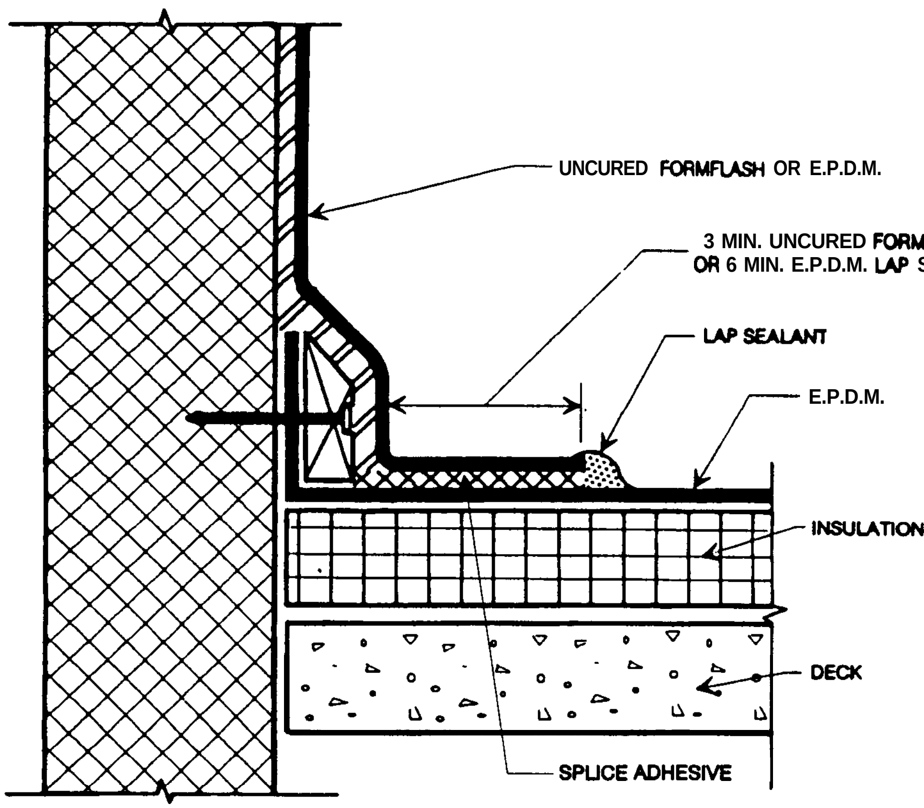
SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF MEMBRANE		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-1



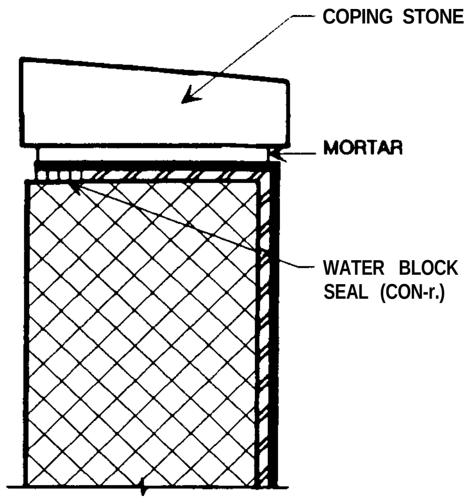


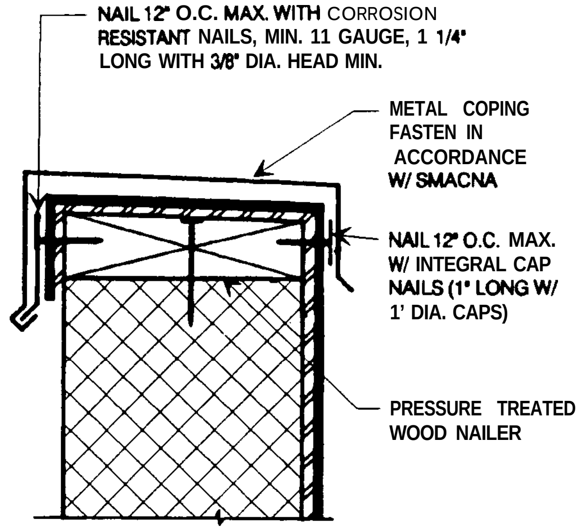


SYSTEM ASSEMBLY DETAILS-ROOFING	MEMBRANE SEAM OVERLAPS		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-2

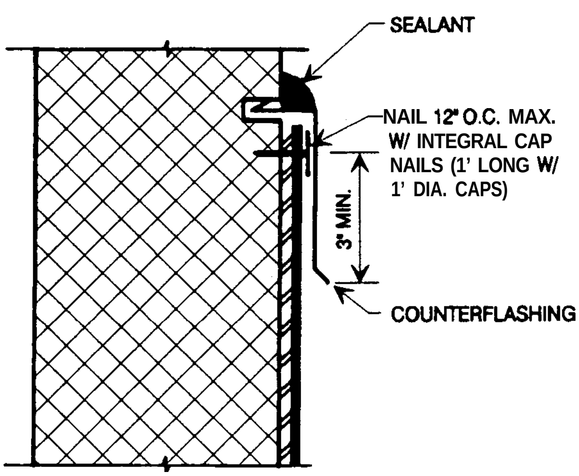


SYSTEM ASSEMBLY DETAILS-ROOFING	BASE TIE-IN		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-3

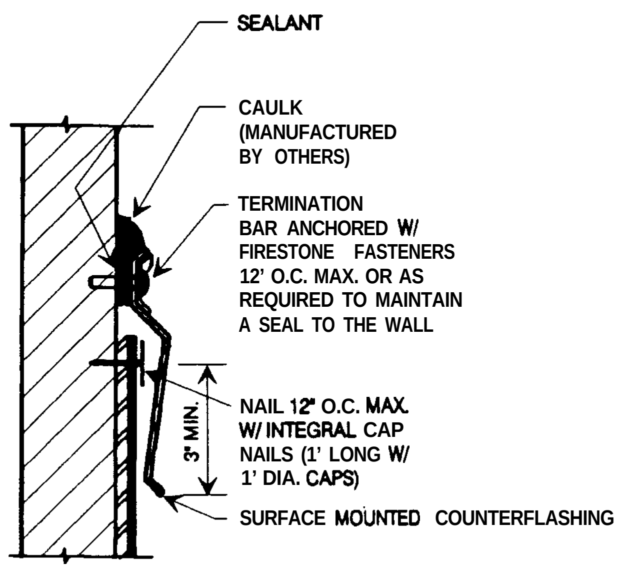




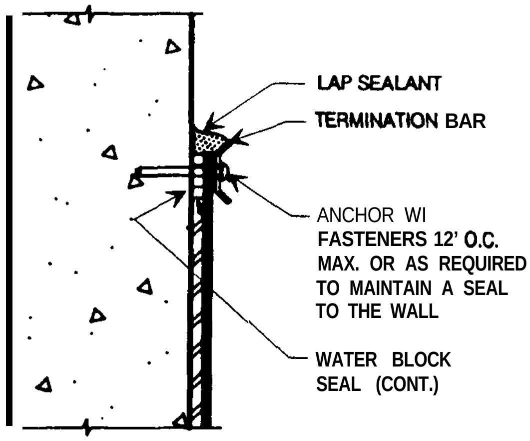
NOTES:
1. IF ANCHORS MUST PENETRATE SHEET METAL, NEOPRENE WASHERS MUST BE USED AND SUBSEQUENTLY CAULKED WITH HIGH GRADE CAULKING.

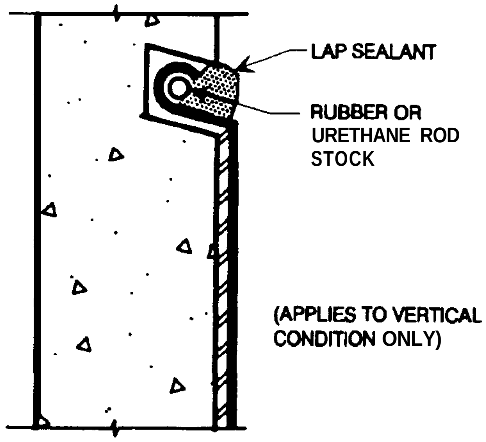


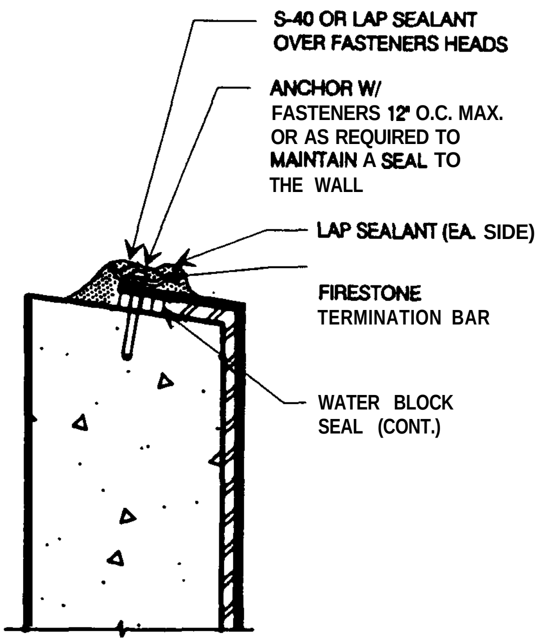
NOTES:
1. IF ANCHORS MUST PENETRATE SHEET METAL NEOPRENE WASHERS MUST BE USED AND SUBSEQUENTLY CAULKED WITH HIGH GRADE CAULKING.

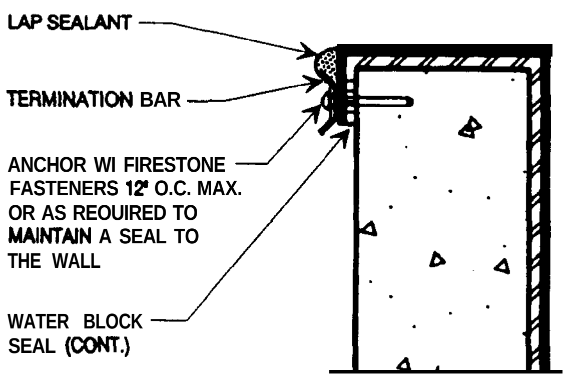


SYSTEM ASSEMBLY DETAILS-ROOFING	FLASHING TERMINATIONS		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-4



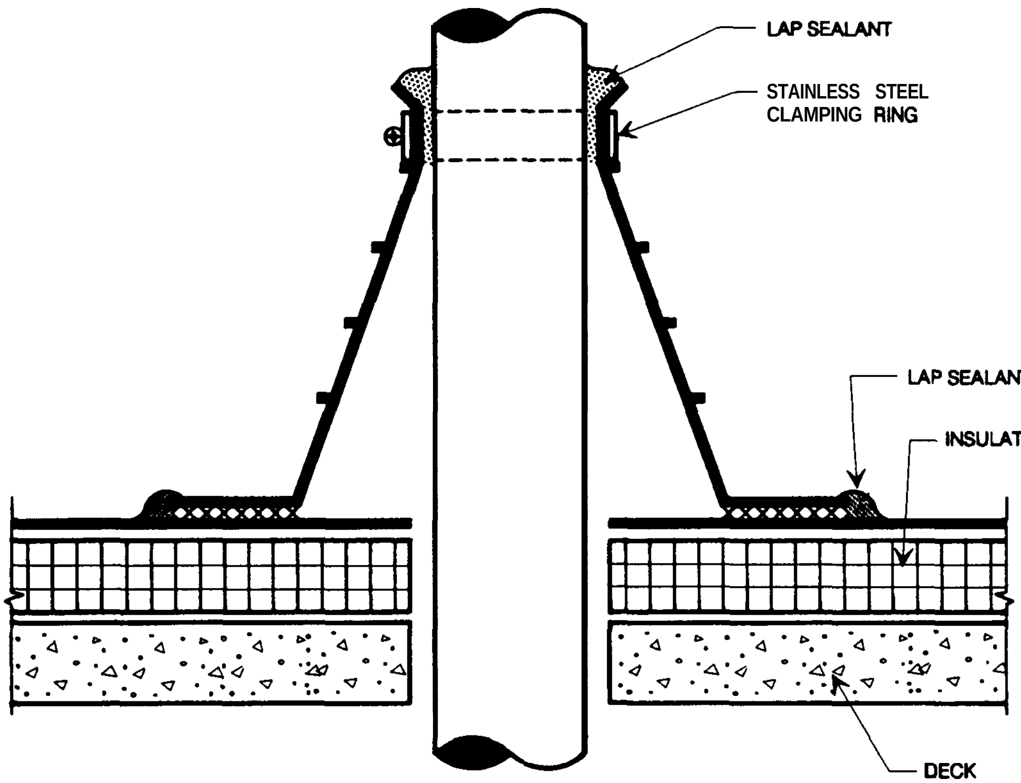






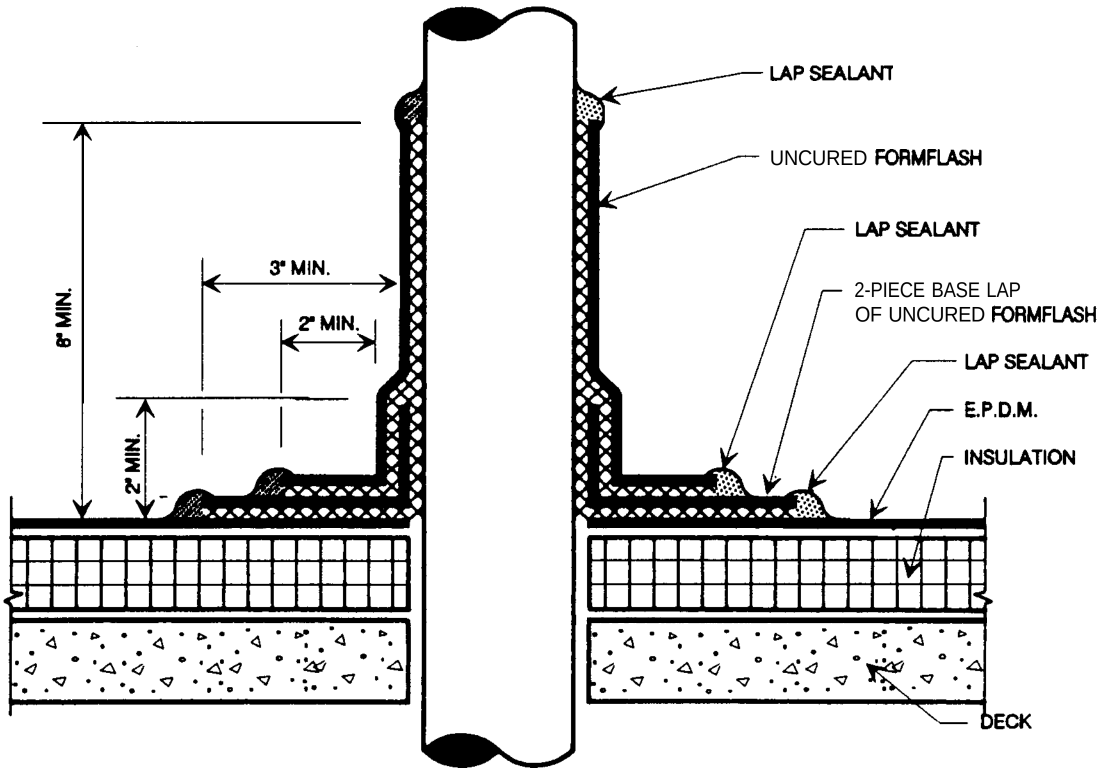
NOTES
1. KEEP EACH 10' LENGTH OF TERMINATION BAR SEPERATED FROM ADJOINING BAR BY 1/4".
2. TERMINATION BARS MUST BE INSTALLED DIRECTLY TO THE WALL SURFACE, NOT TO EXISTING SHEET METAL, FLASHING, ETC.
3. INSTALL TERMINATION BAR ON HARD SMOOTH SURFACES ONLY. DO NOT INSTALL SUBSTRATES WHERE SEAL IS LOST AT MORTAR JOINTS, ETC.
4. INSTALL TERMINATION BAR VERTICALLY WHERE BASE FLASHING(S) END.
5. DO NOT INSTALL TERMINATION BAR TO WOOD OR OTHER POROUS SURFACES.
6. AT INSIDE AND OUTSIDE CORNERS, TERMINATION BAR MUST BE CUT AND CONTINUED.
7. TERMINATION BAR MUST BE FASTENED A MAX. 1’ IN FROM END Of AU SECTIONS.

SYSTEM ASSEMBLY DETAILS-ROOFING	FLASHING TERMINATIONS		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawhg No. A0502-5



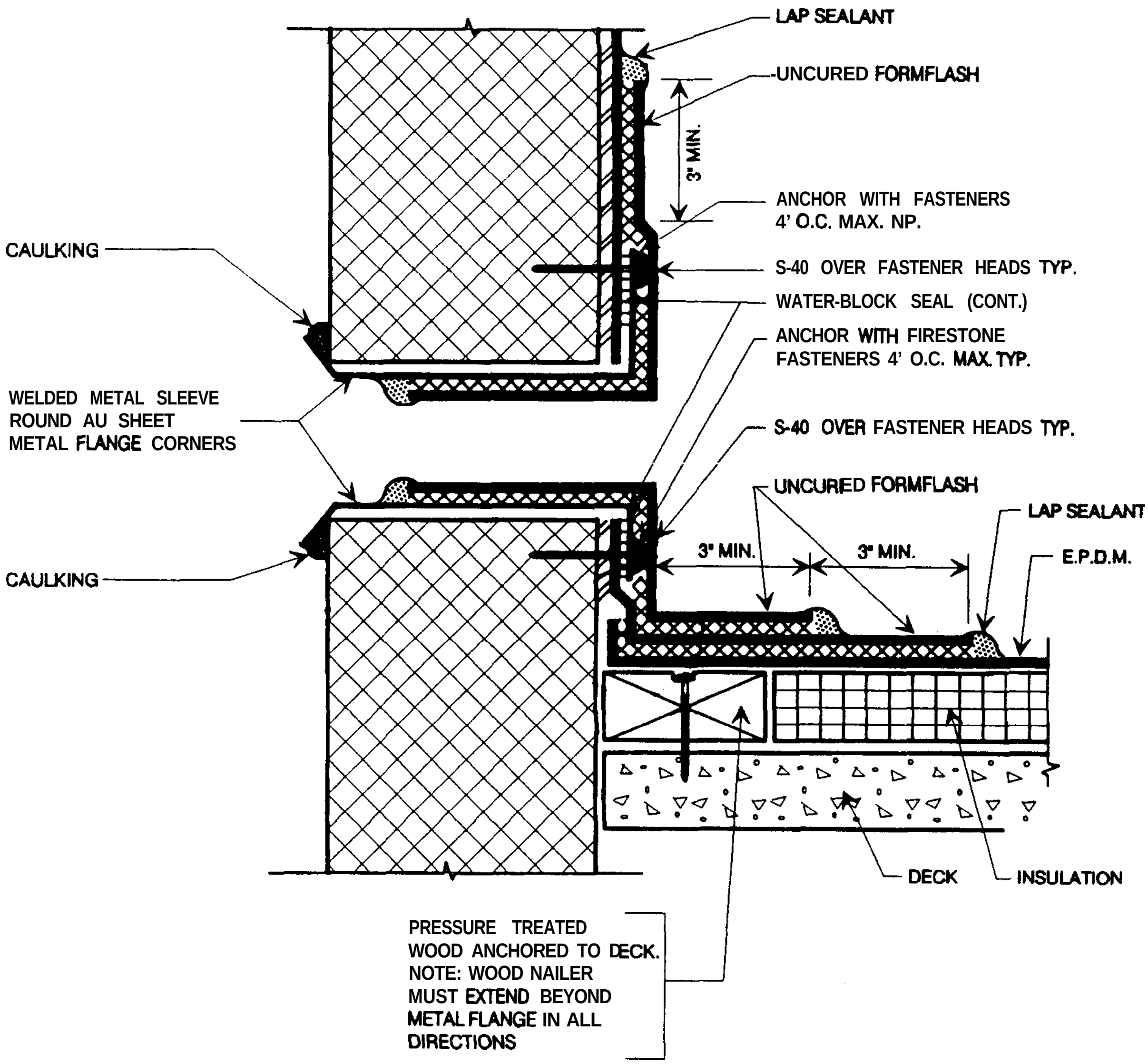
NOTES:
1. PIPE BATTEN REQUIRED WHEN THIS DETAIL IS USED ON MECHANICALLY ANCHORED SYSTEMS.
2. REMOVE AU EXISTING FLASHING, LEADS ETC. PIPE SURFACE MUST BE FREE OF AU RUST, GREASE ETC.
3. PIPE MUST BE ANCHORED TO BOTTOM SIDE OF DECK TO ASSURE STABILITY.

SYSTEM ASSEMBLY DETAILS-ROOFING	PRE-FAB PIPE FLASHING		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issua Date 5/93	Drawing No. A0502-6

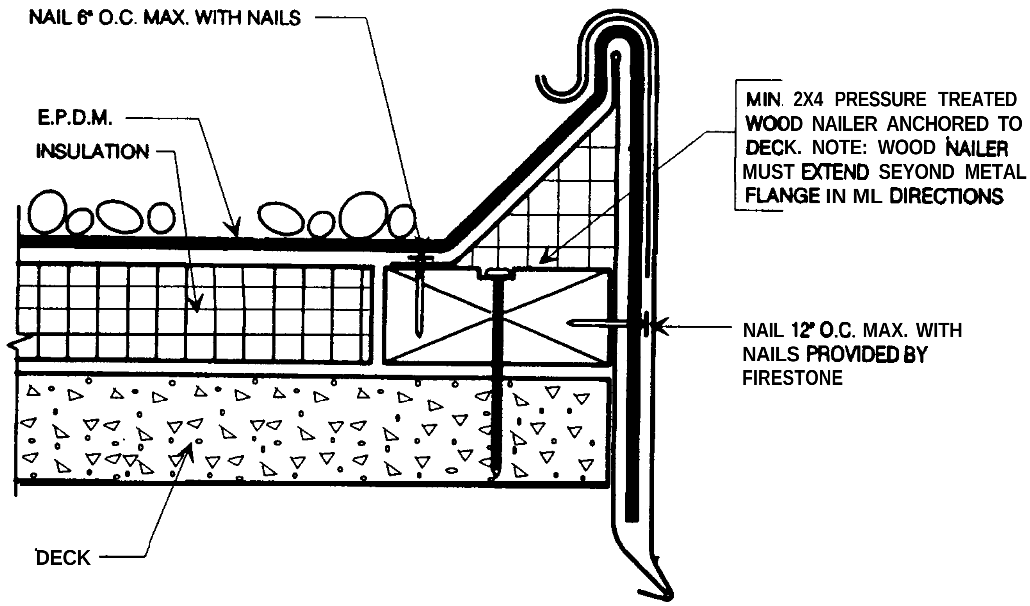


NOTES
1. PIPE BATTEN REQUIRED WHEN MIS DETAIL IS USED ON MECHANICALLY ANCHORED SYSTEMS.
2. REMOVE ALL MISTING FLASHINGS, LEADS ETC. PIPE SURFACE MUST BE FREE OF ALL RUST, GREASE ETC.
3. PIPE MUST BE ANCHORED TO BOTTOM SIDE OF DECK TO ASSURE STABILITY.
4. DC NOT INSTALL CLAMPING RING AROUND TOP OF FLASHING.
5. PRESSURE TREATED WOOD NAILER REQUIRED WHEN OUTSIDE DIAMETER OF PIPE EXCEEDS 18".

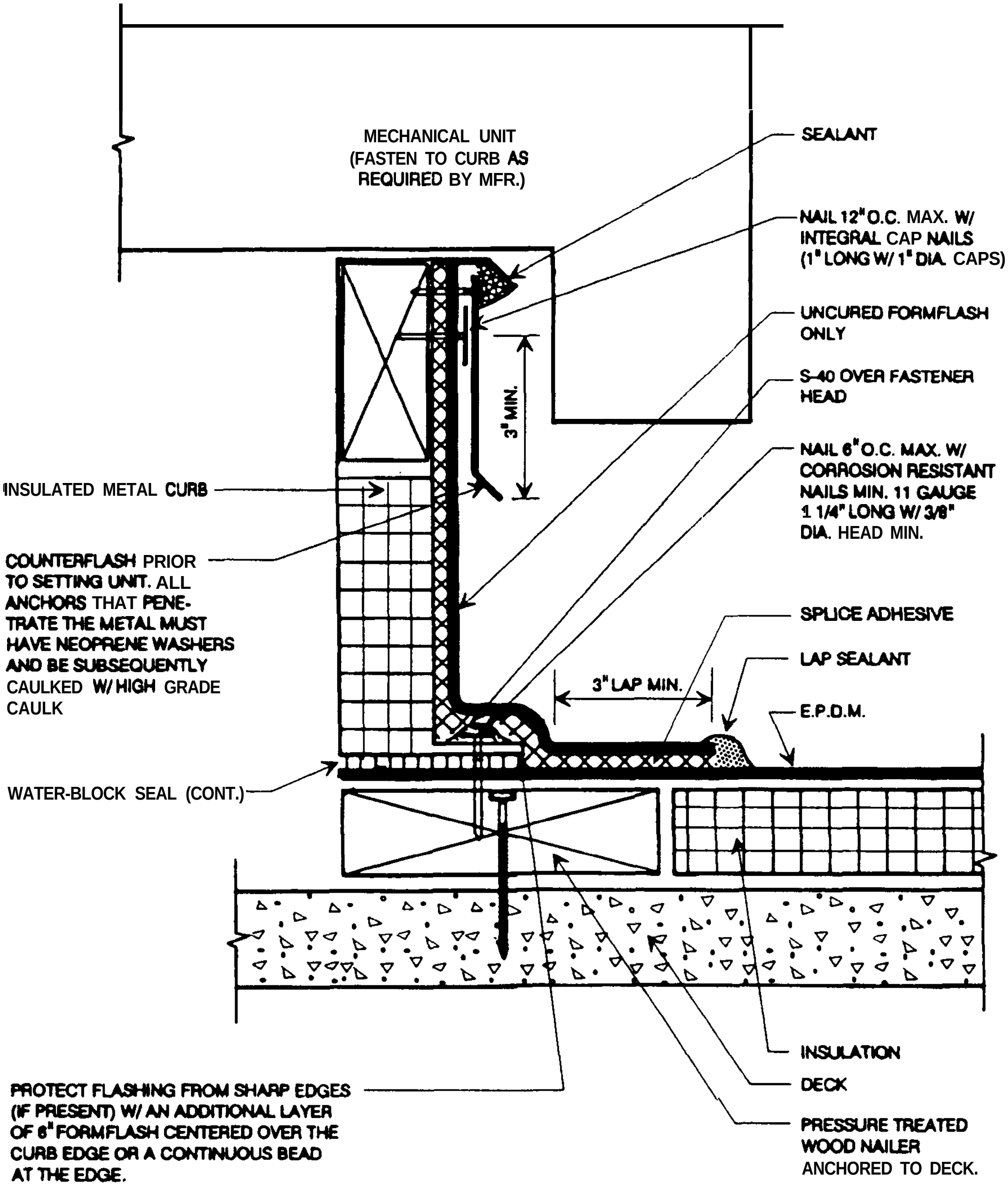
SYSTEM ASSEMBLY DETAILS-ROOFING	FIELD FABRICATED PIPE FLASHING		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-7



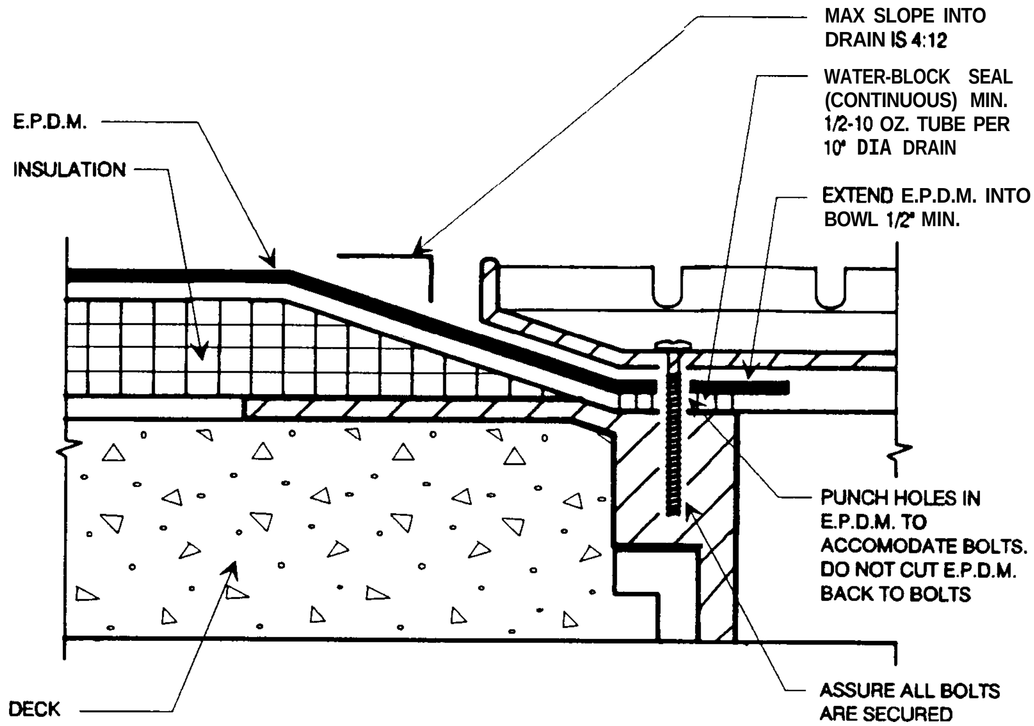
SYSTEM ASSEMBLY DETAILS-ROOFING	OVERFLOW SCUPPER		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-8



SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF EDGE/GRAVEL STOP		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-9



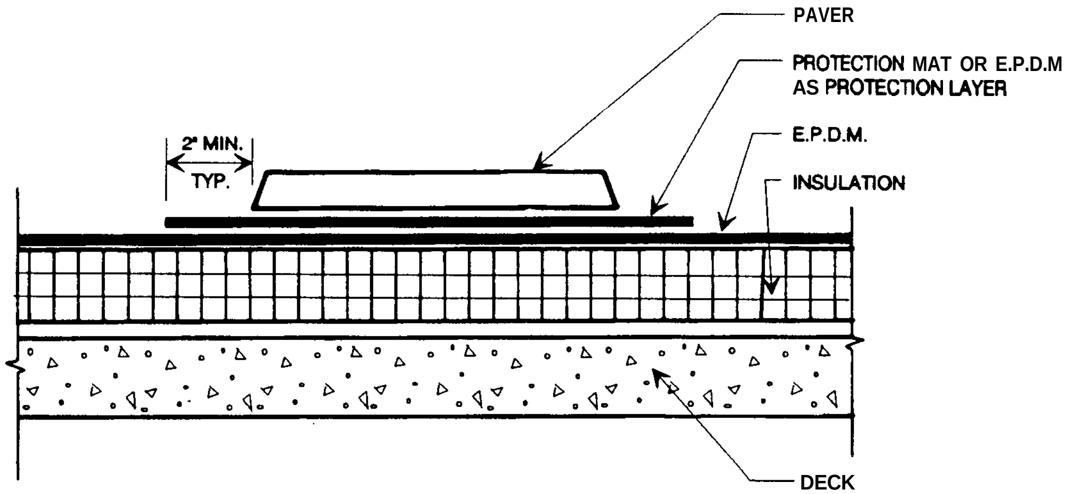
SYSTEM ASSEMBLY DETAILS-ROOFING	CURB FLASHING-HVAC UNIT		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-10



NOTES:

1. IF SEAMS RUN WITHIN 18" OF DRAIN, INSTALL MIN. 4' X 4' E.P.D.M. PATCH ON TOP OF ROOF MEMBRANE, ASSURING SEAM IS COVERED. AS AN ALTERNATE, FLASH IN THE SEAM WITH 6" FORMFLASH A MIN. OF 3" ONTO HORIZONTAL ROOF SURFACE.

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF DRAIN		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-11



PAVER WALKWAY

SYSTEM ASSEMBLY DETAILS-ROOFING	PAVER WALKWAY PROTECTION		
SINGLE-PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. A0502-12

DEFICIENCY FACTORS
0.05.02 SINGLE-PLY MEMBRANE (CSI 07530)

PROBABLE FAILURE POINTS

- improper roof slope causing ponding (minimum slope 1/8 inch per foot but recommend 1/4 inch per foot or greater).
- Membrane surface splitting or blistering.
- Membrane seam separation allowing water penetration.
- Membrane surface deterioration surface from prolonged exposure to ultraviolet light.
- Membrane punctures due to roof traffic or penetrations from sharp objects (eg. tools).
- Ballast loss usually from wind scour exposing membrane or insulation in IRMA systems. Exposed insulation in IRMA systems can result in insulation loss or deterioration.
- Fasteners or adhesive failure resulting in membrane slippage or ballooning from wind pressures.
- Seam failure due to lack of proper construction techniques (eg., electric-welder heat not in desired range, inadequate glue application, fishmouths).
- Membrane degradation due to spillage or accumulation of chemicals on the membrane (eg., oil leak from mechanical equipment, exhaust containing harmful chemicals settling on the membrane from a nearby exhaust vent).
- Flashing failures due to improper construction methods.

SYSTEM ASSEMBLIES/DEFICIENCIES

Membrane

Exposed Membrane & Damaged Areas:	Ballast loss from traffic or wind action that exposes membrane or insulation in IRMA systems and causing membrane deterioration or movement.
Membrane Splitting:	Surface cracking or splitting that allows water penetration. Caused by ultraviolet light or deck movement.
Large Blisters or Buckles:	Puckered or loose membrane areas caused by failure of adhesive, insulation deterioration, or deck movement.
Fishmouths/Loose Seams:	Seam openings caused by adhesive failure that allows water penetration.
Punctures/Holes:	Membrane tears, punctures, or holes caused by traffic and/or impact with sharp objects.
Ponding:	Standing water in low spots caused by improper slopes, insulation deterioration, or deck sagging.

Flashing

Failed Fasteners:	Loose, missing, and broken fasteners caused by corrosion, impact damage, weathering, or deck movement.
Damaged Base, Valley & CounterFlashing:	Bent, torn, punctured, or loose flashing.
Broken Vertical Laps/Seams:	Separating, breaking, or opening vertical seams.

DEFICIENCY FACTORS
0.05.02 SINGLE-PLY MEMBRANE (CSI 07530)

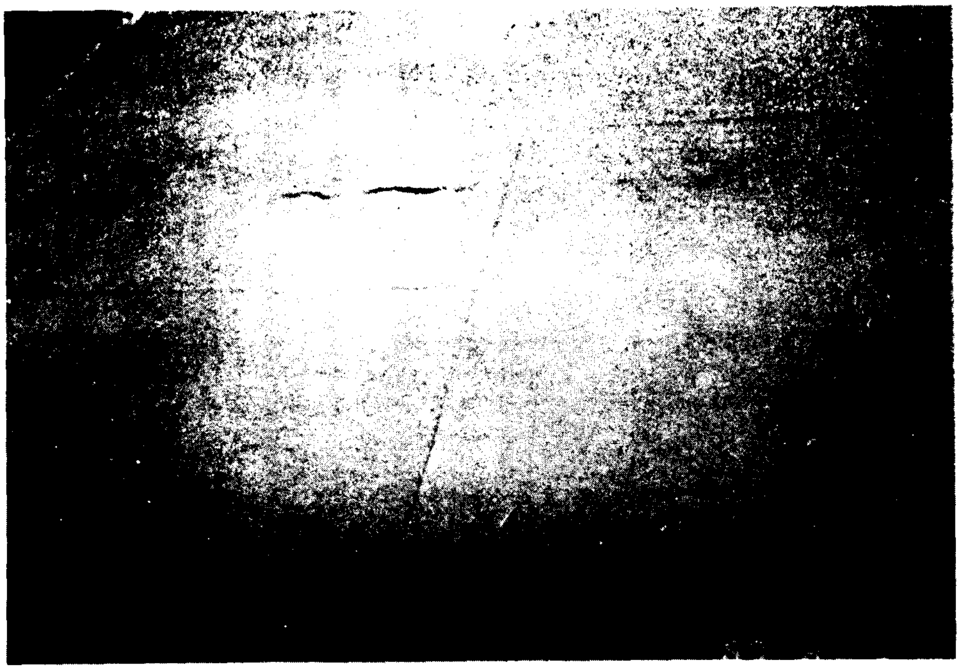
SYSTEM ASSEMBLIES/DEFICIENCIES

Flashing (Continued)

Deteriorated Material:	Eroded and/or weathered flashing exhibiting corrosion at surfaces, holes, etc.
Missing Sections:	Missing cap flashing exposing base flashing.

Insulation

Exposed Damaged Insulation:	Rapid deterioration caused by insulation exposed to direct sunlight and inclement weather conditions.
Missing Insulation:	Caused by wind or other external adverse conditions.
Wet Insulation:	Membrane failure that allows water penetration into Roof Assembly to saturate insulation.

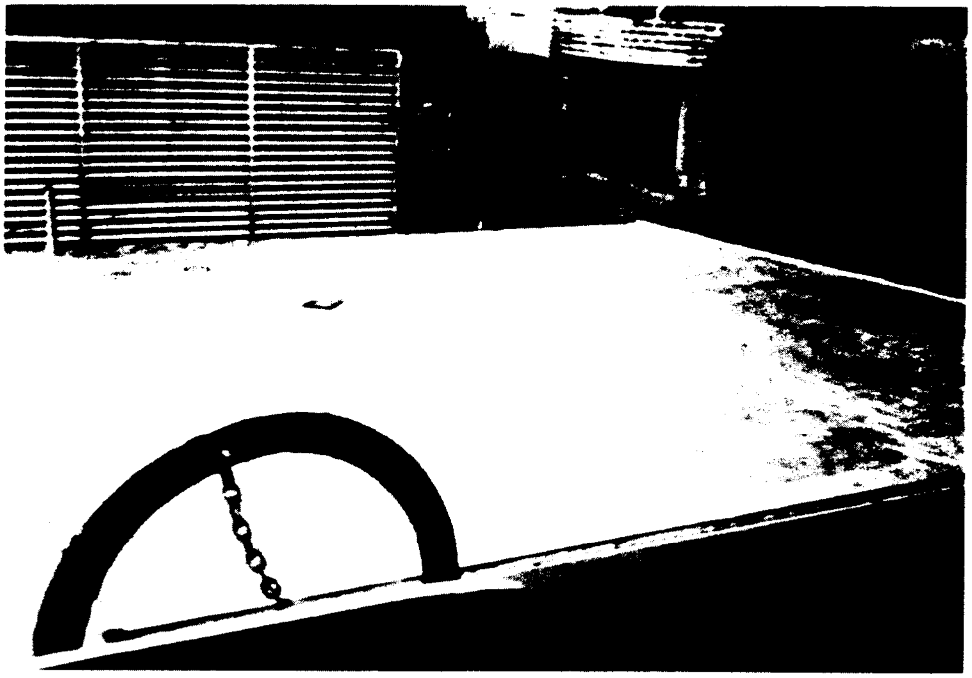


MEMBRANE CRACKS

MEMBRANE DELAMINATION

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	DELAMINATION, SEPARATION		
SINGLE PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. D0502-1



MEMBRANE DELAMINATION

MEMBRANE SEPARATION

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	DELAMINATION, SEPARATION		
SINGLE PLY MEMBRANE (CSI 07530)	Revision No.	Issue Date 5/93	Drawing No. D0502-2

DEFICIENCY FACTORS
0.05.02 SINGLE-PLY MEMBRANE (CSI 07530)

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DEFICIENCY FACTORS
0.05.02 SINGLE-PLY MEMBRANE (CSI 07530)

END OF SUBSECTION

0.05.04 COATED FOAM MEMBRANE (CSI 07545)

DESCRIPTION

This narrative and the following details describe coated foam membrane. It forms a rigid, homogeneous "single ply membrane," which is then topped with a coating to protect it from ultraviolet light, moisture, and impact or traffic damage. 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

Polyurethane Foam (PUF) is a sprayed-in-place system applied with a special spray gun that mixes the "Part A" and "Part B" components and deposits the foaming mixture onto the roof surface. When properly applied, PUF forms a rigid, homogeneous "single-ply," which is then topped with a coating to protect the thick "membrane" from ultraviolet light, moisture, and impact or traffic damage.

Coating Quantity Required

Surface Texture Description	Surface Characteristics	Additional Material Percentage (AMP)*
"Smooth"	Shows spray undulation, but no pronounced nodules or valleys.	0.05
"Orange Peel"	Shows a fine texture, similar to that of an orange peel.	0.10
"Verge of Popcorn"	The roughest acceptable texture suitable for receiving coating. Nodules are larger than valleys; valleys are curved, not sharp.	0.50
"Popcorn"	Large nodules on surface; valleys form sharp angles. Unacceptable surface for coating.	N/A
"Treebark"	Large nodules and ridges; valleys form sharp angles. Unacceptable for coating.	N/A

Metal Deck (CSI 05310)

Metal roof decking is required to be a minimum 22-gauge with minimum spans recommended by Factory Mutual, Underwriters Laboratories, and the requirements of the local building code. Depth and configuration is dependent on the structural requirements of the roof. Maximum deck deflection should be limited to the following values:

Span	Deflection
4 feet	0.20 inch
5 feet	0.25 inch
6 feet	0.30 inch

*NOTE: Additional material (measured as a total percentage of the PUF membrane) is required to create the proper substrate to receive protective coating.

0.05.04 COATED FOAM MEMBRANE (CSI 07545)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

Flashing (CSI 07620)

Roof flashing may include curb flashing, base flashing, counterflashing, and foam stops

Gypsum or Wood Underlayment (CSI 06125 or 09250)

Underlayment is used to cover the metal deck flutes to allow for a smooth base for applying the coated foam membrane. Flutes can also be filled.

Protective Coating (CSI 07540)

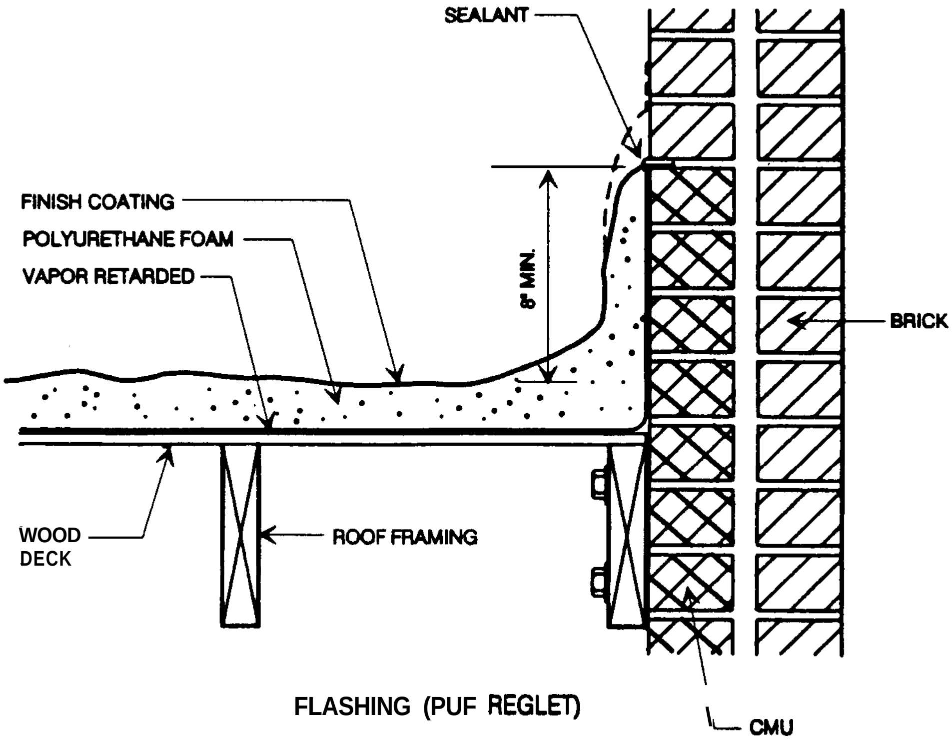
The elastomeric coatings used on coated foamed membrane systems serve to protect the polyurethane from UV (ultra violet rays) degradation. It is imperative that the coating be applied on the same day as the member, or at least within 24 hours. Severe degradation may occur if moisture enters the membrane before the coating is applied. If the membrane attains a tan or cream colored dusted surface, it may have undergone excessive degradation, and it may be too late to obtain protection with an application of coating.

Expansion & Control Joints (CSI 07710)

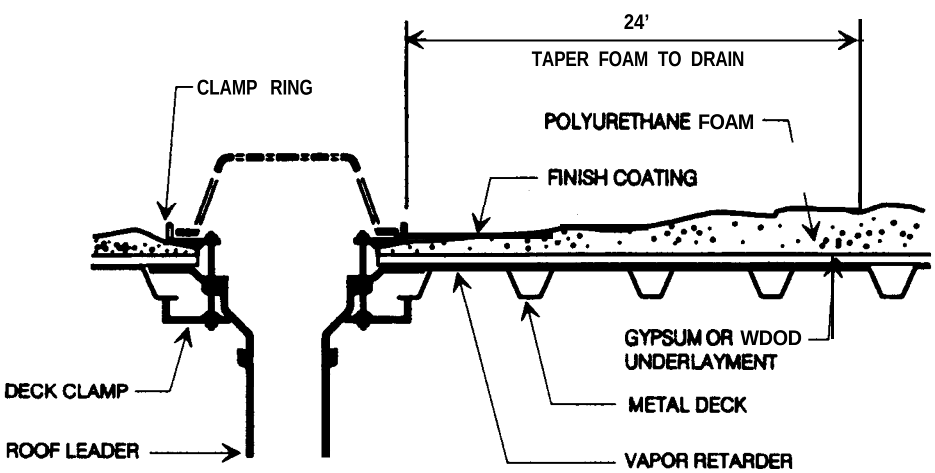
Foam, with its high coefficient of thermal expansion, may require more expansion or control joints according to the installation guide of the membrane manufacturer. These joints should be placed in both directions at all re-entrant corners to form rectangular "pours."

OTHER RELATED COMPONENTS

See the following subsections for related components:

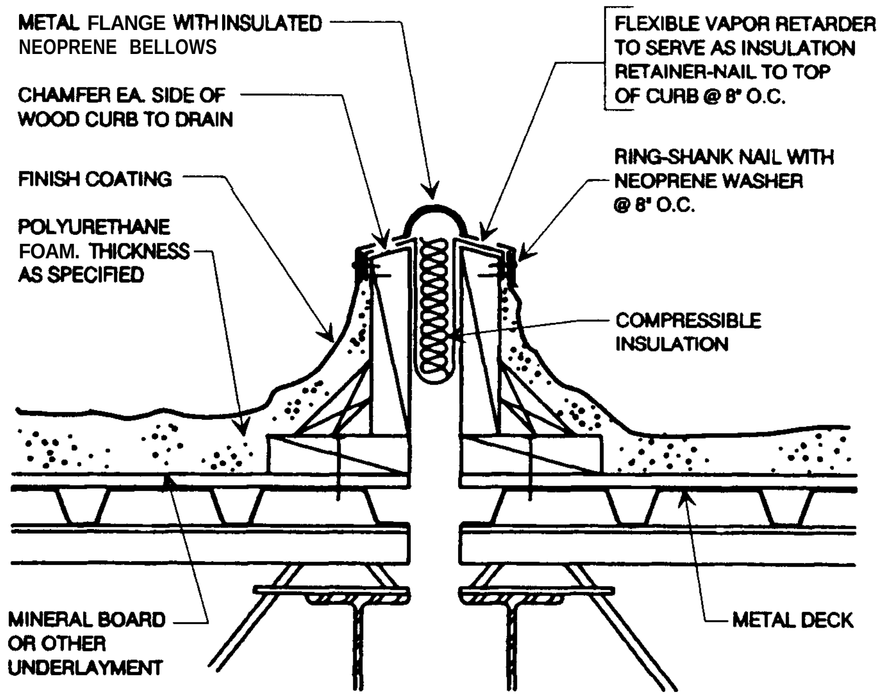


FLASHING (PUF REGLET)

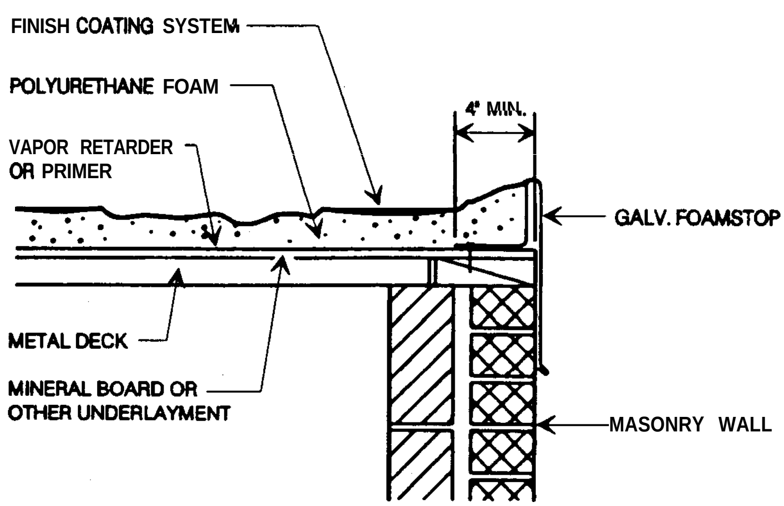


PUF ROOF DRAIN

SYSTEM ASSEMBLY DETAILS-ROOFING	PARAPET FLASHING/ROOF DRAIN		
COATED FOAM MEMBRANE (CSI 07545)	Revision No.	Issue Date 5/93	Drawing No. A0504-1

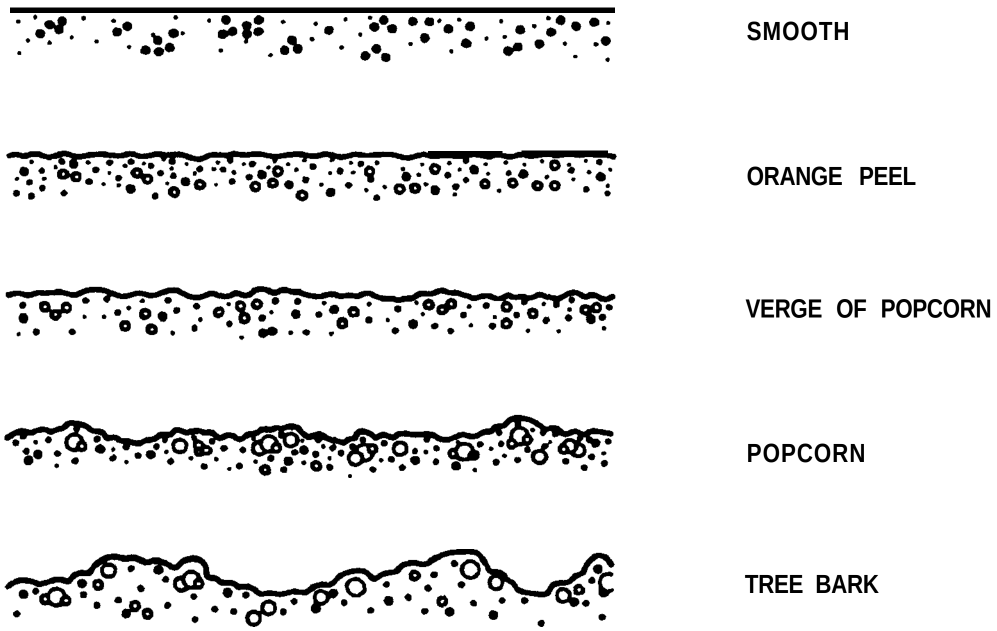


PUF EXPANSION JOINT



PUF EAVE FLASHING

SYSTEM ASSEMBLY DETAILS-ROOFING	EXPANSION JOINT/EAVE FLASHING		
COATED FOAM MEMBRANE (CSI 07545)	Revision No.	Issue Date 5/93	Drawing No. A0504-2



ROOF SURFACE TEXTURES

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF SURFACE TEXTURES		
COATED FOAM MEMBRANE (CSI 07545)	Revision No.	Issue Date 5/93	Drawing No. A0504-3

DEFICIENCY FACTORS
0.05.04 COATED FOAM MEMBRANE (CSI 07545)

PROBABLE FAILURE POINTS

- Improper adhesion to the substrate and delamination.
- Surface deterioration and degradation due to ultraviolet rays.
- Roof deck deflection or membrane shrinkage resulting in cracks and delamination.
- Water contamination resulting in improper mixture.
- Uneven membrane application resulting in ponding.
- Holes or punctures caused by traffic and equipment movement over roof, objects striking the surface, or birds or insects burrowing into the surface.
- Uneven application due to shape/configuration of roof. This occurs at valleys especially.

SYSTEM ASSEMBLIES/DEFICIENCIES

Membrane

Surface Punctures or Holes:	Breaks in the membrane surface from roof traffic, impacts from falling objects, or burrowing insects and birds.
Surface Cracks or Splitting:	Surface cracking or splitting due to roof deck deflection or membrane shrinkage that result in leaks.
Surface Deterioration:	Surface deterioration or degradation from ultraviolet rays.
Sponginess:	Membrane deterioration that results in water penetration and membrane breakdown.
Standing Water:	Water ponding in roof depressions due to improper membrane application or membrane deterioration.

Flashing

Damaged Base, CounterFlashing, & Foam Stops:	Missing cap flashing that exposes base flashing.
Deteriorated:	Eroded or weathered flashing that exhibits surface corrosion, holes, etc.

DEFICIENCY FACTORS
0.05.04 COATED FOAM MEMBRANE **(CSI 07545)**

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MEMBRANE DETERIORATING

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	DETERIORATION		
COATED FOAM MEMBRANE (CSI 07545)	Revision No.	Issue Date 5/93	Drawing No. D0504-1

NON-UNIFORM APPLICATION, THICKNESS AND DETERIORATION

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	IMPROPER THICKNESS AND DETERIORATION		
COATED FOAM MEMBRANE (CSI 07545)	Revision No.	Issue Date 5/93	Drawing No. D0504-2

DEFICIENCY FACTORS
0.05.04 COATED FOAM MEMBRANE (CSI 07545)

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DEFICIENCY FACTORS
0.05.04 COATED FOAM MEMBRANE (CSI 07545)

END OF SUBSECTION

0.0505 SHINGLES (CSI 07310)

DESCRIPTION

This narrative and the following details describe shingles. Shingles are normally applied on felt paper over sheathing. Shingles are a roof-covering unit made of asphalt, wood, slate, asbestos, cement, or other material cut into stock sizes and applied on sloping roofs in an overlapping pattern. 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

Shingles (CSI 07310)

Shingle materials include asphalt, fiberglass, mineral fiber cement, slate, wood, and wood shakes. Configuration and style vary between materials; thickness and size depend on the type used.

Felt/Building Paper (CSI 07520)

A fabric of matted compressed fibers, usually manufactured from wood, paper, rags, or glass fibers. A layer of roofing felt is required to prevent wind-driven snow or foreign matter from entering the building. Felt baffle omission is the most common error in applying shingles and causes premature roof failures.

To be effective, the top of the felt baffle must rest on the sheathing. When using spaced sheathing, nails should be driven through the upper portion of the sheathing with the felt baffle attached to the lower portion. A minimum 30-lb. roof felt should be applied to the underlayment or roof deck.

Fasteners & Mechanical Attachments (CSI 07700)

Any mechanical device used to hold together two or more pieces, parts, members, etc. All nails or anchors should be non-corrosive.

Flashings (CSI 07600)

Flashings should be made of non-corrosive metal, such as copper or stainless steel, and should conform to the standard details shown in the NRCA manual. Step flashing at walls and should be carefully installed by an experienced mechanic. The first leakage usually occurs at the step flashing.

Roof Deck (CSI 07600)

Roof finish materials may vary and include plywood roof sheathing, wood plank, and tongue and groove wood roof deck. Expansion should be provided in roof sheathing, and all sheets should be exterior grade of adequate thickness to satisfy nailing and span requirements.

Ventilation (CSI 07720)

Inadequate ventilation can cause early roof failures due to excessive heat and/or moisture buildup, whether wood or asphalt shingles are used. This is a common installation problem. Vents should be as close to the ridge as possible or along the ridge itself. An equal opening area should be provided in the ridge and soffits to allow proper ventilation.

0.05.05 SHINGLES (CSI 07310)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

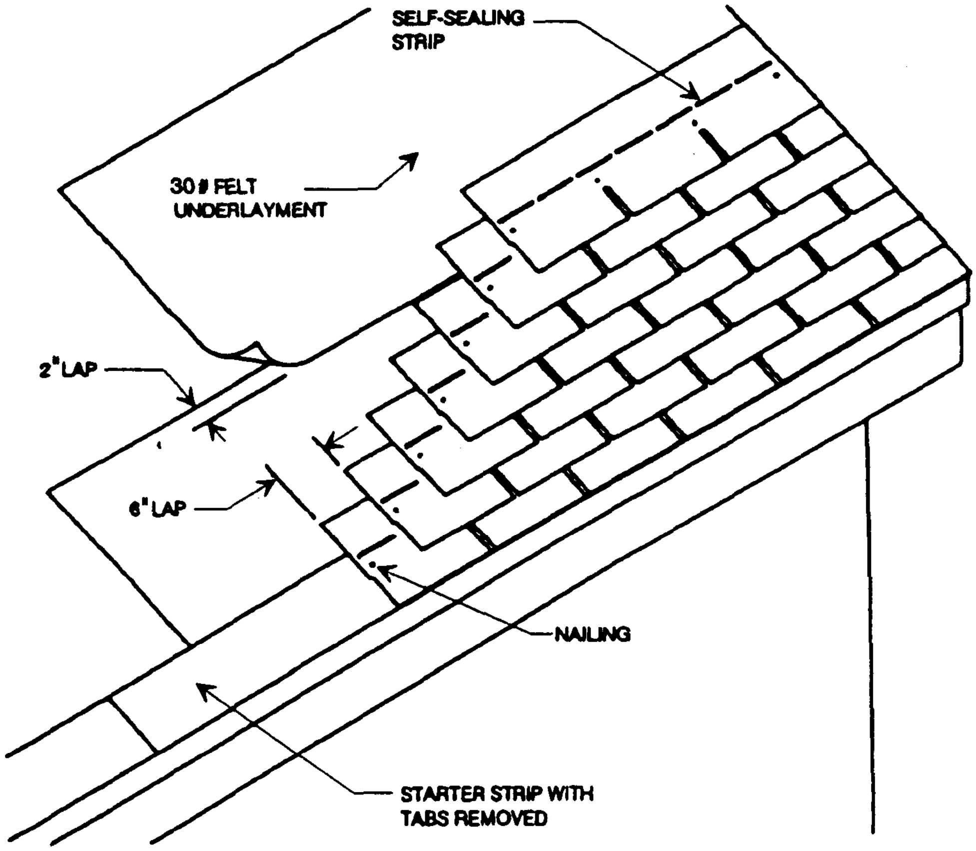
Roof Deck Insulation (CSI 07220)

Glass Fiber Batt Insulation is usually installed beneath the roof deck material between the structural members. If rigid insulation is used and placed on the exterior of the roof deck, all shingles or shakes should be securely anchored to the roof deck with wood sleepers and anchors. Composite board, polyurethane foam board, and polyisocyanurate foam board require protection or a vented base sheet. Thickness varies as required by thermal resistance needed. Insulation must have sufficient strength to span the flutes of metal decking and must have adequate strength to support the applied design load.

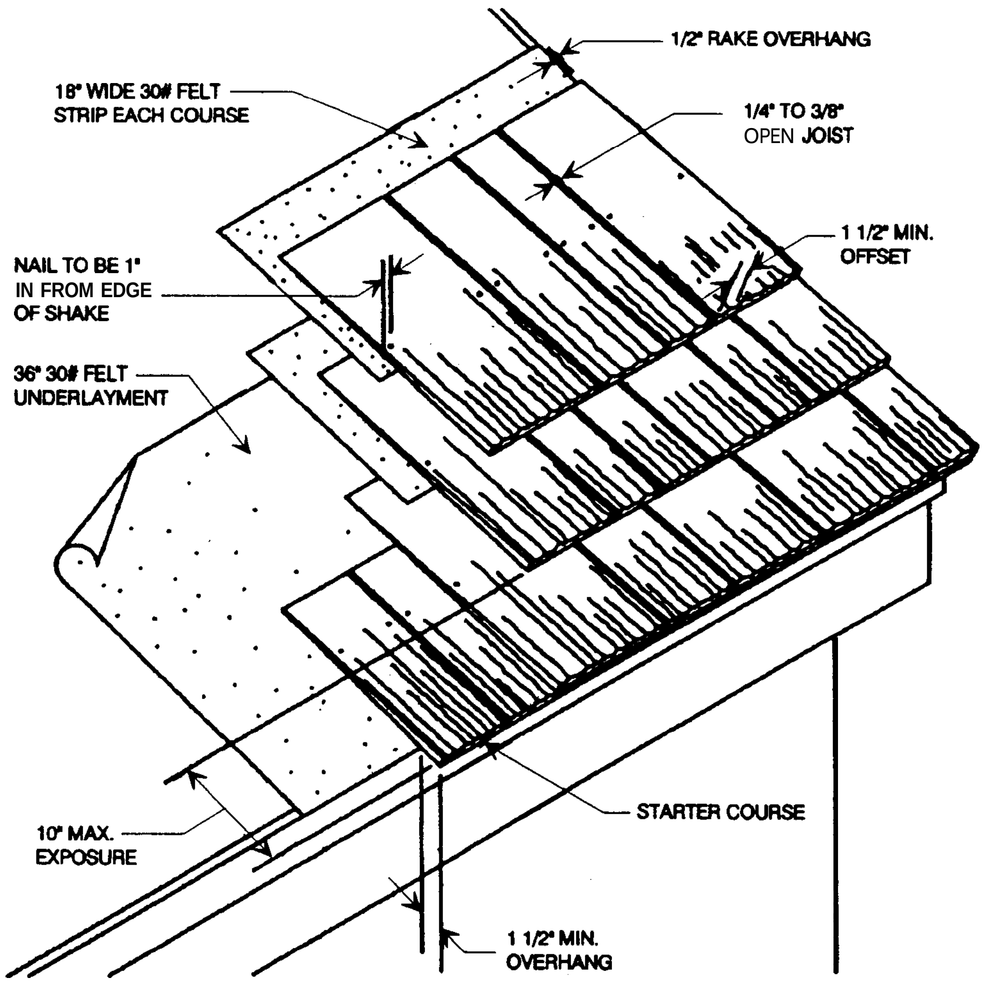
OTHER RELATED COMPONENTS

See the following subsections for related components:

0.05.09 Roof Specialties 2.9-1
0.05.10 Skylights 2.10-1



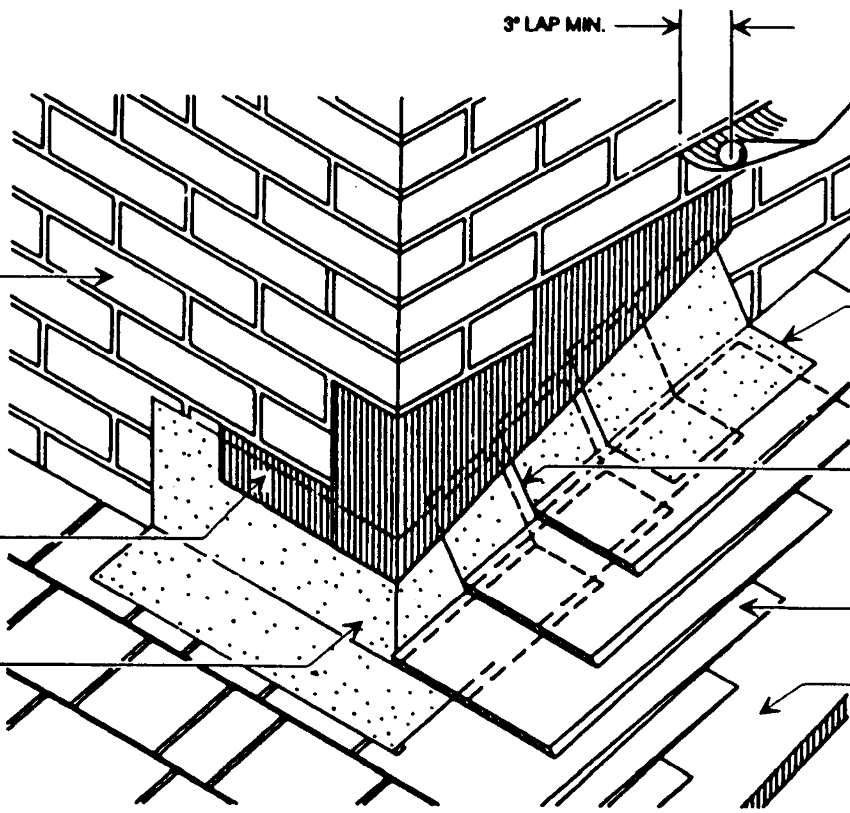
SYSTEM ASSEMBLY DETAILS-ROOFING	COMPOSITE SHINGLE ROOF SYSTEM		
SHINGLES (CSI 07310)	Revision No.	Issue Date 5/93	Drawing No. A0505-1



WOOD SHAKE ROOF SYSTEM

SOURCE: MEANS ROOFING DESIGN CRITERIA, OPTIONS, SELECTION. "R.S. Means Co., Inc., Kingston, Massachusetts"

SYSTEM ASSEMBLY DETAILS-ROOFING	WOOD SHAKE ROOF SYSTEM		
SHINGLES (CSI 07310)	Revision No.	Issue Date 5/93	Drawing No. A0505-2



SOURCE: MEANS ROOFING DESIGN CRITERIA, OPTIONS, SELECTION, "R.S. Means Co., Inc., Kingston, Massachusetts"

SYSTEM ASSEMBLY DETAILS-ROOFING	**COMPOSITE/WOOD SHINGLE** FLASHING AT CHIMNEY OR PENETRATION		
SHINGLES (CSI 07310)	**Revision** No.	**Issue** Date 5/93	Drawing No. A0505-3

DEFICIENCY FACTORS
0.05.05 SHINGLES (CSI 07310)

PROBABLE FAILURE POINTS

- No definite periods can be ascribed to various weathering phases: they will vary with the direction of exposure, climate, and roof slope. Weathering is more rapid in hot, humid climates, on southern and western exposure, and on low pitched roofs.
- Improper nail placement, nailing too near the top of the shingles, rather than 1/2 to 3/4 inch above a line drawn through the top of the cut-out portions. No attempts should be made to re-nail shingles in the proper location because the bending required may damage the shingle tabs.
- Felt underlayment disintegration.
- Improper roof slope that causes premature wood shingle or shake deterioration (minimum slope 4 to 12).
- The lack of or improper placement of felt baffle with wood shakes allowing wind-driven moisture to penetrate roof surface.
- Severe hail storms that damage shingle roof beyond repair, particularly when exposed for a number of years.

SYSTEM ASSEMBLIES/DEFICIENCIES

Material

Damaged or Missing Shingles or Shakes:	Broken, cracked, split, or missing shingles/shakes that expose felt and/or roof underlayment.
Worn-out/Eroded:	Excessive weathering that causes changes in color, textures, strength, chemical composition, or other properties.
Splitting or Wood Rot:	Surface cracking and splitting of wood shingles and shakes, or rot causing rapid material deterioration.
Failed Fasteners:	Corroded or missing fasteners such as nails.

Flashing

Damaged Base, Valley, & Counterflashing:	Bent, torn, punctured, separated flashing.
Missing Cap Flashing:	Missing cap flashing that exposes base flashing.
Deteriorated:	Eroded or weathered flashing that exhibits surface corrosion, holes, etc.

Insulation

Exposed, Damaged Insulation:	Insulation exposed to direct sunlight and inclement weather conditions. Deteriorates rapidly.
Missing Insulation:	Caused by wind or other external adverse conditions.
Wet Insulation:	Membrane failure that allows water penetration into the Roof Assembly.

DEFICIENCY FACTORS
0.05.05 SHINGLES **(CSI** 07310)

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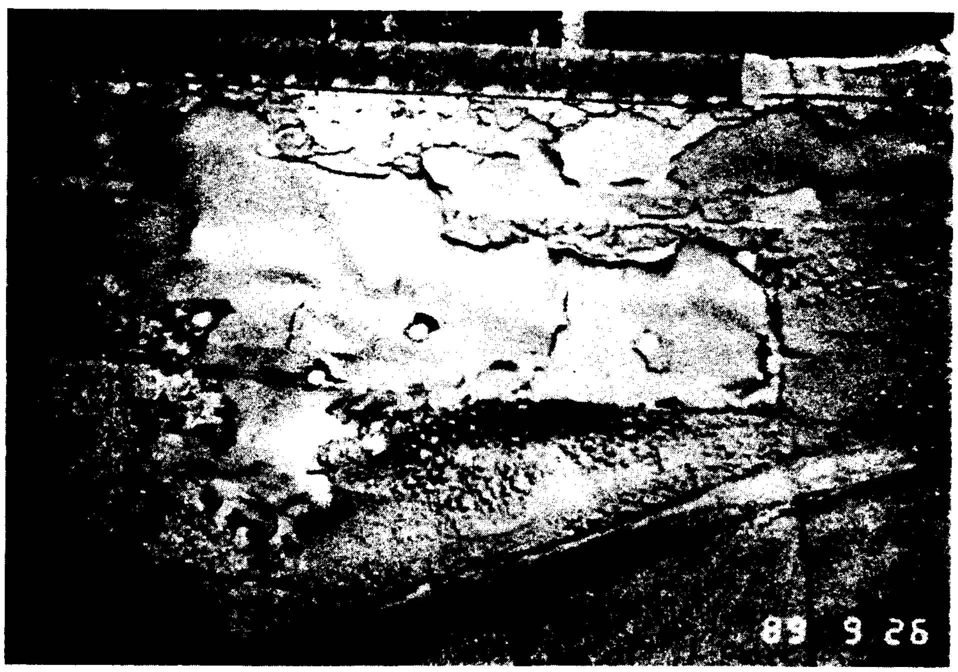
MISSING SHINGLE



BADLY DETERIORATED

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	MISSING, DETERIORATED		
SHINGLES (CSI 07310)	**Revision** No.	**Issue** Date 5/93	**Drawing** No. D0505-1

DEFICIENCY FACTORS
0.05.05 SHINGLES (CSI 07310)

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DEFICIENCY FACTORS
0.05.05 SHINGLES (CSI 07310)

END OF SUBSECTION

0.05.06 TILES (CSI 07320)

DESCRIPTION

Tiles are classified as watershed materials, which means they are designed to direct water by means of sloping (pitch) the roof surface. Such tile systems, therefore, cannot retain water. Roof pitch minimum of 4 in 12 or greater is usually standard. However, flat tiles should be installed on a minimum of 5 in 12 slopes. 3 in 12 to 4 in 12 may be used under the following conditions: two layers of 30 lb. felt set in hot asphalt or mastic is provided and tiles are set in mortar. Tile materials include, clay, concrete, metal, mineral fiber cement, and plastic. It should be noted that clay and concrete roofing tiles require stronger roof deck and support structure due to the added weight per square foot of this material. 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

Roof Tiler (CSI 07320)

Materials include clay, metal, plastic, concrete, and mineral fiber cement. Configurations and style vary from roll tile, which consists of Spanish, Mission, Scandia; flat tile consisting of Norman, Classic Interlocking, Flat Concrete, and Ridge tiles consisting of open-end, closed-end, "V"-Type, special shape tiles, slate, and imitation tile (eg., concrete resembling slate). Thickness and size depends on type and style.

Felt/Building Paper (CSI 075200)

A fabric of matted compressed fibers, usually manufactured from wood, paper, rags, or glass fibers. Used as lining and/or vapor barrier between sheathing, outside roof coverings, or as a lining between rough and finish material. A minimum 30 lb. roofing felt should be applied to the underlayment. Because the underlayment is a waterproofing course, 43 lb. is the best base sheet for this purpose. The tile will last over a hundred years, but the felt will not.

Fasteners & Mechanical Attachments (CSI 07700)

Any mechanical device used to hold together two or more pieces, parts, members, etc. Nails are minimum 11 gauge non-corrosive type.

Roof Deck (CSI 06100)

Roof finish materials may vary and include plywood roof sheathing, wood plank, tongue and groove wood roof deck, concrete, and lightweight concrete. If a plywood deck is used, the sheets should be separated by at least 1/16 inch for expansion. The sheets should be exterior grade plywood of a thickness adequate to satisfy nailing and span requirements.

Roof Deck Insulation (CSI 07220)

Glass Fiber Batt Insulation is usually installed beneath the roof deck material between the structural members. If rigid insulation is used and placed on the exterior of the roof deck, tile should be anchored to wood strips securely attached to the roof deck. Composite board, polyurethane foam board, and polyisocyanurate foam board require protection or a vented base sheet. Thickness varies as required by thermal resistance needed. Insulation must have sufficient strength to span the flutes of metal decking and must have adequate strength to support the applied design load.

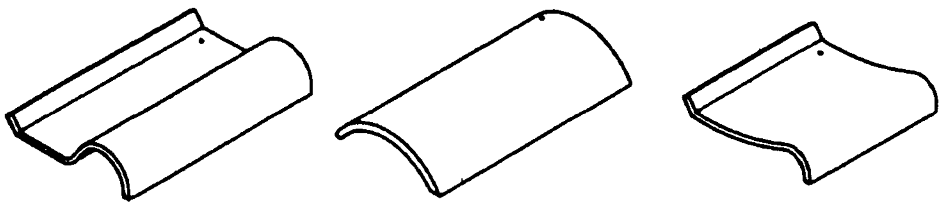
Flashing (CSI 07600)

Roof flashing may include curb flashing, base and counter flashing, valley flashing, or expansion flashing (joints, etc.). Material varies and may include copper, aluminum, galvanized steel, membrane, etc., left natural, painted, or coated with asphalt.

0.05.06 TILES (CSI 07320)

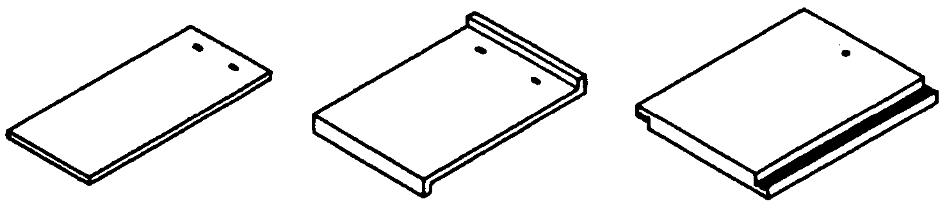
OTHER RELATED COMPONENTS

See the following subsections for related components:



SPANISH MISSION SCANDIA

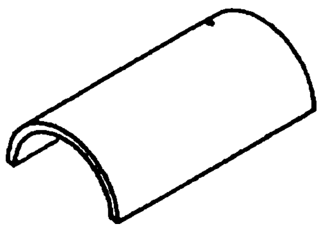
ROLL TILE



NORMAN CLASSIC INTERLOCKING FIAT CONCRETE

FIAT TILE

SYSTEM ASSEMBLY DETAILS-ROOFING	TILE CONFIGURATIONS		
TILES (CSI 07320)	Revision No.	Issue Date 5/93	Drawing No. A0506-1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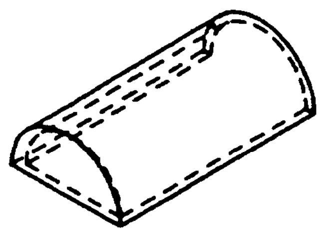
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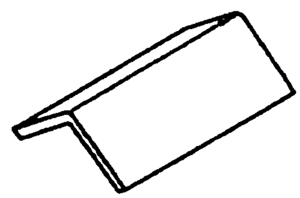
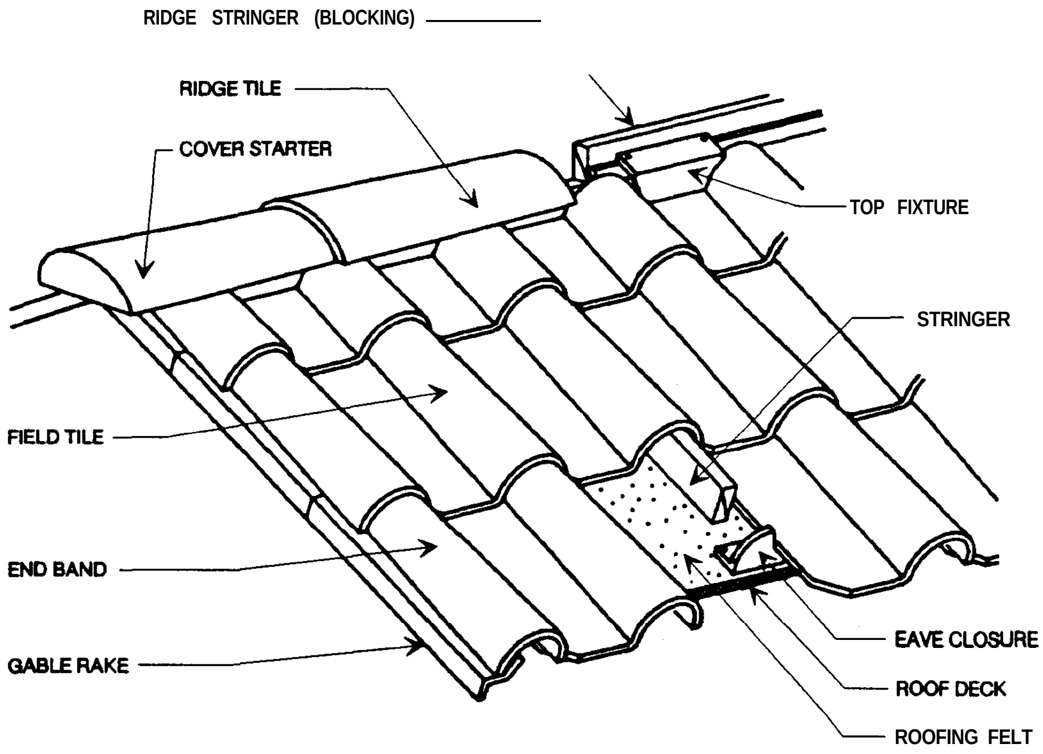

"V" TYPE

RIDGE TILES

SYSTEM ASSEMBLY DETAILS-ROOFING	TILE CONFIGURATIONS		
TILES (CSI 07320)	Revision No.	Issue Date 5/93	Drawing No. A0506-2



CLAY TILE APPLICATION

SOURCE: MEANS ROOFING DESIGN CRITERIA, OPTIONS, SELECTION, "R.S. Means Co., Inc., Kingston, Massachusetts"

SYSTEM ASSEMBLY DETAILS-ROOFING	TILE CONFIGURATIONS		
TILES (CSI 07320)	Revision No.	Issue Date 5/93	Drawing No. A0506-3

DEFICIENCY FACTORS
0.05.06 TILES (CSI 07320)

PROBABLE FAILURE POINTS

- Fastener failure and the mechanical damage that result from hail, traffic, contact with tree limbs, and roof deck warping.
- Felt underlayment disintegration.
- Too few expansion joints between the tile or expansion joints becoming filled with non-resilient material.
- Improper roof slope that caused premature tile deterioration (minimum slope 4 to 12; 5 to 12 for flat tiles).
- Lack of ice shield in severe climates (January mean temperature 30°F or less).
- Lack of closure strip at eaves for first tile course
- Improper fastener method in high wind areas: hurricane clips should be used

SYSTEM ASSEMBLIES/DEFICIENCIES

Material

Weathering:	Changes in color, textures, strength, chemical composition, or other properties of a natural (slate) or artificial (concrete) material due to age and weathering.
Spalling:	Flaking, scaling tile caused by aging, weathering, (freeze/thaw) and/or defective material.
Damaged or Missing Tile:	Broken, cracked, or missing tile that exposes felt and/or roof underlayment.
Failed Fasteners:	Broken, cracked, corroded, rusted, loose, or missing fasteners or anchors.

Flashing

Damaged Base, Valley, & Counterflashing:	Bent, torn, punctured, separated flashing.
Missing Cap Flashing:	Missing cap flashing that exposes base flashing.
Deteriorated Material:	Eroded and/or weathered flashing that exhibits surface corrosion, holes, etc.

Insulation

Exposed, Damaged Insulation:	Rapid insulation deterioration caused by exposure to direct sunlight and inclement weather conditions.
Missing Insulation:	Caused by wind or other external adverse conditions.
Wet Insulation:	Material or tile failure that allows water penetration into the Roof Assembly.

DEFICIENCY FACTORS
0.05.06 TILES **(CSI 07320)**

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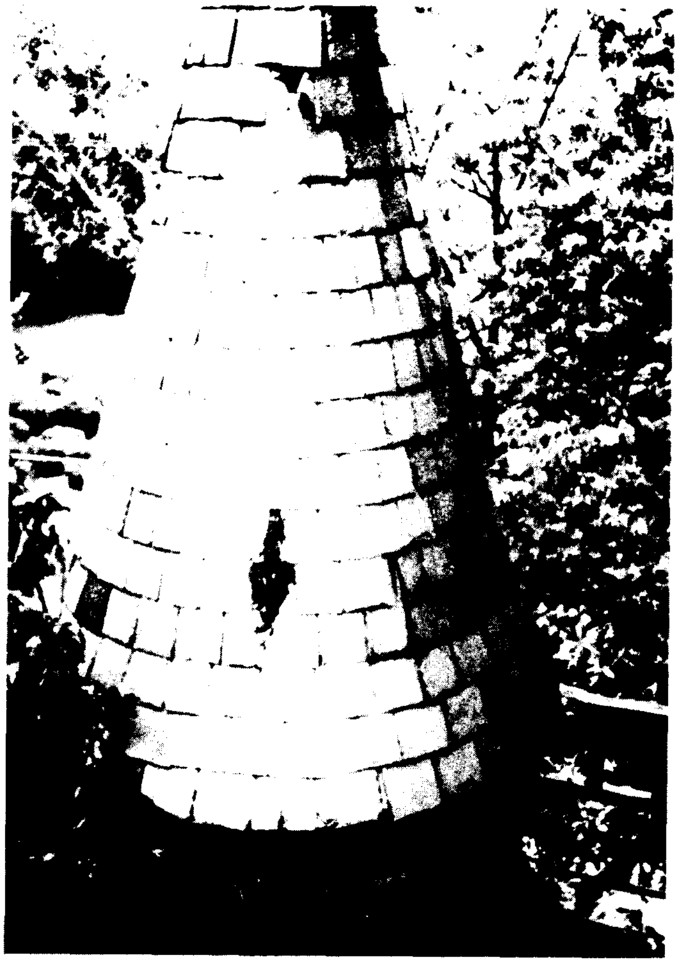
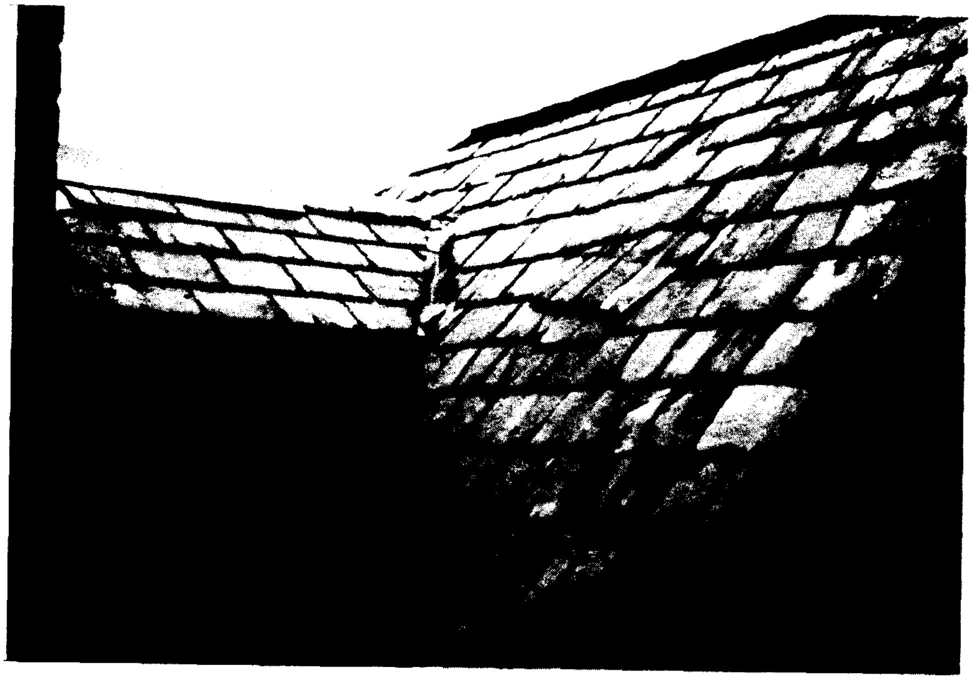


MISSING TILE

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	MISSING TILE		
TILES (CSI 07320)	Revision No.	Issue Date 5/93	Drawing No. D0506-1



MISSING TILE AND WORN SURFACES

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	MISSING TILE		
TILES (CSI 07320)	Revision No.	Issue Date 5/93	Drawing No. D0506-2

DEFICIENCY FACTORS
0.05.06 TILES (CSI 07320)

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DEFICIENCY FACTORS
0.05.06 TILES (CSI 07320)

END OF SUBSECTION

0.05.07 PARAPETS (CSI 07320)

DESCRIPTION

This narrative and the following details describe parapet walls, the part of the wall that extends above the roof level. 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

Concrete (CSI 03450)

A composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregates. In Portland cement concrete, the binder is a mixture of Portland cement and water.

Concrete parapets require less frequent maintenance than most outside materials, but certain failures can occur. For example, leakage through concrete walls is caused by cracks in the concrete and in rare cases, concrete porosity. The cracks may be caused by foundation settlement, excessive floor loading, temperature expansion and contraction in structural members, or poor materials and workmanship in the original construction. Exteriors should be inspected quarterly for structural cracks, open mortar joints, settlement, efflorescence, stains, and deteriorated paint or other surface covering.

Masonry (CSI 04200)

Constructed of shaped or molded units, usually small enough to be handled by one man. Composed of stone, ceramic brick or tile, adobe, or the like.

Masonry walls crack at or near the junction of parapets and roof lines. This is perhaps the most difficult of all types of masonry cracking to eliminate is due to severe exposures to which the parapet is subjected, to its relatively light weight, to movements between parapets and building walls, and to other factors often hard to identify.

Stone (CSI 04400)

Stone parapets are composed of individual blocks of rock processed by shaping, cutting, or sizing for use in masonry work.

Stone parapets, such as granite, limestone, and marbles, require less frequent maintenance than most outside materials, but certain failures do occur (eg., open mortar joints, settlement, efflorescence, stains, and other surface coverings).

Curtain Walls (CSI 08900)

Generally defined as an exterior non-load bearing wall that may consist entirely or principally of metal or may be a combination of metal, glass, and other surfacing materials supported by or within a metal framework. Many materials such as glass, masonry, or plastic may be used for the "infilling" panels that may cover a large portion of the wall surface. These materials are carried in a metal framework to provide a nonbearing wall system.

Metal (CSI 07400)

Materials commonly used for metal parapets include aluminum-protected metal, galvanized iron and steel, metal siding, and prefabricated sheet metal. All require similar maintenance measures.

Precision shop fabrication of metal siding and new methods of fastening panels with interlocking joints and clips generally insure against misalignment in erecting metal buildings. Buildings may sag, lean, or suffer surface damage from foundation settlement, heavy wind pressures, corrosion, or impact of heavy objects (eg., vehicles).

0.05.07 PARAPETS (CSI 07320)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Metal (CSI 07400) (Continued)

Where severe wind or vibration affects siding stability, additional bracing and fasteners should be applied according to the manufacturer's recommendations.

Wood & Plastic (CSI 07400)

Exterior wall coverings are made of a wide variety of materials, including wood (shingles, weatherboard siding, plywood).

When wood and plastic are repaired, the original material specifications should be followed to match adjacent existing materials. Improved construction techniques and materials should be constantly examined to prevent or offset similar failure.

The main causes of wood exterior failures are: moisture, inferior workmanship and materials, and surface deterioration due to age.

Gravel Stop - **Fascia** (CSI 07710)

Materials vary and include galvanized steel, copper, aluminum, zinc alloy, stainless steel, etc. A gravel stop consists of a metal strip or flange around the edge of a built-up roof to prevent loose gravel or other surfacing from falling or being blown off a roof.

RECOMMENDED MINIMUM THICKNESS FOR GRAVEL STOP-FASCIA

D (MAX.) (IN.)	GAL STEEL (GAUGE)	COPPER (OZ.)	ALUMINUM (IN.)	ZINC ALLOY (IN.)	STAIN. STL. (GAUGE)
4	24	16	0.025	0.020	26
5	24	16	0.032	0.027	26
6	22	20	0.040	0.027	24
7	22	20	0.040		22
8	20	20	0.050		20

Coping (CSI 07710)

The protective top member of any vertical construction or parapet wall. Varies from concrete, brick, tile exterior insulation finish system, or metal and is usually sloping or beveled to shed water in such a way that it runs down the vertical face of the wall onto the roof. Coping often projects out from a wall with a drip edge on the underside.

RECOMMENDED MINIMUM GAUGES FOR COPING

WIDTH OF COPING TOP (IN)	GAL STEEL (GAUGE)	STAIN. STL (GAUGE)	ALUMINUM (IN.)	COPPER (OZ.)
THR. 12	24	26	0.032	16
13T0 18	22	24	0.400	20

Flashing & Cant **Strip** (CSI 07620)

Parapet flashing may include base and counterflashing, expansion flashing (joints etc.) Material varies and may include galvanized steel, copper, aluminum, zinc alloy, stainless steel, etc.

Treated Wood **Blocking** (CSI 06110)

Wood framing members anchored to parapet to attach coping or flashing with any chemical preservative, applied by washing on or pressure-impregnating. Products used include creosote, sodium fluoride, copper sulfate, and tar or pitch. Verify treatment method with owner/laboratory.

0.05.07 PARAPETS (CSI 07320)

OTHER RELATED COMPONENTS

See the following subsections for related components:

0.05.07 PARAPETS (CSI 07320)

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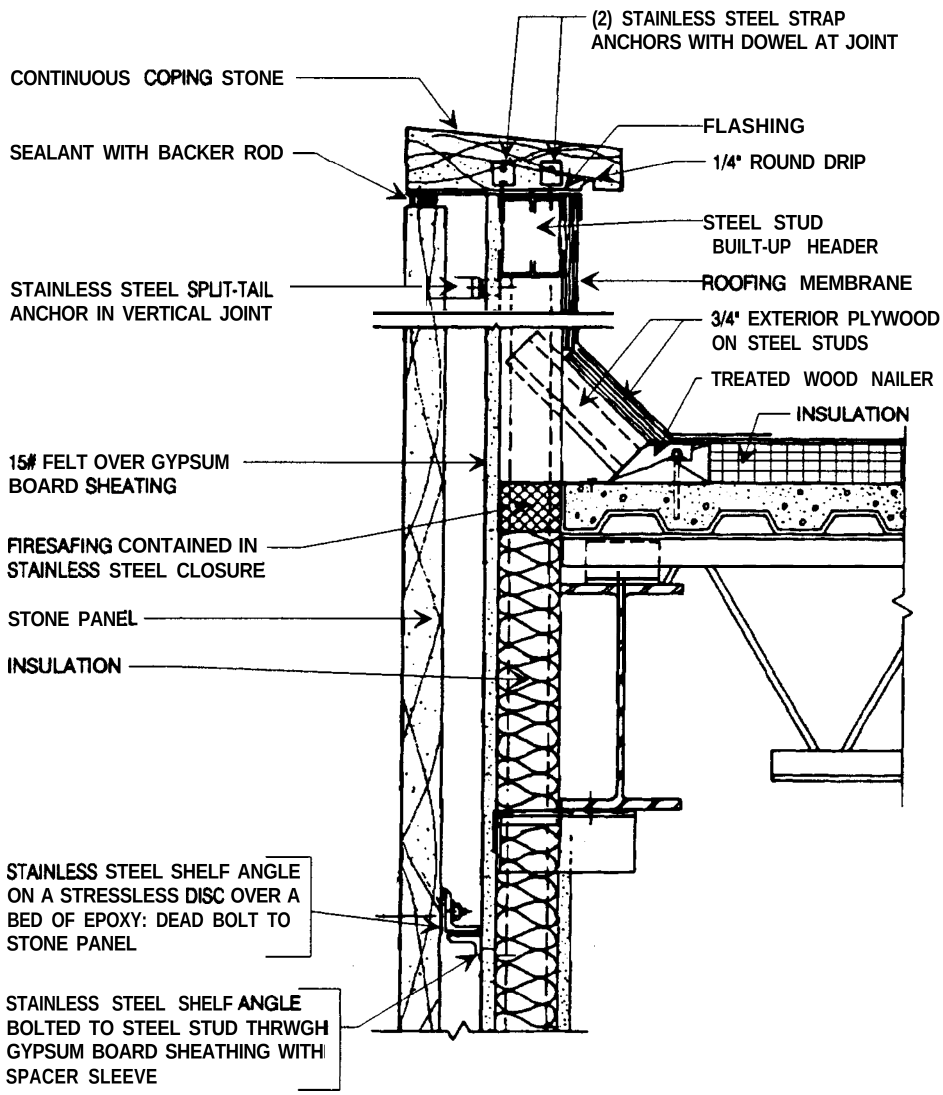
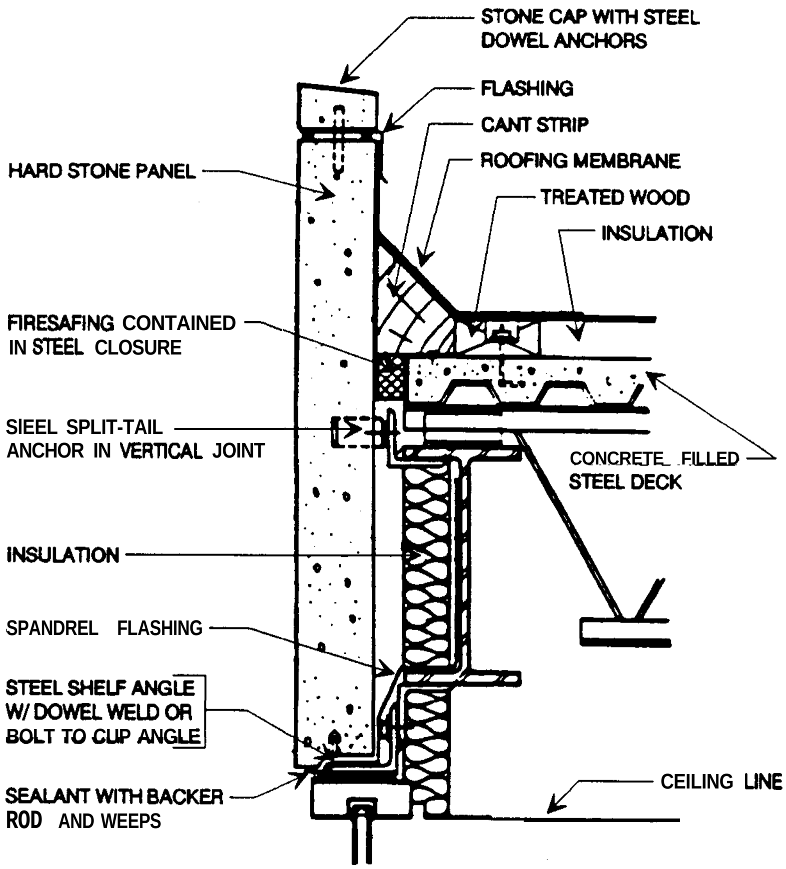


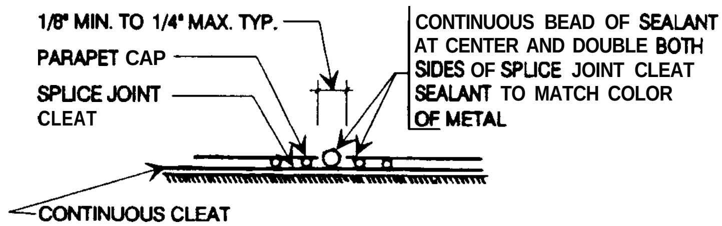
SECTION AT ROOF PARAPET

SYSTEM ASSEMBLY DETAILS-ROOFING	TYP. PARAPET WITH STONE PANEL		
PARAPETS (CSI 07310)	Revision No.	Issue Date 5/93	Drawing No. A0507-1

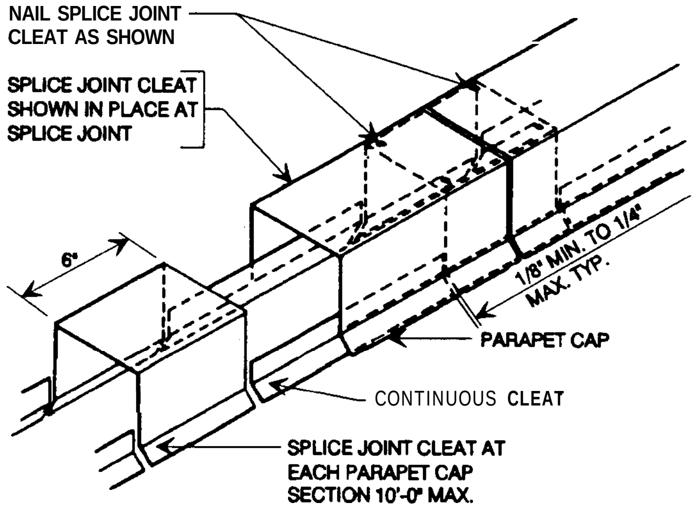


SECTION THROUGH ROOF PARAPET AT PRECAST CONCRETE PANEL

SYSTEM ASSEMBLY DETAILS-ROOFING	TYP. PARAPET WITH PRECAST CONCRETE PANEL		
PARAPETS (CSI 07710)	Revision No.	Issue Dots 5/93	Drawing No. A0507-2



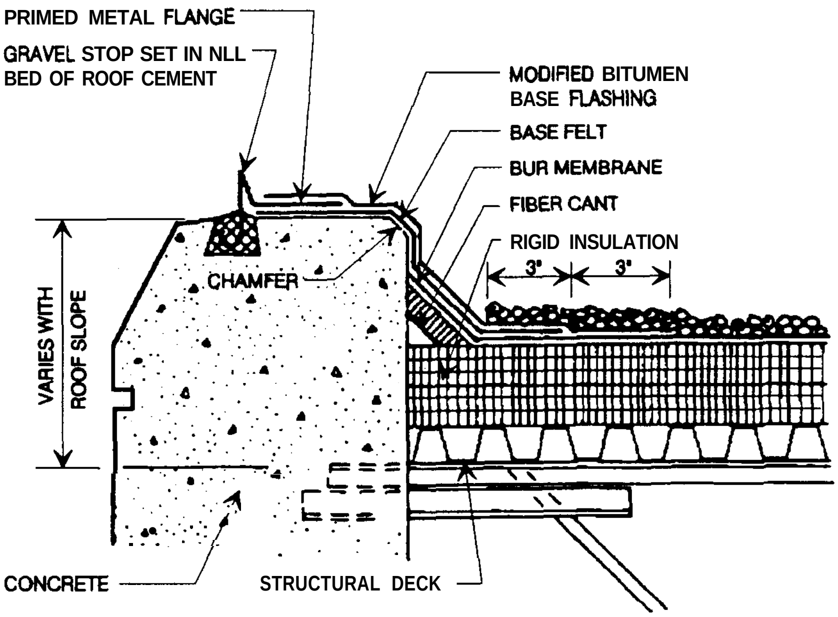
SECTION THROUGH SPLICE JOINT



PARAPET CAP SPLICE JOINT

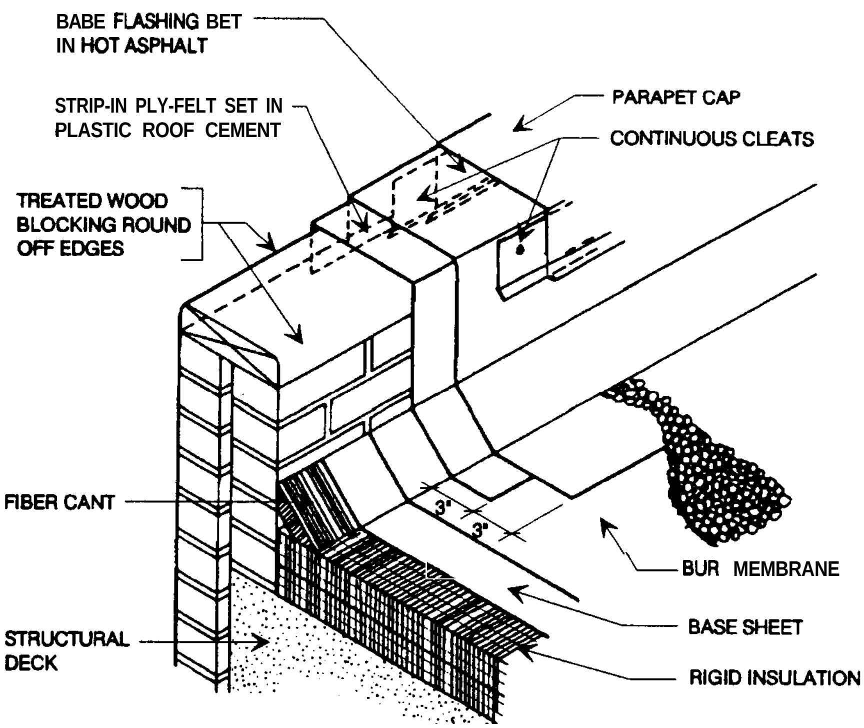
SOURCE: ARCHITECTURAL GRAPHIC STANDARDS, EIGHTH EDITION ("Reprinted by permission of the American Institute of Architects")

SYSTEM ASSEMBLY DETAILS-ROOFING	PARAPET CAP CONSTRUCTION		
PARAPETS (CSI 07710)	Revision No.	Issue Date 5/93	Drawing No. A0507-3



EDGE DETAIL

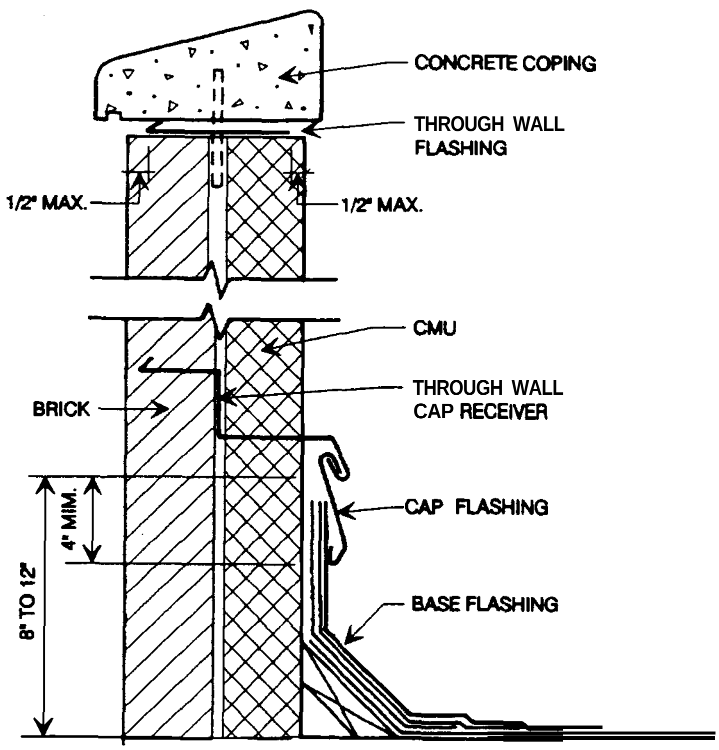
SYSTEM ASSEMBLY DETAILS-ROOFING	TYPICAL EDGE DETAIL		
PARAPETS (CSI 07710)	Revision No.	Issue Date 5/93	Drawing No. A0507-4



PARAPET EDGE DETAIL

SOURCE: ARCHITECTURAL GRAPHIC STANDARDS, EIGHTH EDITION ("Reprinted by permission of the American Institute of Architects")

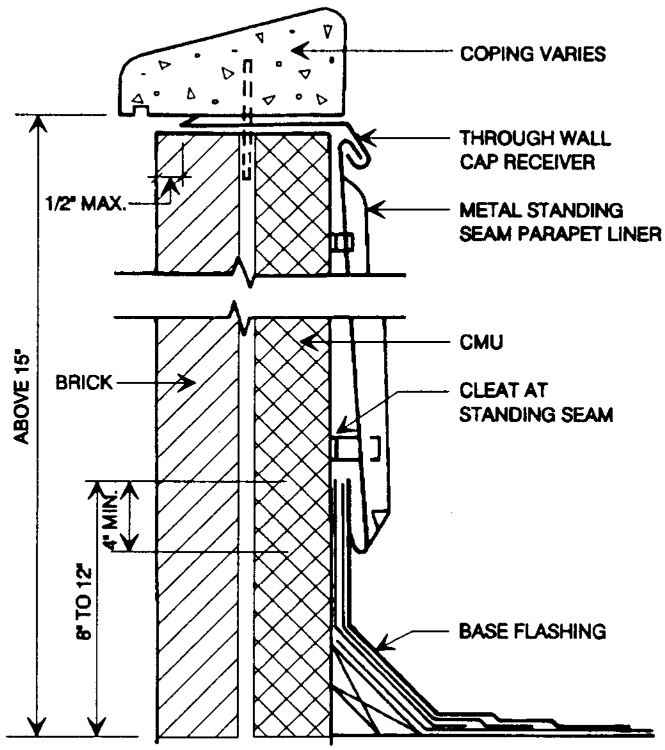
SYSTEM ASSEMBLY DETAILS-ROOFING	TYPICAL EDGE DETAIL		
PARAPETS (CSI 07710)	Revision No.	Issue Date 5/93	Drawing No. A0507-5



HIGH PARAPET FLASHING

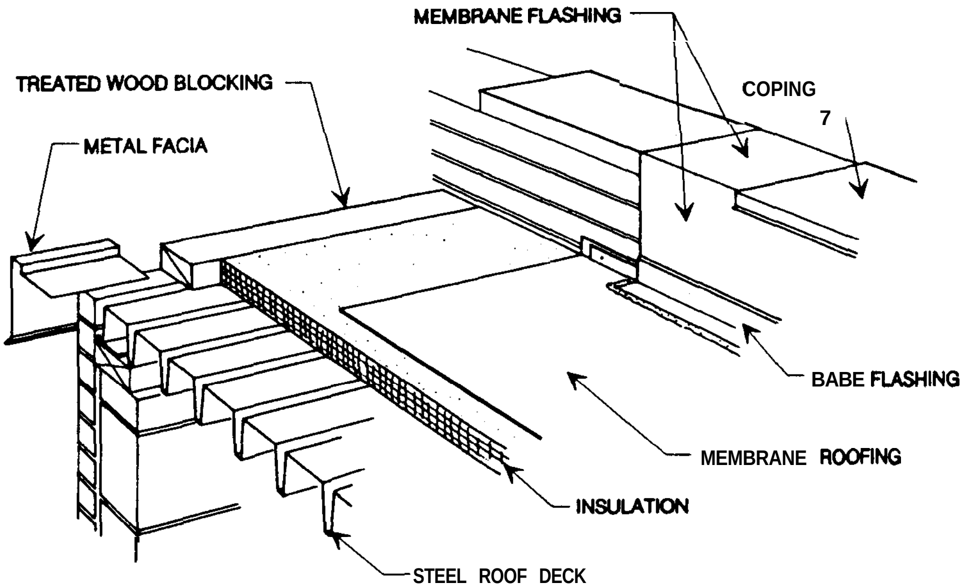
SYSTEM ASSEMBLY DETAILS-ROOFING	TYPICAL FLASHING AT PARAPET

	Revision No.	Issue Date	Drawing No.
PARAPETS (CSI 07710)		5/93	A0507-6



HIGH PARAPET WITH LINING

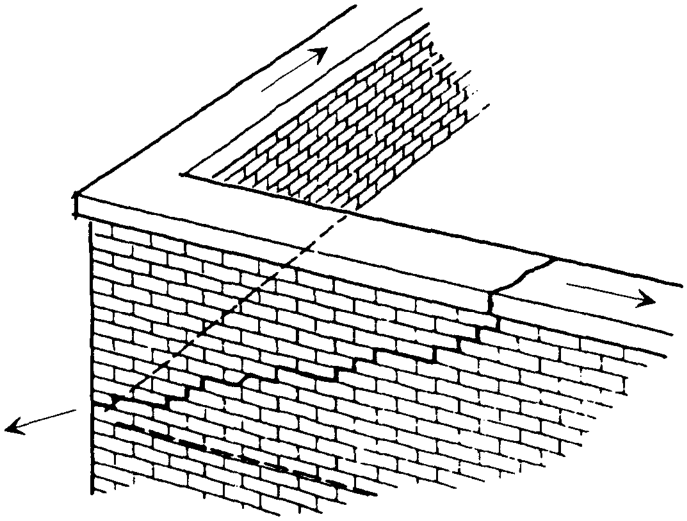
SYSTEM ASSEMBLY DETAILS-ROOFING	TYPICAL PARAPET WITH LINING		
PARAPETS (CSI 07710)	Revision No.	Issue Date 5/93	Drawing No. A0507-7



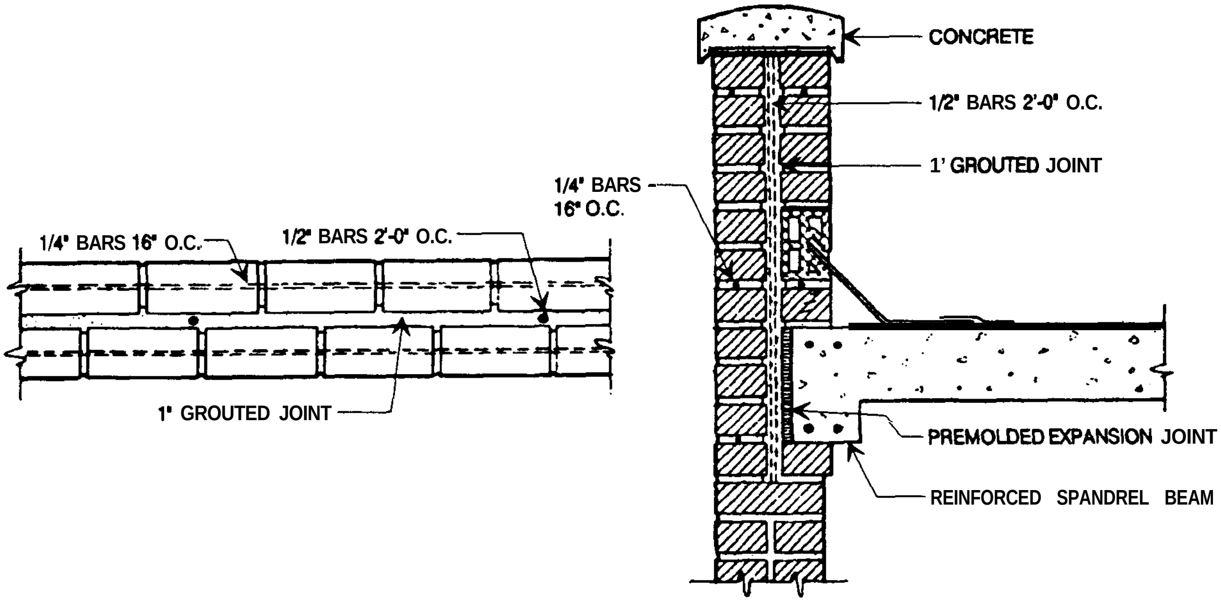
PARAPET WALL FLASHING

SOURCE: MEANS GRAPHIC CONSTRUCTION STANDARDS, 1ST EDITION "R.S. Means Co., Inc., Kingston, Massachusetts"

SYSTEM ASSEMBLY DETAILS-ROOFING	PARAPET WALL FLASHING		
PARAPETS (CSI 07710)	Revision No.	Issue Date 5/93	Drawing No. A0507-8

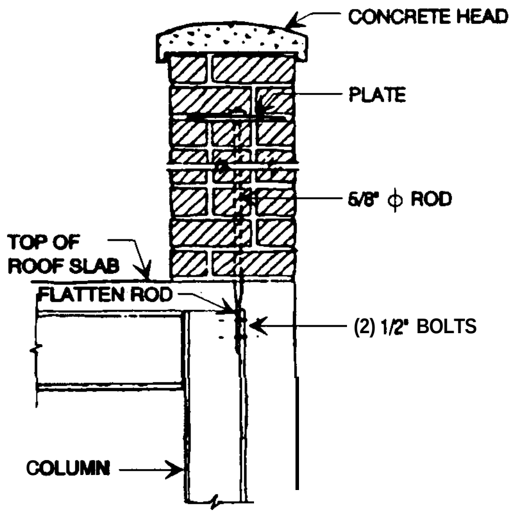


TYPICAL CORNER CRACK ON PARAPET WALLS

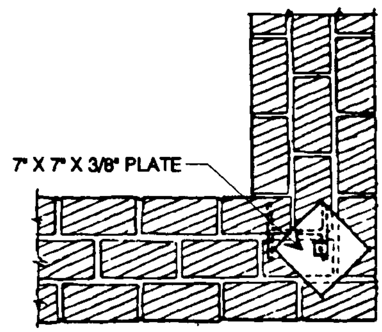


REINFORCED PARAPET WALL

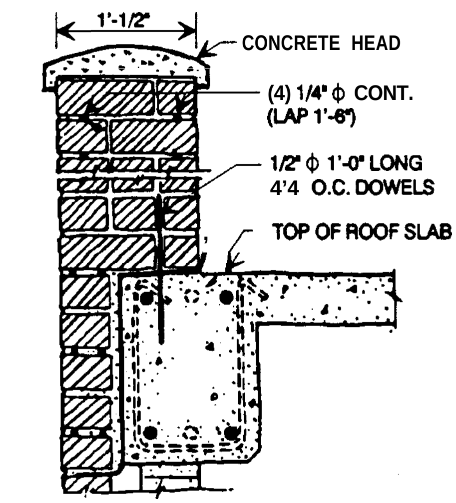
SYSTEM ASSEMBLY DETAILS-ROOFING	VARIOUS DETAILS AND TYPICAL CORNER CRACK		
PARAPETS (CSI 04200)	Revision No.	Issue Date 5/93	Drawing No. A0507-9

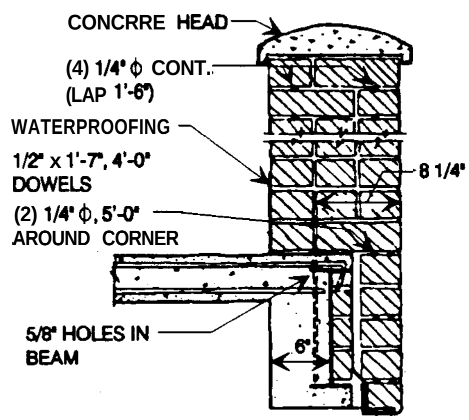


SECTION



PLAN





SECTION

STANDARD DETAILS FOR WALL

SYSTEM ASSEMBLY DETAILS-ROOFING	VARIOUS DETAILS AT TYPICAL PARAPETS		
PARAPETS (CSI 04200)	Revision No.	Issue Date 5/93	Drawing No. A0507-10

DEFICIENCY FACTORS
0.05.07 PARAPETS (CSI 07320)

PROBABLE FAILURE POINTS

- Spalling or surface deterioration resulting from adverse weather or environmental conditions.
- Cracking or structural movement including creep with the roof structure separating from the parapet.
- Surface corrosion or rust that results in weakened structural integrity.
- Damaged, broken, cracked, or missing units such as brick or sections.
- Expansion/control joint deterioration or breakdown that results in water penetration.
- Damaged, broken, or missing sections of flashing or coping that results in water penetration
- Water penetration through coping surface flaws or horizontal surfaces.

SYSTEM ASSEMBLIES/DEFICIENCIES

Masonry

Spalling:	Fragment flakes due to weather, pressure, or other actions. Usually results in rough, almost circular depressions.
Out-of-Alignment:	Bowing, deflection, or other movement that brings the surface out-of-plumb or not level in one or more directions.
Mortar/Joint Material Missing/Eroded:	Deteriorated or damaged mortar joints that have fallen out or worn down.
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 facing surface cracks, or surface breakdown due to weather, thermal movement, pressure, or other actions.
Inadequate Expansion Joint:	Lack of expansion or control joints that result in surface cracking from stresses.
Insufficient/Clogged Weepholes:	Blocked, closed, or improper number of weepholes that prevents trapped water drainage.
Staining:	Surface discoloration 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 results from excessive moisture.
Cant Strip Missing/Damaged:	Broken, damaged, or missing cant strips caused by impact damage, roof deterioration, etc. that result in possible water penetration.
Loose, Missing, Damaged Coping:	Broken, loose, cracked, or missing coping caused by excessive movement, joint failure, etc.
Damaged/Missing Sections:	Broken, cracked, or' missing units or sections caused by settlement, undue stress impact, damage, etc.

DEFICIENCY FACTORS
0.05.07 PARAPETS **(CSI 07320)**

SYSTEM ASSEMBLIES/DEFICIENCIES (Continued)

Concrete

Spalling:	Fragment flakes due to weather, pressure, or other actions. Usually results in roughly circular depressions.
Out-of-Alignment:	Bowing, deflection, or other movement that brings the surface out-of-plumb or not level in one or more directions.
Mortar/Joint Material Missing/Eroded:	Deteriorated or damaged joints that have fallen out or worn down.
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 facing cracks, or surface breakdown due to weather, thermal movement, pressure, or other actions.
Inadequate Expansion Joint:	Lack of expansion or control joints that results in material cracking from stresses.
Insufficient/Clogged Weepholes:	Blocked or closed weepholes, roof downspouts, scuppers, or improper number of weepholes that prevent trapped water drainage.
Staining:	Surface discoloration 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 results from excessive moisture.
Cant Strip Missing/Damaged:	Broken, damaged, or missing cant strips that result in possible water penetration.
Loose, Missing, Damaged Coping:	Broken, loose, damaged, cracked, or missing coping.
Damaged/Missing Sections:	Broken, damaged, cracked, or missing units, or sections.
Corrosion of Rebar:	Metal rebar oxidation or corrosion by chemical or electrochemical action after prolonged exposure.
Improper/Insufficient Anchorage:	Broken, damaged, loose, corroded, or missing anchorage or fasteners.

Stone

Spalling:	Fragment flakes due to weather, thermal movement, 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.
Mortar/Joint Material Missing/Eroded:	Deteriorated or damaged mortar joints that have fallen out or worn down.

DEFICIENCY FACTORS
0.05.07 PARAPETS (CSI 07320)

SYSTEM ASSEMBLIES/DEFICIENCIES

Stone (Continued)

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, or surface corrosion and breakdown due to weather, pressure, or other actions.
Inadequate Expansion Joint:	Lack of expansion or control joints that result in surface cracking from stresses.
Insufficient/Clogged Weepholes:	Blocked, closed, or improper number of weepholes preventing trapped water drainage.
Staining:	Surface discoloration 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 results from excessive moisture.
Cant Strip Missing/Damaged:	Broken, damaged, or missing cant strips that result in possible water penetration.
Loose, Missing, Damaged Coping:	Broken, loose, damaged, cracked, or missing coping.
Damaged/Missing Sections:	Broken, damaged, cracked, or missing units or sections.
Corrosion/Rust:	Metal (or other material) oxidation or corrosion due to chemical or electrochemical action after prolonged exposure. Applies to attachment or anchor devices.
Improper/Insufficient Anchorage:	Broken, damaged, loose, corroded, or missing anchorage or fasteners.

Metal

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 of flashing material. Cracks can be random, horizontal, vertical, or diagonal.
Surface Deterioration:	Crazing, small surface cracks, or surface corrosion and breakdown due to weather, pressure, or other actions.
Inadequate Expansion Joint:	Lack of expansion or control joints that result in surface cracking from stresses.
Insufficient/Clogged Weepholes:	Blocked, closed, or improper number of weepholes preventing trapped water drainage.
Staining:	Surface discoloration from a foreign substance or material.
Plant Growth Moss/Algae:	Moss or algae growth over the surface; usually results from excessive moisture.

DEFICIENCY FACTORS
0.05.07 PARAPETS **(CSI 07320)**

SYSTEM ASSEMBLIES/DEFICIENCIES

Metal (Continued)

Cant Strip Missing/Damaged:	Broken, damaged, or missing cant strips that result in possible water penetration.
Loose, Missing, Damaged Coping:	Broken, loose, damaged, cracked, or missing coping.
Damaged/Missing Sections:	Broken, damaged, cracked, or missing units or sections.
Corrosion/Rust:	Metal (or other material) oxidation or corrosion due to chemical or electrochemical action after prolonged exposure.
Joint Separation:	Separation of lap joints.
Punctures/Holes/Tears:	Holes, punctures, or tears in surface caused by missing fasteners, corrosion, or roof traffic.
Impact Damage/Denting:	Depressions, punctures, or buckled surface from objects striking or impacting surface.
Metal Fatigue:	Loss of structural integrity and weakening of material from stress cracks, torquing, or bending.

Wood/Plastic

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 of the material. Cracks can be random, horizontal, vertical, or diagonal.
Surface Deterioration:	Crazing, small surface cracks, or surface corrosion and breakdown due to weather, pressure, or other actions.
Inadequate Expansion Joint:	Lack of expansion or control joints that results in surface cracking from stresses.
Insufficient/Clogged Weepholes:	Blocked, closed, or improper number of weepholes preventing trapped water drainage.
Staining:	Surface discoloration from a foreign substance or material.
Plant Growth Moss/Algae:	Moss or algae growth over the surface; usually results from excessive moisture.
Cant Strip Missing/Damaged:	Broken, damaged, or missing cant strips that result in possible water penetration.
Loose, Missing, Damaged Coping:	Broken, loose, damaged, cracked, or missing coping.
Damaged/Missing Sections:	Broken, damaged, cracked, or missing units or sections.
Corrosion/Rust:	Metal (or other material) oxidation or corrosion due to chemical or electrochemical action after prolonged exposure. Applies to attachment or anchorage devices.
Punctures/Holes/Tears:	Holes, punctures, or tears in surface caused by missing fasteners, corrosion, or roof traffic.

DEFICIENCY FACTORS
0.05.07 PARAPETS (CSI 07320)

SYSTEM ASSEMBLIES/DEFICIENCIES

Wood/Plastic (Continued)

Impact Damage/Denting:	Depressions, punctures, or buckled surface from objects striking or impacting surface.
Insufficient Anchorage:	Broken, damaged, loose, corroded, or missing anchorage or fasteners.
Dry Rot/Decay:	Breakdown of structural integrity from mold/mildew or dry rot.
Loss of Protective Coating/Paint:	Chalking, peeling, erosion, blistering (temperature and moisture), or deterioration.
Splitting:	Surface splitting or tearing.
Insect Damage:	Holes, cracks, or punctures from burrowing insects.

Curtainwall/Glass

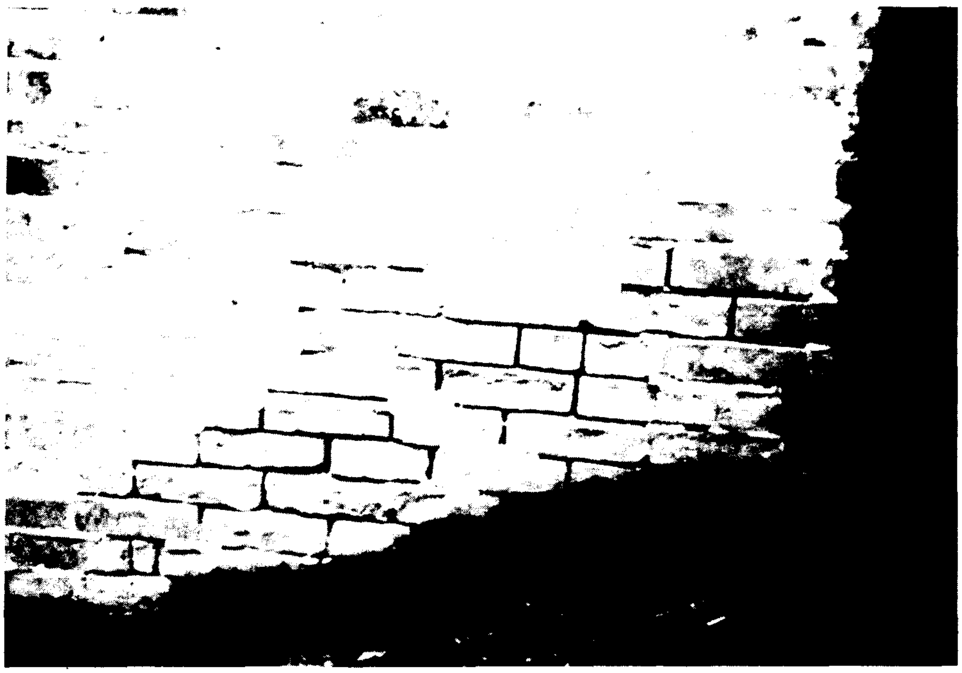
Out-of-Alignment:	Bowing, deflection, or other movement that brings the surface out-of-plumb or not level in one or more directions.
Cracking:	Cracking, usually structural in nature, that results in tearing, ripping, or shearing of the flashing material.
Surface Deterioration:	Crazing, small surface cracks, or surface corrosion and breakdown due to weather, pressure, or other actions.
Inadequate Expansion Joint:	Lack of expansion or control joints that results in surface cracking from stresses.
Insufficient/Clogged Weepholes:	Blocked or closed weepholes, roof downspouts, scuppers, or improper number of weepholes preventing trapped water drainage.
Staining:	Surface discoloration from a foreign substance or material or from ponding on sills.
Plant Growth Moss/Algae:	Moss or algae growth over the surface; usually results from excessive moisture.
Cant Strip Missing/Damaged:	Broken, damaged, or missing cant strips that results in possible water penetration.
Loose, Missing, Damaged Coping:	Broken, loose, damaged, cracked, or missing coping.
Damaged/Missing Sections:	Broken, damaged, cracked, or missing units or sections.
Corrosion/Rust:	Metal (or other material) oxidation or corrosion due to chemical or electrochemical action after prolonged exposure or from ponding on sills.
Improper/Insufficient Anchorage:	Broken, damaged, loose, corroded, or missing anchorage or fasteners.
Cracked or Shattered Glazing:	Broken, cracked, or shattered glazing units.
Impact Damage/Denting:	Depressions, punctures, or buckled surface from objects striking or impacting surface.

DEFICIENCY FACTORS
0.05.07 PARAPETS **(CSI 07320)**

SYSTEM ASSEMBLIES/DEFICIENCIES

Curtainwall/Glass (Continued)

Metal Fatigue:	Loss of structural integrity and weakening of material from stress cracks, torquing, or bending.
Loss of Protective Coating/Paint:	Chalking, peeling, erosion, blistering (temperature and moisture), or deterioration.



MORTAR JOINTS DETERIORATING

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	DETERIORATION		
PARAPETS (CSI 04210)	Revision No.	Issue Date 5/93	Drawing No. D0507-1

DEFICIENCY FACTORS
0.05.07 PARAPETS (CSI 07320)

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DEFICIENCY FACTORS
0.05.07 PARAPETS (CSI 07320)

END OF SUBSECTION

0.05.08 ROOF DRAINAGE SYSTEMS (CSI 07700)

DESCRIPTION

This narrative and the following details describe Roof Drainage System A roof's drainage system includes the gutters, leaders, drain openings, and scuppers, as well as the slope provrded by the structural deck, tapered insulation, and crickets. The primary function of the drainage system is to prevent water retention on the roof by removing it as quickly as possible. All details that affect the integrity of the roof should be evaluated, including mechanical and electrical penetrations 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 Flashing (CSI 07620)

A thin, impervious sheet of material placed in construction to prevent water penetration or to direct water flow. Flashing is used especially at roof hips and valleys, roof penetrations, and joints between a roof and vertical walls. It may include base and counterflashing, or expansion flashing (joints, etc.). Material varies and may include galvanized steel, copper, aluminum, zinc alloy, stainless steel, etc.

Gravel Stops/Metal Strips (CSI 07710)

The primary functions of gravel stops (aggregate-sulfated roof) and metal roof edge strips (for smooth surface roofs) are to close off the edge of the roof and to prevent aggregate loss into the roof drainage system.

Gutters/Leaders (CSI 07630)

Gutters and leaders are made up of aluminum, plastic/vinyl, copper, galvanized steel, painted steel, and stainless steel. Aluminum has a high coefficient of expansion and contraction. Plastic or vinyl breaks down under ultraviolet rays and is susceptible to impact damage causing breaks or cracks. Typical material thickness ranges from 24 to 28 gauge for metal.

Gutter. Available Sizes

Area in Sq Inches	Actual Size	Nominal Size
7.73	2.375" x 3.25"	2" x 3"
11.70	2.75. x 4.25"	3" x 4"
18.75	3.75" x 5"	4" x 5"

Roof Drains (CSI 07720)

Interior "field" drains located at various points in the roof surface. The roof is pitched at a recommended 1/4 inch per foot slope or greater, with a minimum 1/8 inch per foot (considered flat). Drains are normally cast iron, steel, or plastic with strainer screens or grate covers to stop debris; they drain into cast iron or PVC leaders down through buildings. Drain size depends on the roof area size to be served, but 4 inches is usually minimum. A minimum of two drains should be provided. Refer to Mechanical Volume 8, Work Breakdown Structure, 0.08.01.02, Drain, Waste and Vent, for a description and inspection of interior leader/conductors system.

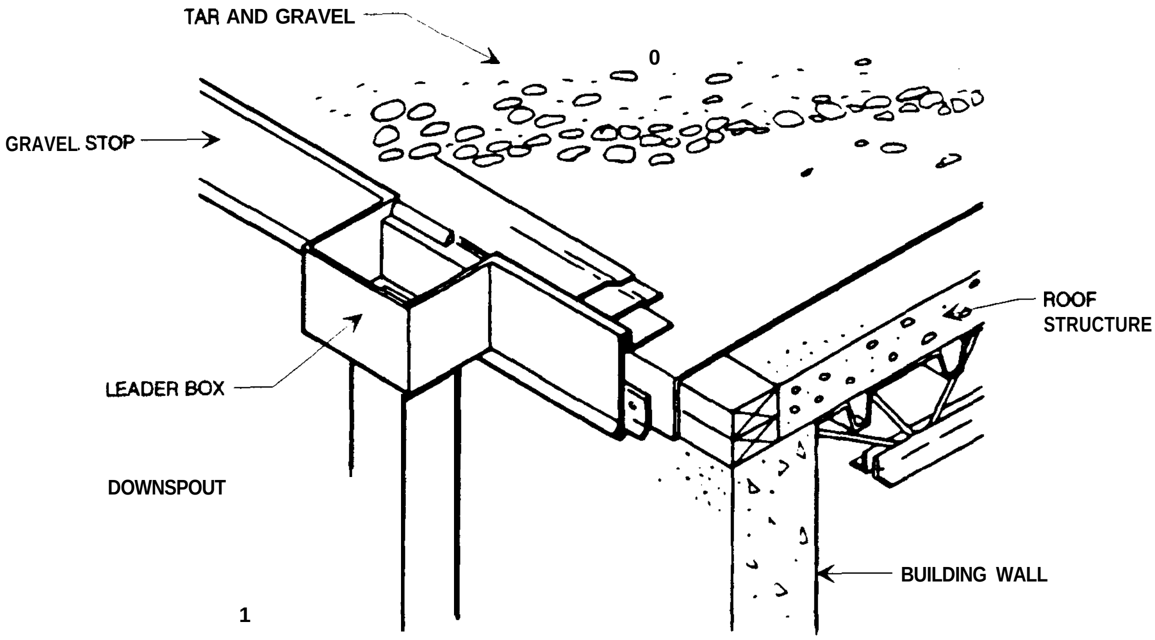
Scuppers (CSI 07630)

Short sections of gutter or "heads" that drain the roof through parapets to downspouts. Materials include aluminum, steel, copper, or tin. The most economical is 26-gauge aluminum. Scuppers can be factory finished or field painted. Storm water on roof is directed by slope and crickets. They may be used as emergency overflows without downspouts in situations when roof drains become clogged.

0.05.08 ROOF DRAINAGE SYSTEMS (CSI 07700)

OTHER RELATED COMPONENTS

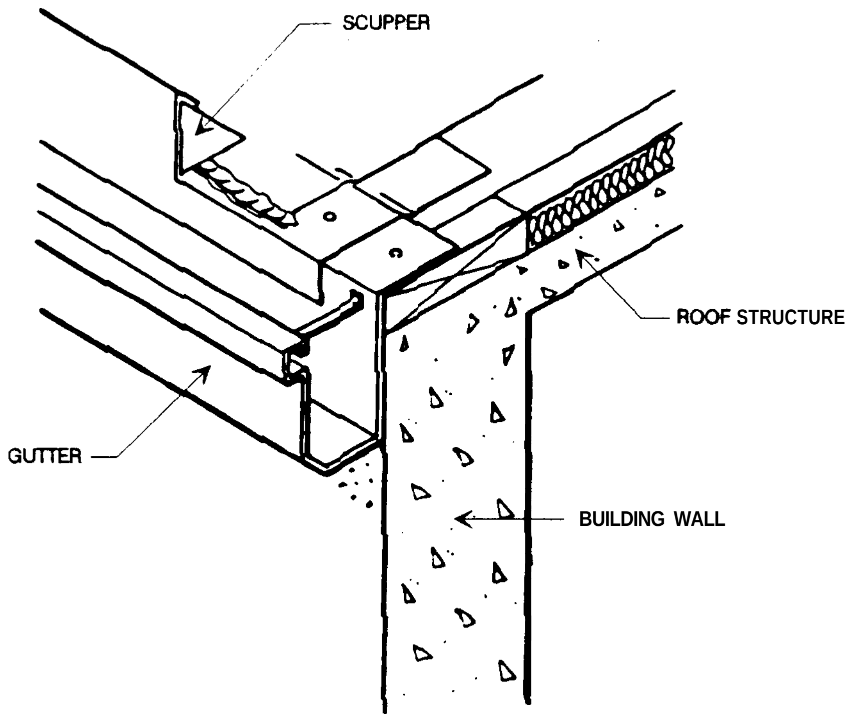
See the following subsections for related components



FLAT ROOF WITH LEADER BOX

SOURCE: MEANS GRAPHIC CONSTRUCTION STANDARDS, 1ST EDITION., "R.S. Means Co., Inc., Kingston, Massachusetts"

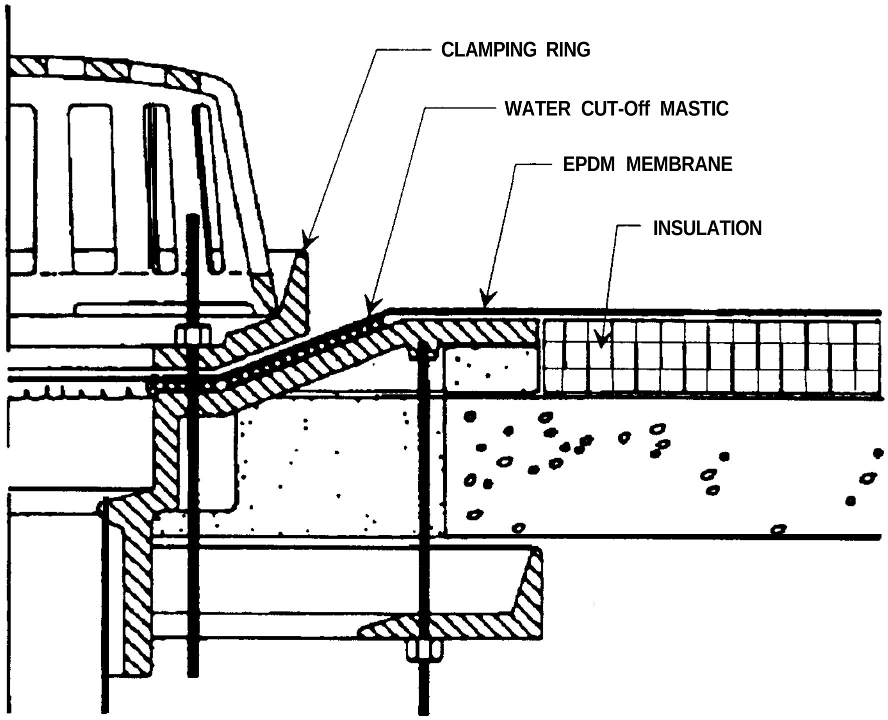
SYSTEM ASSEMBLY DETAILS-ROOFING	LEADER BOX SYSTEM		
ROOF DRAINAGE SYSTEMS (CSI 07630)	Revision No.	Issue Date 5/93	Drawing No. A0508-1



FIAT ROOF WITH GUTTER

SOURCE: MEANS GRAPHIC CONSTRUCTION STANDARDS, 1ST EDITION., "R.S. Means Co., Inc., Kingston, Massachusetts"

SYSTEM ASSEMBLY DETAILS-ROOFING	GUTTER SYSTEM		
ROOF DRAINAGE SYSTEMS (CSI 07630)	Revision No.	Issue Date 5/93	Drawing No. A0508-2

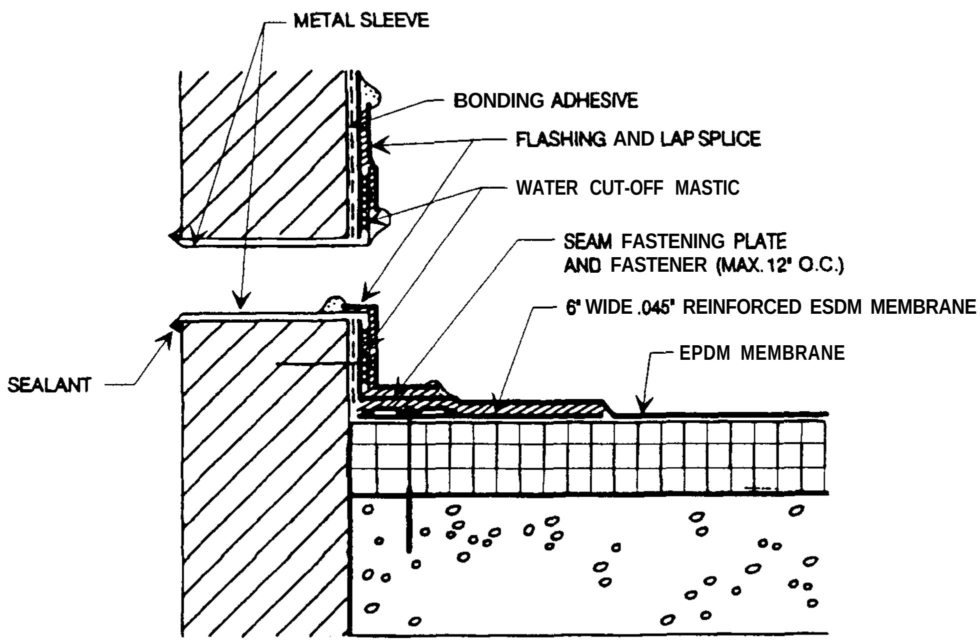


ROOF DRAIN

SYSTEM ASSEMBLY DETAILS-ROOFING	SECTION AT ROOF DRAIN		
ROOF DRAINAGE SYSTEM (CSI 07600)	Revision No.	Issue Date 5/93	Drawing No. A0508-3

NOTES:

1. METAL SCUPPER BOX MUST HAVE CONTINUOUS SIDES: METAL FLANGE MUST BE CONTINUOUS WITH ROUNDED CORNERS
2. WATER CUT-OFF MASTIC MUST BE HELD UNDER CONSTANT COMPRESSION
3. METAL SCUPPER FLANGE ON WALL MUST BE TOTALLY COVERED BY UNCURED ELASTOFORM FLASHING
4. UNCURED ELASTOFORM FLASHING MUST OVERLAP WALL FLASHING 3' MIN.



OVERFLOW SCUPPER

SYSTEM ASSEMBLY DETAILS-ROOFING	OVERFLOW SCUPPER		
ROOF DRAINAGE SYSTEMS (CSI 07630)	Revision No.	Issue Date 5/93	Drawing No. A0508-4

DEFICIENCY FACTORS
0.05.08 ROOF DRAINAGE SYSTEMS (CSI 07700)

PROBABLE FAILURE POINTS

- Debris clogs that might interfere with proper storm water runoff
- Inadequately designed or improperly installed drainage systems (eg., the use of only one drain, failure to install overflow scuppers in parapet walls).
- Drains placed next to support columns instead of at points of maximum deflection
- Loose or missing drain clamping ring
- Discoloration and other evidence of water entry on the inside and outside of -walls and parapets.
- Sagging/depressed areas or standing/ponding water.
- Plant Growth (eg., algae, moss, and other plant life from dropped seeds)
- Broken or clogged roof drains.

SYSTEM ASSEMBLIES/DEFICIENCIES

Types

Loose:	Failed or loose anchorage of gutter or downspouts to building face.
Cracks:	Broken or cracked sections of gutter, downspouts or roof drains.
Clogged/Improper Drain Flow:	Debris or trash build-up, improper slope, and/or low spots.
Missing Parts/Fasteners:	Missing or removed, broken, cracked, or corroded sections of gutter, downspouts, roof drain covers, or fasteners.
Corrosion/Rust:	Metal (or other material) oxidation or corrosion due to chemical or electrochemical action after prolonged exposure.
Hole/Puncture:	Tears, punctures, or holes in surface.
Open Seams:	Loose or separated joints/seams.
Surface Deterioration:	Loss of protective coatings or paint. Signs include cracking, chalking, and flaking.
Impact Damage:	Dents, depressions, or crushed sections including roof drain strainers.
Metal Fatigue:	Eroded and/or weathered surface material that exhibits corrosion, holes, and breakdown of structural integrity.
Leaks:	Water penetration from cracked, broken, loose seams, holes, or penetrations of surface or joints.

DEFICIENCY FACTORS
0.05.08 ROOF DRAINAGE SYSTEMS **(CSI** 077001

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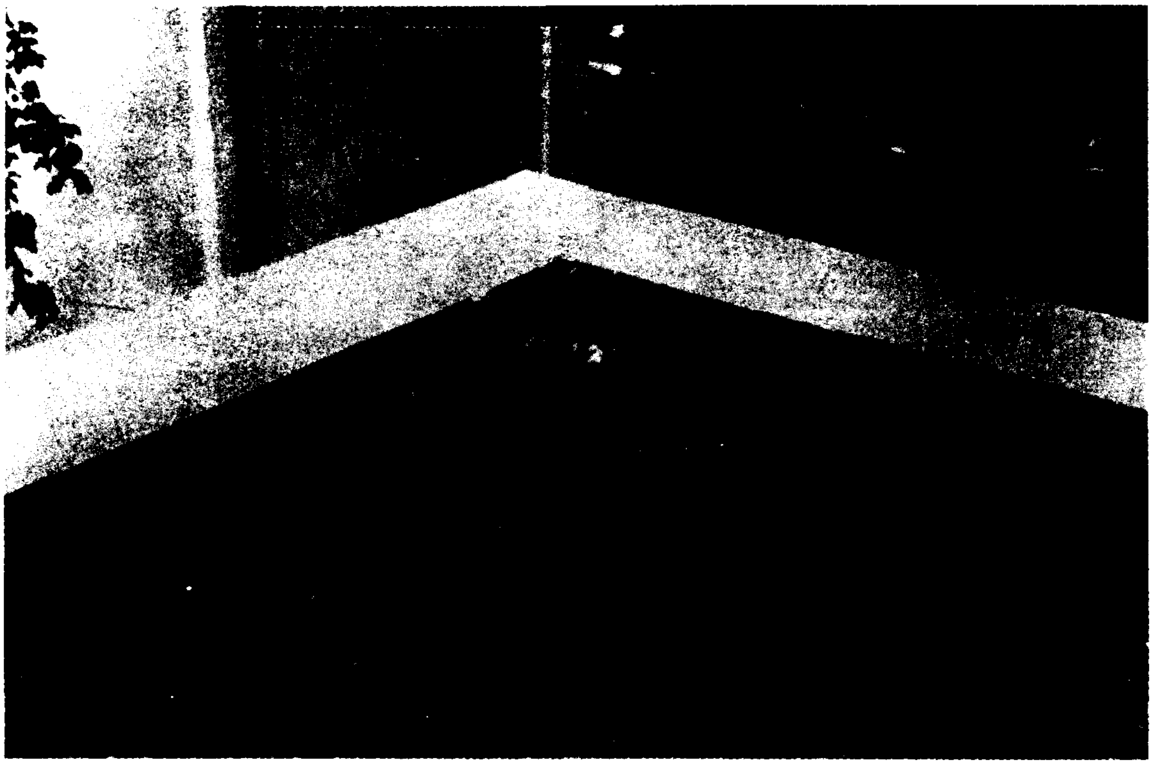
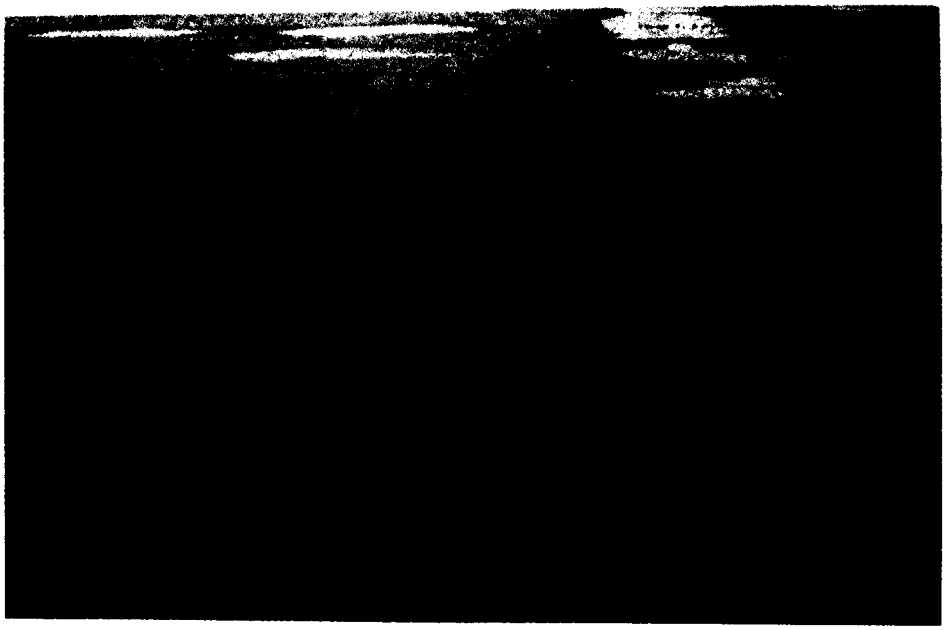


DEBRIS AROUND ROOF DRAIN INTERFERES WITH DRAINAGE

PHOTO ILLUSTRATION

SOURCE: NRCA/ARMA, MANUAL OF ROOF MAINTENANCE AND REPAIR

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	DEBRIS AT DRAINAGE		
ROOF DRAINAGE SYSTEMS (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. 00508-I



DRAIN NOT LOCATED AT POINT OF MAXIMUM ROOF DECK DEFLECTION

PHOTO ILLUSTRATION

SOURCE. NRCA/ARMA, MANUAL OF ROOF MAINTENANCE AND REPAIR

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	DRAINAGE IS NOT LOCATED AT DEFLECTION POINT		
ROOF DRAINAGE SYSTEMS (CSI 07510)	Revision No.	Issue Date 5/93	Drawing No. D0508-2

MISSING GUTTERS

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	MISSING GUTTER		
ROOF DRAINAGE SYSTEMS (CSI 07600)	Revision No.	Issue Date 5/93	Drawing No. D0508-3

TRASH, DEBRIS AROUND DRAIN

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	**TRASH, DEBRIS AROUND DRAIN**		
ROOF DRAINAGE SYSTEMS (CSI 07600)	**Revision No.**	**Issue Date** 5/93	Drawing No. D0508-4

DEFICIENCY FACTORS
0.05.08 ROOF DRAINAGE SYSTEMS (CSI 07700)

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DEFICIENCY FACTORS

0.05.08 ROOF DRAINAGE SYSTEMS (CSI 07700)

END OF SUBSECTION

0.05.09 ROOF SPECIALTIES (CSI 07720)

DESCRIPTION

The following narrative and details describe key elements under roof specialties including smoke vents, scuttles, etc. Graphic assembly details that follow illustrate general assembly/component types only and are not meant as a defrnitive, exhaustive, in-depth system breakdown Field conditions will vary and are subject to project type, local requirements, and facility design

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS

Fire/Smoke Vent (CSI 07720)

Fire/Smoke Vents are designed to automatically dispense or open in emergency situations These vents are usually premanufactured and are designed to the following specifications.

- Material: 22 gauge galvanized or stainless steel or 11 gauge aluminum. Factory primed (red oxide) and/or finished.
- Curb: Premanufactured as part of unit
- Insulation: Rigid fiberboard (doors and curbwalls) - thickness varies.
- Hardware: Positive hold/release mechanism, heavy-duty hinges, compression spring operation, thermoplastic rubber gasket heavy duty shock absorbers and pull handles for inside or outside operation.
- Operation: Door opens automatically when heat breaks the 165° fusible link and is labeled as being FM-approved or UL-listed.
- Modifications: Other versions include explosion, electric, motorized, or winch operation.
- Configurations: Size as required by local code; units can be single or double leaf.

Roof Hatch/Scuttle (CSI 07720)

Roof Hatch/Scuttles provide direct access to facility roofs and/or other restricted areas. These openings can be premanufactured or field-fabricated. The description below is for a premanufactured hatch/scuttle assembly; field-fabricated hatches will vary widely both in operation and materials and should be assessed based on actual field assembly.

- Material: 22 gauge galvanized steel or 11 gauge aluminum. Factory primed (red oxide) and/or finished. Field fabrication may include various materials including wood, copper, tin veneer over wood, etc.
- Curb: Manufactured as part of unit, Field-fabricated curbs vary widely and will depend exclusively on roofing and construction materials.
- Insulation: Rigid fiberboard (doors and curbwalls) - thickness varies. Insulation in field-fabricated units will depend exclusively on insulation types used generally in facility.
- Hardware: Lifting mechanism, automatic hold-open arm and cover release, heavy-duty hinges, inside/outside handles, and padlock hasps and gaskets. Field-fabricated units may or may not contain all the hardware described depending on actual field assembly.
- Operation: Open/close operation controlled by hardware assembly.
- Modifications: Primarily occurs in field-fabricated units; usually reflects prevailing type of existing construction employed.

0.05.09 ROOF SPECIALTIES (CSI 07720)

ASSOCIATED ASSEMBLY/STANDARD COMPONENTS (Continued)

Pre-engineered Curbs & Supports (CSI 07720)

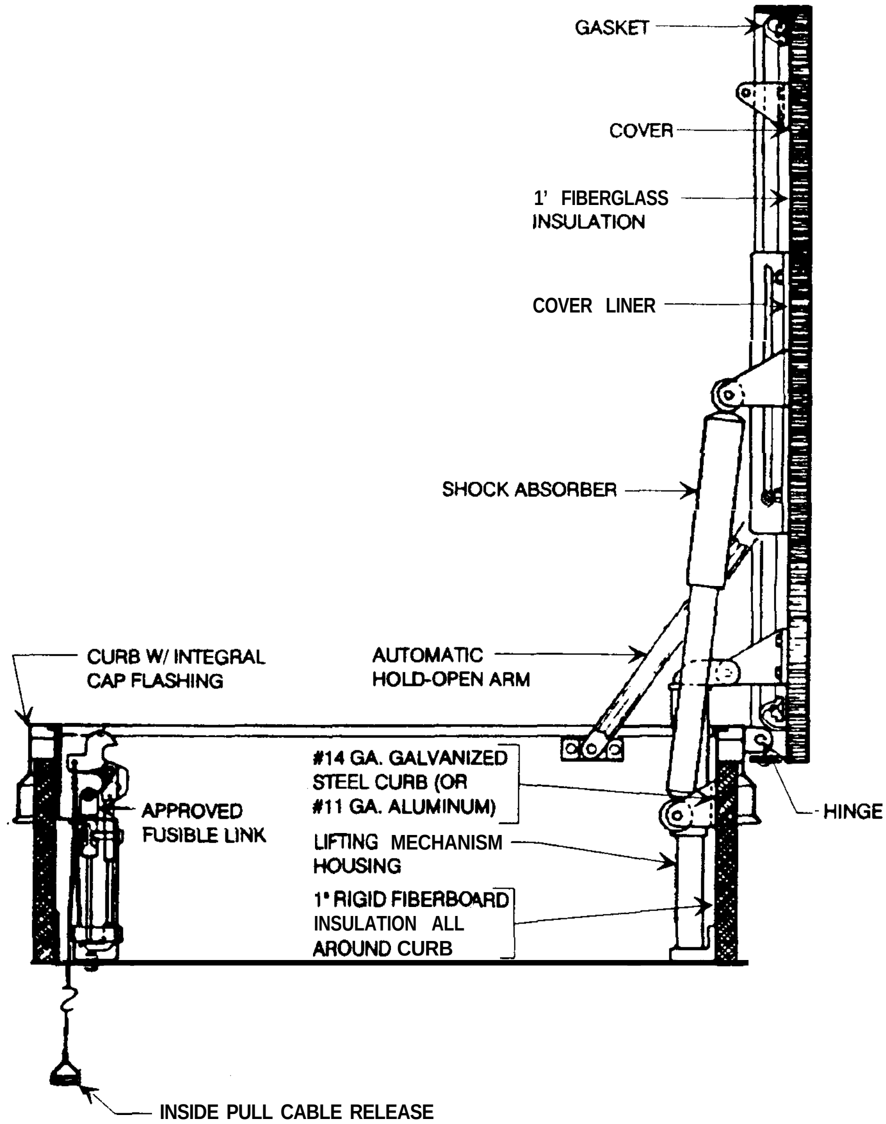
Pre-engineered curbs and supports are designed by manufacturers for specific use, including mechanical equipment and roof access hatchways. Construction assembly depends exclusively on type of equipment supported; wood, sheet metal (various gauges), and steel framing (heavy-duty) are the most common materials. Roofing elements are designed to receive pre-engineered units Finally, exposed metal sections are usually factory primed and field painted for final finish.

Miscellaneous Items (CSI 07720)

Among a number of items that may be included on the roof are tie-down rings, lightning protection, and pavers.

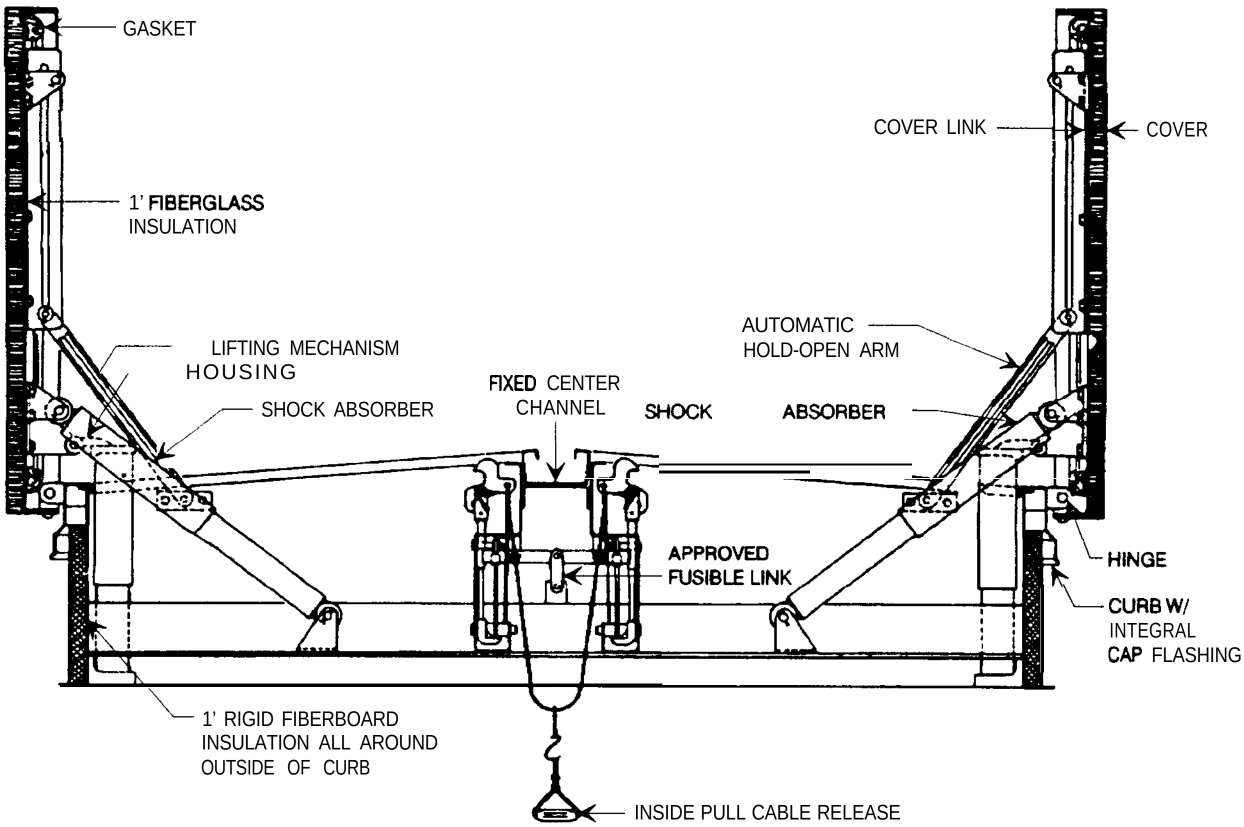
OTHER RELATED COMPONENTS

See the following subsections for related components



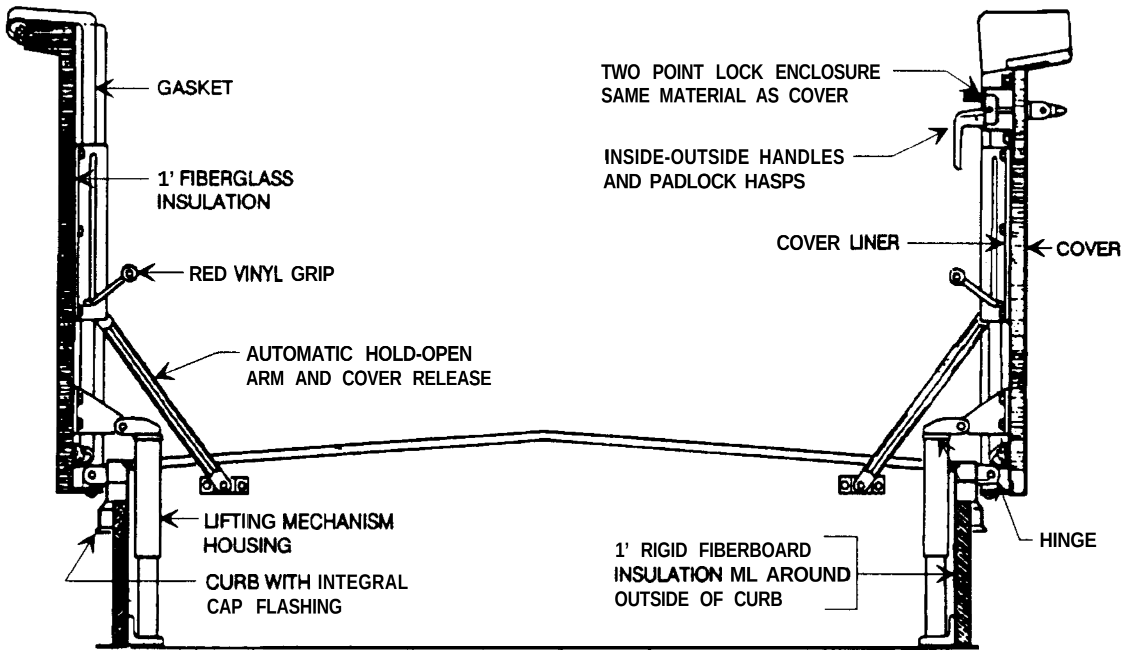
SMOKE VENT SECTIONS

SYSTEM ASSEMBLY DETAILS-ROOFING	SMOKE VENT		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. A0509-1



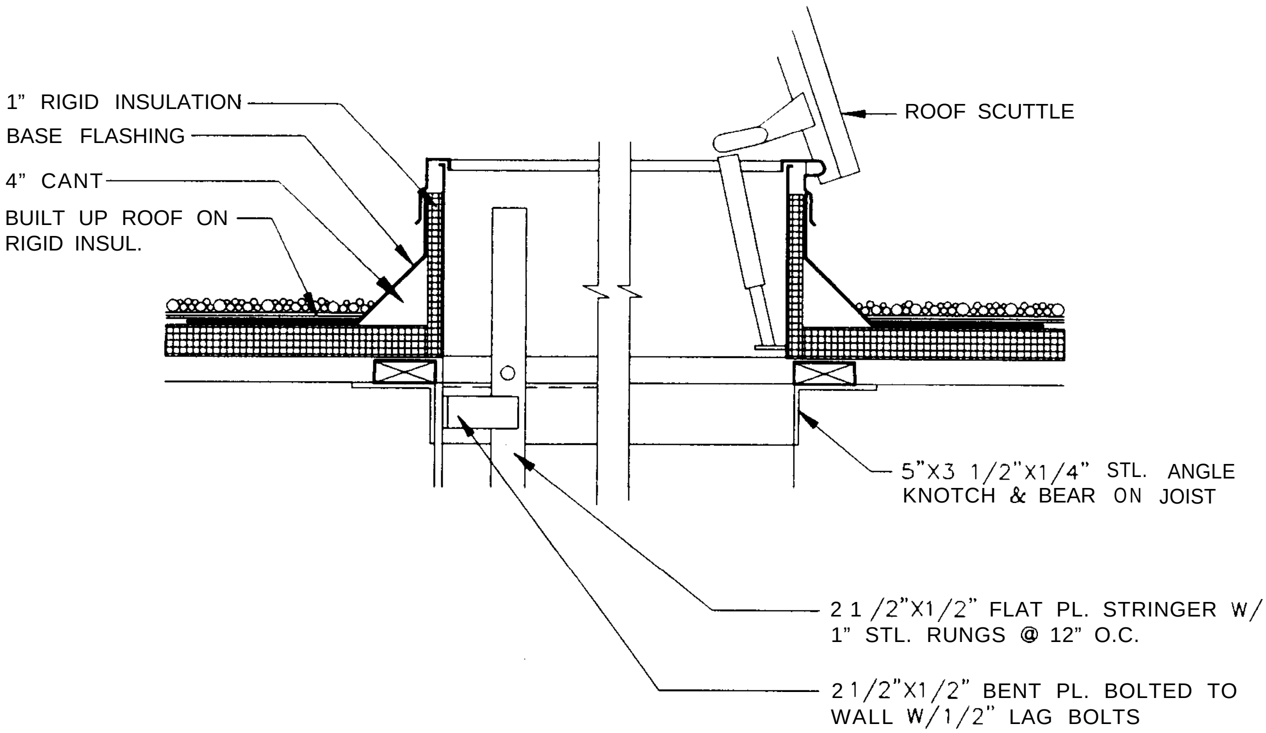
SMOKE VENT SECTIONS

SYSTEM ASSEMBLY DETAILS-ROOFING	SMOKE VENT		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. A0509-2



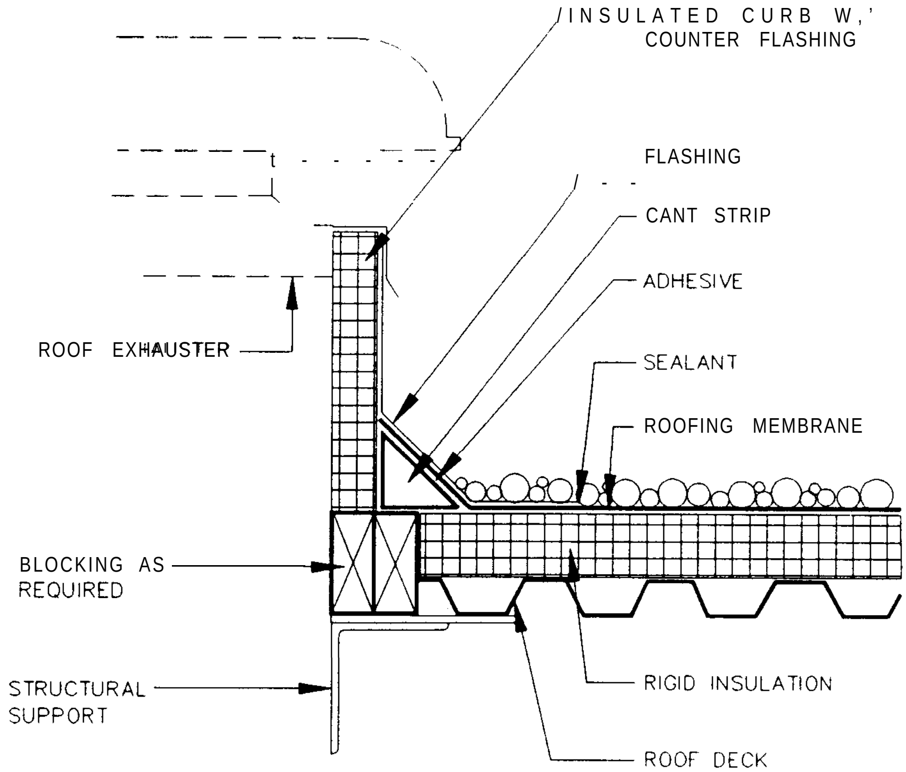
ROOF SCUTTLE SECTION

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF SCUTTLE		
ROOF SPECIALTIES (CSI 07720)	Revlslon No.	Issue Date 5/93	Drawing No. A0509-3



SINGLE ROOF SCUTTLE SECTION

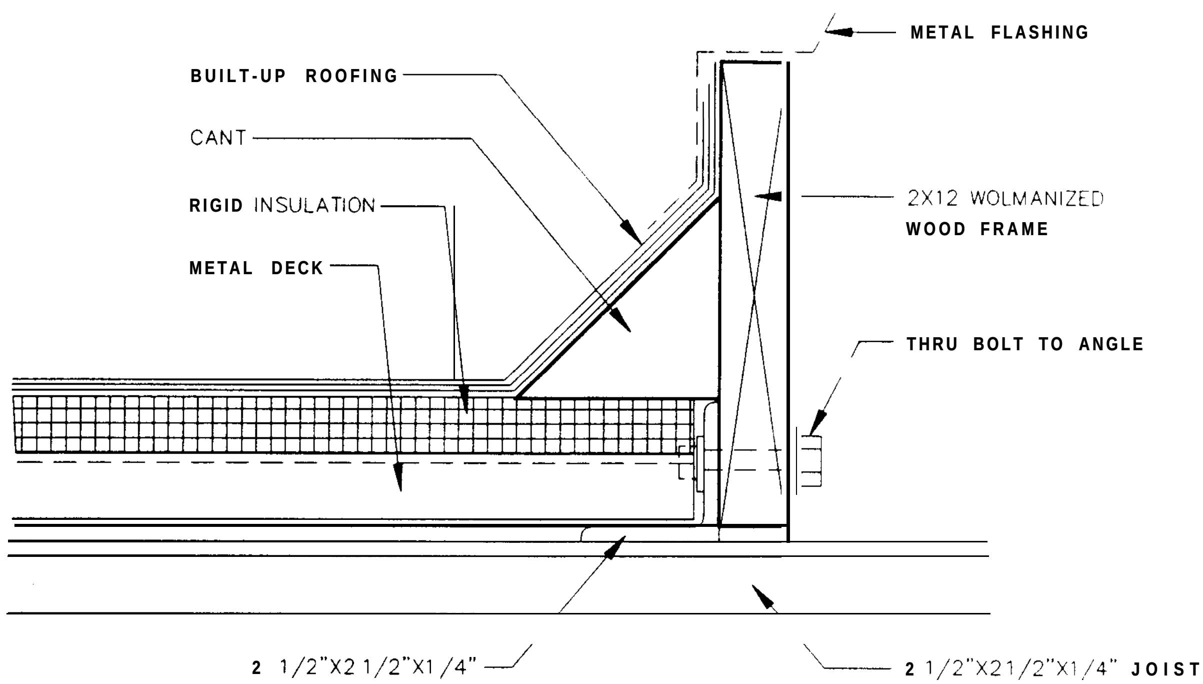
SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF SCUTTLE		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. A0509-4



ROOF CURB SECTION

(PRE-ENGINEERED)

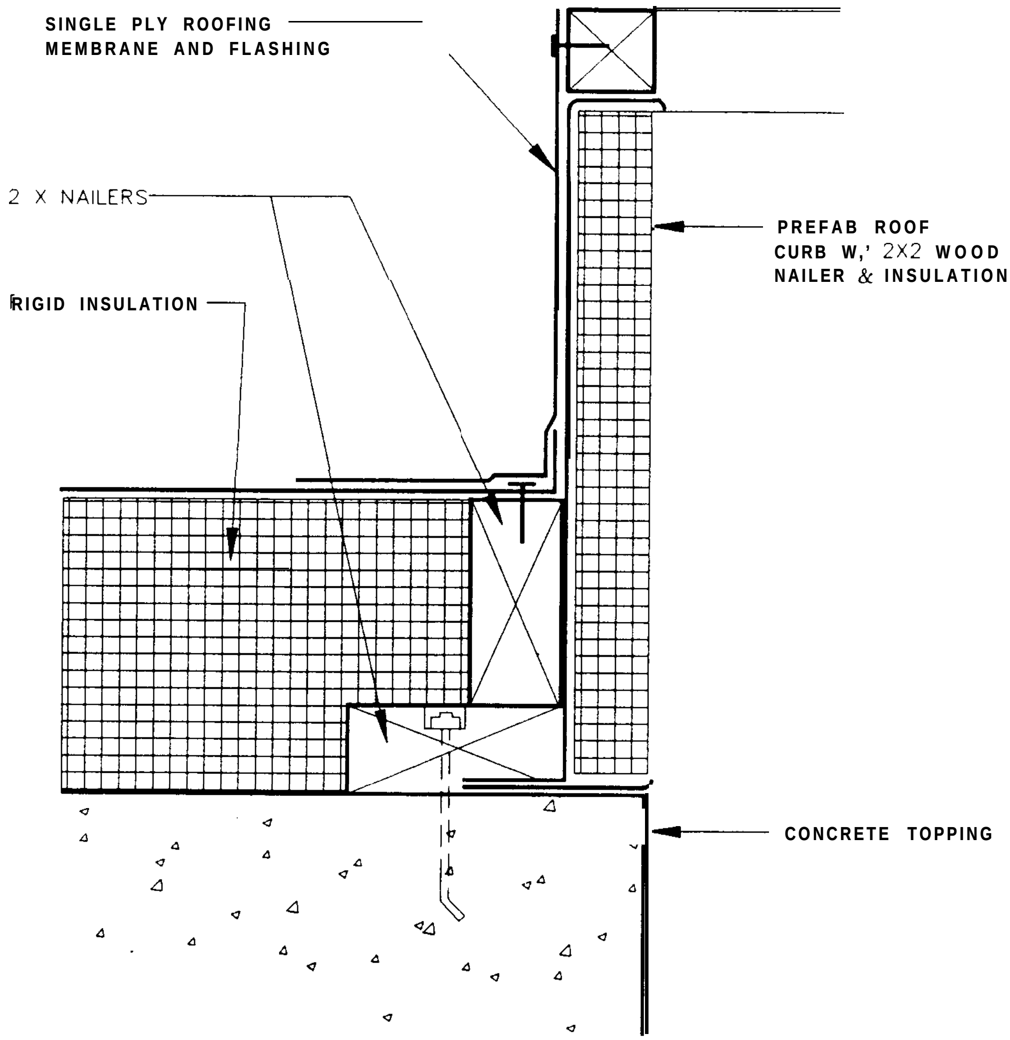
SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF CURB		
ROOF SPECIALTIES (CSI 07720)	Revlsion No.	Issue Date 5/93	Drawing No. A0509-5



ROOF CURB SECTION

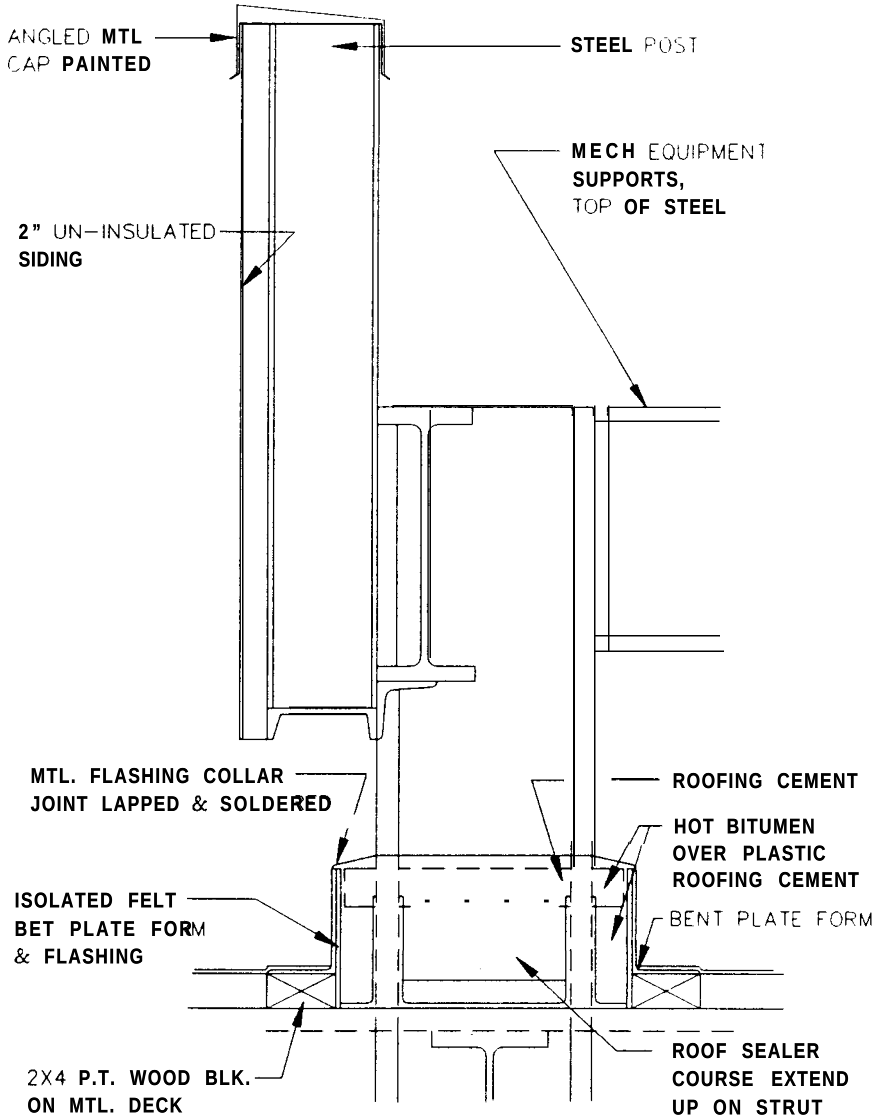
NOTE:
WOLMANIZED WOOD DENOTES WOOD THAT HAS BEEN PRESSURE TREATED WITH A WATER SOLUTION OF PRESERVATIVE CHEMICALS

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF CURB		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. A0509-6



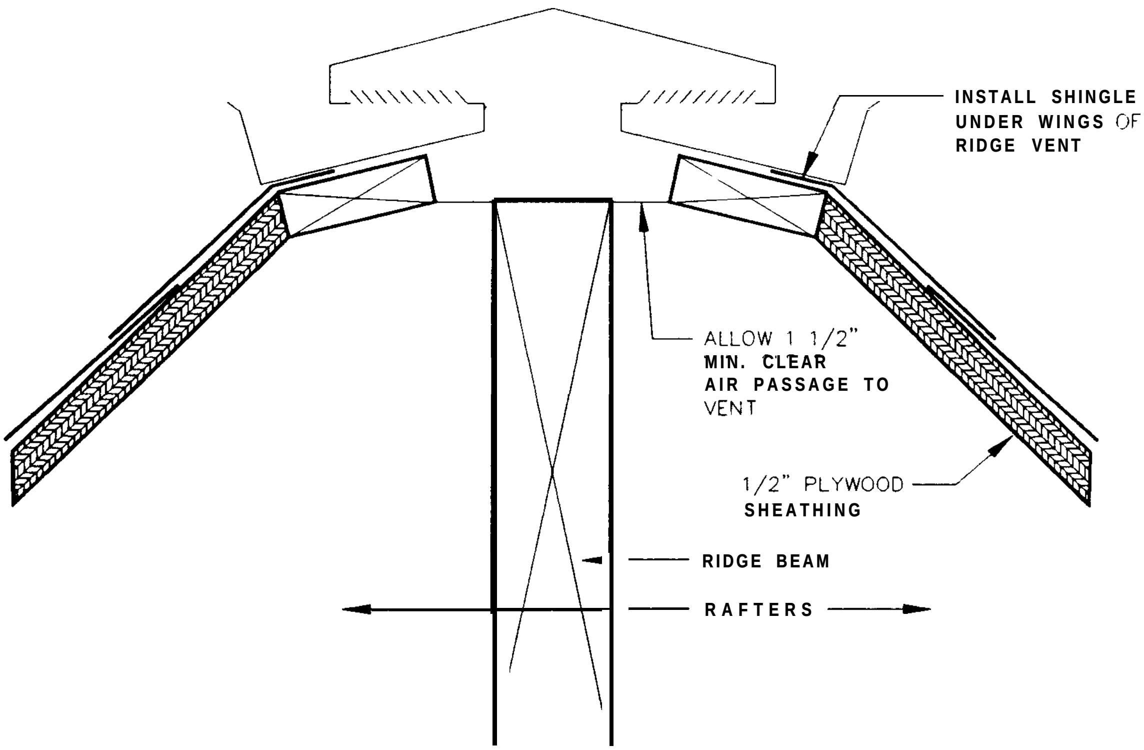
ROOF CURB SECTION
(SINGLE PLY ROOF)

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF CURB		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. A0509-7



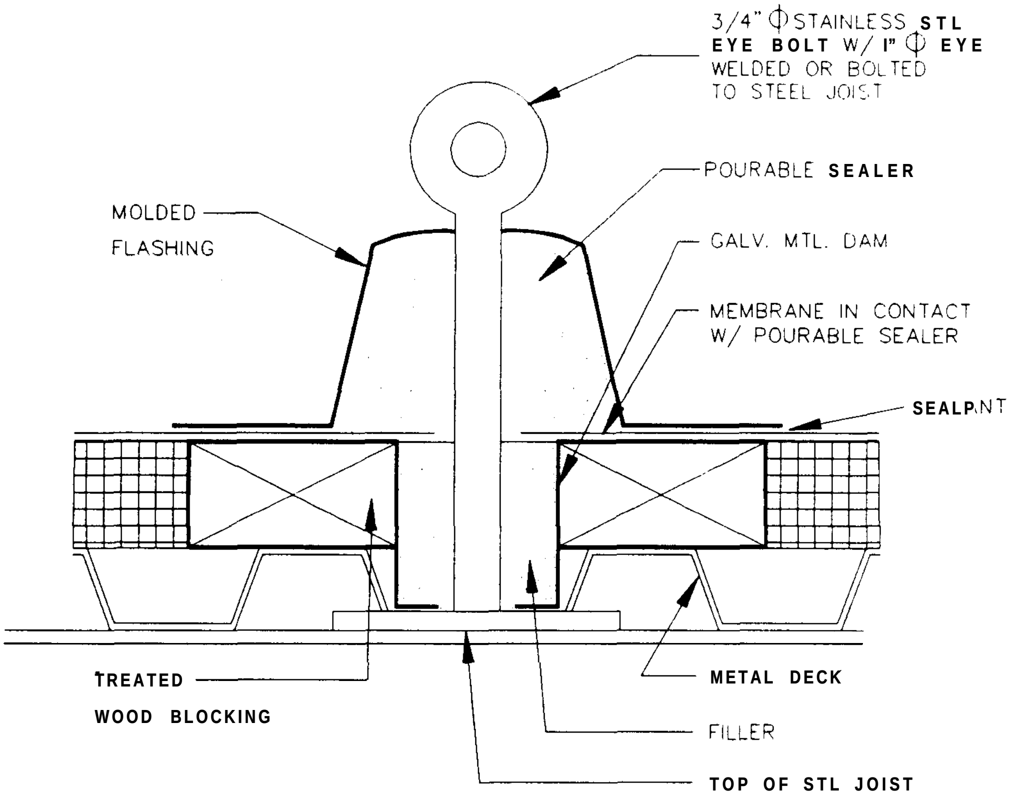
ROOF SCREEN
MECHANICAL EQUIPMENT

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF SCREEN		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. A0509-8



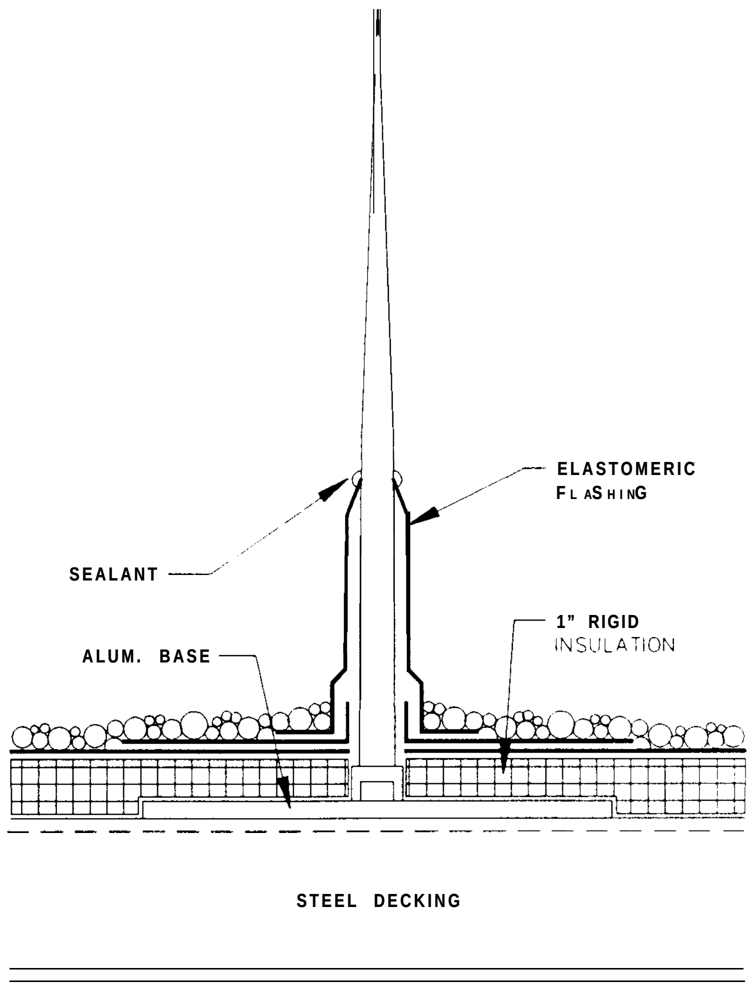
RIDGE VENT SECTION

SYSTEM ASSEMBLY DETAILS-ROOFING	RIDGE VENT		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. A0509-9



SECTION @ ROOF TIE DOWN

SYSTEM ASSEMBLY DETAILS-ROOFING	ROOF TIE DOWN		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. A0509-10



LIGHTNING ROD SECTION

SYSTEM ASSEMBLY DETAILS-ROOFING	LIGHTNING ROD		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. A0509-11

DEFICIENCY FACTORS
0.05.09 ROOF SPECIALTIES (CSI 07720)

PROBABLE FAILURE POINTS

- Operating parts fail or adjustments are required
- Rust or corrosion of metal surfaces.
- Loss of protective coating or paints and surface deterioration.
- Cracking or dried out and missing joint sealants.
- Damaged or missing flashing resulting in leaks

SYSTEM ASSEMBLIES/DEFICIENCIES

Units

Broken/Inoperative Parts:	Non-working parts or parts that stick or require adjustment,
Damaged or Missing Parts:	Missing or removed parts or parts damaged through overuse or abuse.
Impact Damage/Denting:	Dents or depressions found on the surface, usually on the exterior of units.
Loss of Protective Coating/Paints:	Surface deterioration due to loss of protective coatings or paints including primer coat. Signs include cracking, chalking, and flaking.
Corrosion/Rust:	Metal (or other material) oxidation or corrosion due to chemical or electrochemical action after prolonged exposure.
Leaks :	Water penetration through holes, penetrations, or cracks in flashing or sealants.
Joint Material Dried Out/Missing:	Loss of proper watertight seal due to cracked or missing sections of joint material or sealants. Caused by aging and environmental factors.
Improper/Insufficient Anchorage:	Lack of or damaged anchorage to roof assembly caused by weather, corrosion, structural stresses, or failure to install correctly.

DEFICIENCY FACTORS
0.05.09 ROOF SPECIALTIES (CSI 07720)

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MECHANICAL ROOF SUPPORT DETERIORATION

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	ROOF SUPPORT DETERIORATION		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. 00509-I

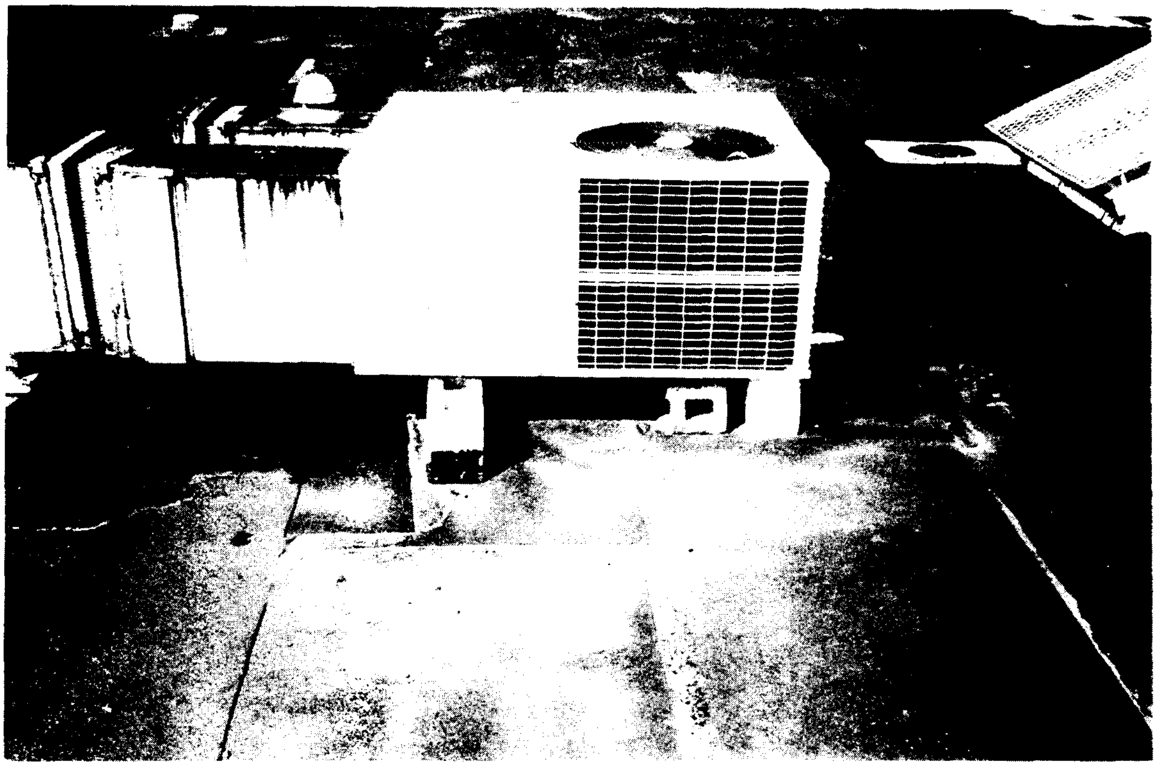
REVIEW PENDING

APPROVAL PENDING

DAMAGED BASE AND COUNTER FLASHING
AND SEPARATED EXPANSION JOINT

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	MAJOR EXPANSION JOINT (VERTICAL) DETERIORATION		
ROOF SPECIALTIES (CSI 07720)	Aevlsion No.	Issue Date 5/93	Drawing No. D0509-2



IMPROPER MECHANICAL CURB SUPPORTS

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	IMPROPER CURB SUPPORTS		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. D0509-3

DETERIORATED HATCH

PHOTO ILLUSTRATION

SYSTEM ASSEMBLY DEFICIENCY DETAILS-ROOFING	DETERIORATED HATCH		
ROOF SPECIALTIES (CSI 07720)	Revision No.	Issue Date 5/93	Drawing No. D0509-4

DEFICIENCY FACTORS
0.05.09 ROOF SPECIALTIES **(CSI** 07720)

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DEFICIENCY FACTORS
0.05.09 ROOF SPECIALTIES **(CSI** 07720)

END OF SUBSECTION

INSPECTION METHODS - STANDARD

GUIDE SHEETS

The following Guide Sheets provide a general overview of inspection methods and requirements used to provide a general roof inspection. Sheets have been developed for each major membrane type and associated assembly components as follows:

TABLE ONE

Assembly/Component	Control Number
Built-Up Membrane..	GSS 0.05.01
Single-Ply Membrane..	GSS 0.05.02
Metal Roofing Systems..	GSS 0.0503
Coated Foam Membrane	GSS 0.05.04
Shingles..	GSS 0.05.05
Tiles	GSS 0.05.06
Parapets	GSS 0.05.07
Roof Specialties	GSS 0.05.08
Roof Drainage System..	GSS 0.05.09
Skylights ..	GSS 0.05.10

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: BUILT-UP MEMBRANE
CONTROL NUMBER: GSS 0.05.01

APPLICATION

This guide applies to all built-up bituminous roofing systems with associated insulation

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions.
3. This is a general inspection, and deficiencies should be handled on a service call or repair basis.
4. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
5. Review any roofing warranties for special requirements.
6. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets. (See GSS 0.05.07)
2. Inspect downspouts, gutters, and/or roof drains as potential sources for deficiencies in the roofing systems. (See GSS 0.05.09)
3. Inspect all roof penetrations. (See GSS 0.05.08)
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.

INSPECTION ACTIONS

A Condition Assessment Survey of Built-Up Membrane Roofing to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance and condition - check for debris, rags, leaves, and equipment that could cause blockage of roof drainage system.
2. Check for overall water tightness, including presence of, or location and duration of, any water leaks. Verify any historical information for leaks during long-continued rain, leaks occurring every rain, etc.
3. Check roof membrane surface for splits, wrinkles, bubbles, buckling, alligatoring, and sponginess and all seams for separating, splitting, deterioration, and looseness.
4. Check for evidence of water ponding. Ponding on the roof is best checked 1 to 3 days after percipitation to assure ponding (lack of drainage) is indeed a problem.
5. Check all flashing for wind damage, loss of bituminous coating, damaged caulking, curling and exposed edges. Check flashing fasteners for looseness and deterioration. Check all metal gravel stops for damage and deterioration.
6. Note that all water entries into a building are not necessarily caused by a leaking roof. Water problems can be caused by condensation, negative air pressure within the building, or entry through walls or mechanical equipment. Condensation problems are common.
7. If roof leaks are extensive, perform flood test. See Section 1.3 for description. Seal all storm water systems; i.e., downspouts, roof drains, and scuppers. Flood to determine actual extent of leak problems.
8. Check all pitch pockets for cracking, proper filling, and flashing and metal damage.
9. Check seats on all roof penetrations for any deterioration.

INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: BUILT-UP MEMBRANE (Continued)
CONTROL NUMBER: GSS 0.05.01

10. Check all roof penetrations for deterioration.
11. Check for excessive condensation (including skylights).

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladder

INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: SINGLE-PLY MEMBRANE
CONTROL NUMBER: GSS 0.05.02

APPLICATION

This guide applies to all single-ply membrane roofing systems

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons.
3. This is a general inspection, and deficiencies should be handled on a service call or repair basis.
4. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
5. Review any roof warranties for special requirements.
6. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets. (See GSS 0.05.07)
2. Inspect all flashing and/or fascia, if applicable.
3. Inspect downspouts, gutters and/or roof drains as potential sources for deficiencies in the roof systems. (See GSS 0.05.09)
4. Inspect all roof penetrations. (See GSS 0.05.08)
5. Inspect all service walkways.
6. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.

INSPECTION ACTIONS

A Condition Assessment Survey of Single-Ply/IRMA roofing to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance, and condition - check for debris, rags, leaves, and equipment that could cause blockage of roof drainage system.
2. Check for overall water tightness, including location and duration of any water leaks.
3. Check for splits, wrinkles, bubbles, buckling, sponginess, and loss of ballast, if applicable.
4. Check all seams for separation, splitting, deterioration, and looseness.
5. Check for evidence of water ponding. Ponding on the roof is best checked 1 to 3 days after percipitation to assure ponding (lack of drainage) is indeed a problem.
6. Check all flashings for wind damage, damaged caulking, curling, exposed edges, etc.
7. Check all metal gravel stops for damage and deterioration.
8. Check for excessive condensation.
9. Check for algae, moss, and plant growth.
10. Check for proper placement of ballast or roof anchorage.
11. Check all roof penetrations for loose anchorage, cracks and holes, etc.
12. If roof leaks are extensive, perform flood test. See Section 1.3 for description. Seal all storm water systems, i.e., downspouts, roof drains, and scuppers. Flood to determine actual extent of leak problems.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladder

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: METAL ROOFING SYSTEMS
CONTROL NUMBER: GSS 0 05.03

APPLICATION

This guide applies to all metal roof panel systems, including standing seam, metal ribbed, and composite material, and associated work.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions
2. Schedule this work prior to heating and cooling seasons.
3. This is a general inspection, and deficiencies should be handled on a service call or repair basis.
4. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
5. Review any roof warranties for special requirements.
6. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Repair any flashing and sheet metal deficiencies.
2. Inspect all flashing.
3. Inspect parapets, if applicable. (See GSS 0.05.07)
4. Inspect downspouts, gutters and/or roof drains as potential sources for deficiencies in the roof systems. (See GSS 0.05.09)
5. Inspect all roof penetrations. (See GSS 0.05.08)
6. Inspect skylights, as applicable. (See GSS 0.05.10)
6. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.

INSPECTION ACTIONS

A Condition Assessment Survey of Metal Roofing to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance, including leaves or any debris that may have accumulated.
2. Check for overall water tightness, including presence of, or location and duration of, any water leaks. Verify any historical information for leaks during long-continued rain, leaks occurring every rain, etc.
3. Check for locations or presence of dampness and stains; note locations, type, and cause of stain.
4. Check all seams and flashing for wind damage, damaged or missing fasteners, or other deterioration.
5. Check all roof penetrations for loose anchorage, cracks, holes, etc.
6. Check for excessive corrosion, pitting, scaling, finish loss, and damaged units.
7. Check for loose or missing anchorage or movement, sagging, bending, or cracks.
8. Check for excessive condensation.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladder

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: COATED FOAM MEMBRANE
CONTROL NUMBER: GSS 0.05.04

APPLICATION

This guide applies to all coated foam membranes

SPECIAL INSTRUCTIONS

1 Review manufacturer's or installer's instructions.
2 Schedule this inspection prior to heating and cooling seasons.
3. This is a general inspection, and deficiencies should be handled on a service call or repair basis.
4. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
5. Review any roof warranties for special requirements.
6. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets and/or fascia, if applicable. (See GSS 0.05.07)
2. Inspect all flashing.
3. Inspect downspouts, gutters and/or roof drains as potential sources for deficiencies in the roof systems. (See GSS 0.05.09)
4. Inspect all roof penetrations. (See GSS 0.05.08)
5. Inspect all service walkways.
6. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.

INSPECTION ACTIONS

A Condition Assessment Survey of Coated Foam Roofing to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance, and condition - check for debris, rags, leaves, and equipment that could cause blockage of roof drainage system.
2. Check for overall water tightness, including presence of or location and duration of any water leaks. Verify any historical information for leaks during long, continued rain, leaks occurring every rain, etc.
3. Check for splits, wrinkles, bubbles, buckling, holes, and sponginess.
4. Check for surface deterioration, separation, splitting, and punctures in protective coating.
5. Check for evidence of water ponding. Ponding on the roof is best checked 1 to 3 days after percipitation to assure ponding (lack of drainage) is indeed a problem.
6. Check all flashing for wind damage, loss of coating, damaged caulking, curling, exposed edges, etc.
7. Check all metal gravel stops and flashing for loose anchorage, damage, and deterioration.
8. Check all pitch pockets for cracking, proper filling, and flashing and metal damage.
9. Check seals on all roof penetrations and for any deterioration, cracks, or holes.
10. Check for excessive condensation.
11. Check for algae, moss, and plant growth.
12. If roof leaks are extensive, perform flood test. See Section 1.3 for description. Seal all storm water systems; i.e., downspouts, roof drains, and scuppers. Flood to determine actual extent of leak problems.

INSPECTION METHODS - STANDARD

SYSTEM/COMPONENT: COATED FOAM MEMBRANE(Continued)
CONTROL NUMBER: GSS 0.05.04

TOOLS & MATERIALS

1 Standard Tools - Basic
2. Ladder

INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: SHINGLES
CONTROL NUMBER: GSS 0.05.05

APPLICATION

This guide applies to all roofing shingles, including asphalt, fiberglass, wood, mineral fiber cement, and slate.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons.
3. This is a general inspection, and deficiencies should be handled on a service call or repair basis.
4. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
5. Review any roof warranties for special requirements.
6. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets and/or fascia, if applicable. (See GSS 0.05.07)
2. Inspect flashing and caulking.
3. Inspect downspouts, gutters and/or roof drains as potential sources for deficiencies in the roof systems. (See GSS 0.05.09)
4. Inspect all roof penetrations. (See GSS 0.05.08)
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.

INSPECTION ACTIONS

A Condition Assessment Survey of Shingle or Shake roofing to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance, and condition - check for debris, rags, leaves, and equipment that could cause blockage of roof drainage system.
2. Check for overall water tightness, including presence of, or location and duration of, any water leaks. Verify any historical information for leaks during long-continued rain, leaks occurring every rain, etc.
3. Check for worn, deteriorated, rotting, split, and missing shingles.
4. Check for failed, loose, or missing fasteners.
5. Check all flashing for soundness, wind damage, loose seams and edges, damaged caulking, curling, and exposed edges.
6. Check all roof penetrations, valleys, and ridges for any damage or deterioration.
7. Check condition of any paints or coating for cracks, peeling, stains, and deterioration.
8. Check for excessive condensation.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladder

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: **TILES**
CONTROL NUMBER: GSS 0.05.06

APPLICATION

This guide applies to all roofing tiles, including metal, plastic, clay, and concrete.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons.
3. This is a general inspection, and deficiencies should be handled on a service call or repair basis.
4. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
5. Review any roof warranties for special requirements.
6. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets and/or fascia, if applicable. (See GSS 0.0507)
2. Inspect flashing and caulking.
3. Inspect downspouts, gutters and/or roof drains as potential sources for deficiencies in the roof systems. (See GSS 0.0509)
4. Inspect all roof penetrations. (See GSS 0.05.08)
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.

INSPECTION ACTIONS

A Condition Assessment Survey of roofing tiles to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance, and condition - check for debris, rags, leaves, and equipment that could cause blockage of roof drainage system.
2. Check for overall water tightness, including presence of, or location and duration of, any water leaks. Verify any historical information for leaks during long-continued rain, leaks occurring every rain, etc.
3. Check for worn, deteriorated, cracked, loose, and missing tiles.
4. Check for failed, loose, or missing fasteners.
5. Check all flashing for soundness, wind damage, loose seams and edges, damaged caulking, curling, and exposed edges.
6. Check all roof penetrations for any damage or deterioration.
7. Check condition of any paints or coatings for any cracks, peeling, stains, and deterioration.
8. Check for excessive condensation.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladder

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: PARAPETS
CONTROL NUMBER: GSS 0.05 07

APPLICATION

This guide applies to all exterior wall assemblies used as building parapet walls, including brick, concrete, metal, stone, precast concrete, concrete masonry units, and terra cotta.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions, if applicable.
2. Schedule this inspection prior to heating and cooling seasons.
3. This is a general inspection, and deficiencies should be handled on a service call or repair basis.
4. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
5. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect roof system.
2. Inspect flashing and caulking.
3. Inspect downspouts, gutters and/or roof drains as potential sources for deficiencies in the roof systems. (See GSS 0.05.09)
4. Inspect all roof penetrations. (See GSS 0.05.08)

INSPECTION ACTIONS

A Condition Assessment Survey of Parapets to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance and condition of construction material for cleanliness, damage, or deterioration.
2. Check for structural-related stress in the form of cracks, pop-outs, or separations.
3. Check condition of coping, counter flashing, base flashing, and expansion/contraction joints for wind damage, soundness, loose seams and edges, curling, exposed edges, holes, or openings.
4. Check condition of sealants including cracking, deformation, or deterioration.
5. Check for separation or gaps between the brick, stone, terra cotta, or concrete masonry units and the mortar and any deterioration or missing sections.
6. Check the condition of the mortar joints relative to size, tooling, shrinkage, cracks, and voids.
7. Check for locations or presence of dampness and/or stains. Note location and determine type of stain and cause.
8. Check for step cracking, cracked units, fractured, pitted, spalling, or crumbling surfaces
9. Check for overall water tightness, including location and duration of any water leaks. Verify any historical information for leaks during long-continued rain, leaks occurring every rain, etc.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladders or Lifts

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: ROOF DRAINAGE SYSTEM
CONTROL NUMBER: GSS 0.05.08

APPLICATION

This guide applies to all roof drainage systems and associated work.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Perform work in late autumn after leaves have fallen or in spring after winter season.
3. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
4. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect roof system.
2. Inspect parapets and/or fascia, if applicable. (See GSS 0.0507)
3. Inspect roof specialties and accessories. (See GSS 0.05.08)
4. Inspect flashing and caulking.
5. Inspect skylights, if applicable. (See GSS 0.05.10)

INSPECTION ACTIONS

A Condition Assessment Survey of roof drainage to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance, and condition - check for debris, rags, leaves, and equipment that could cause blockage of roof drainage system.
2. Check all seams for separation, deterioration, and looseness.
3. Check for obstructions to proper drainage flow.
4. Check for water tightness, including presence of, or location and duration of, any water leaks. Verify any historical information for leaks during long-continued rain, leaks occurring every rain, etc.
5. Check for missing or damaged anchors.
6. Check condition of any paint or coatings for damage or deterioration such as cracks, peeling, etc.
7. Check for any plant growth.
8. Check for broken or clogged drains.
9. Check for proper roof slope.
10. Seal all storm water systems; i.e., downspouts, roof drains, and scuppers. Flood test roof r drainage system to determine water tightness and operation.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladder

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: ROOF SPECIALTIES
CONTROL NUMBER: GSS 0.0509

APPLICATION

This guide applies to all roof specialties, including roof hatches, equipment curbs, ventilators, vents, coping, gravel stops, fascia, roof expansion joints, and associated work.

SPECIAL INSTRUCTIONS

A Condition Assessment Survey of roof specialties to include visual survey, examination of building records, and analysis. Points include:

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons.
3. This is a general inspection and deficiencies should be handled on a service call or repair basis.
4. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.

CONCURRENT ACTIONS

1. Inspect roof system.
2. Inspect flashing and caulking.

INSPECTION ACTIONS

A Condition Assessment Survey of roof specialties to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance and condition of roof specialties (e.g., vents, roof hatch, etc.) for proper operations, surface deterioration, finish loss, damage, and missing parts.
2. Check condition of flashing and curbs for wind damage, soundness, loose seams and edges, curling, exposed edges, and loose or missing fasteners.
3. Check for overall water tightness, including presence of, or location and duration of, any water leaks. Verify any historical information for leaks during long, continued rain, leaks occurring every rain, etc.
4. Check for locations or presence of dampness and or stains; note locations and determine type of stain and cause.
5. Check all sealants for cracks, deformation, or deterioration.
6. Check condition of gaskets and/or putty for deformation, and deterioration including any cracking or missing areas that could allow water penetration or glazing slippage.
7. Check condition of metal frames and surfaces for indications of excessive corrosion, pitting, scaling, checking, warping, and finish loss.
8. Check condition of wood frames for indications of wood rot, cracked and broken sections, and finish failure.
9. Check operation and condition of hardware for smoke/explosion relief vents, roof hatches, ventilators, and vents where applicable. Lookifor any damaged, inoperative, or deteriorating conditions.
10. If roof leaks are extensive, perform flood test. See Section 1.3 for description. Flood to determine actual extent of leak problems.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladder

INSPECTION METHODS • STANDARD

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INSPECTION METHODS - STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: SKYLIGHTS
CONTROL NUMBER: GSS 0.05.10

APPLICATION

This guide applies to all skylights, glass and plastic, and associated frames and curbs

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons.
3. This is a general inspection, and deficiencies should be handled on a service call or repair basis.
4. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
5. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect roof system.
2. Inspect flashing and caulking.

INSPECTION ACTIONS

A Condition Assessment Survey of skylights to include visual survey, examination of building records, and analysis. Points include:

1. Check general appearance and condition of sealants for cracking, deformation, or deterioration.
2. Check condition of flashing and curbs for wind damage, soundness, loose seams and edges, curling, exposed edges, and loose or missing fasteners.
3. Check for overall water tightness, including presence of, or location and duration of, any water leaks. Verify any historical information for leaks during long-continued rain, leaks occurring every rain, etc.
4. Check for locations or presence of dampness and/or stains. Note locations and determine type of stain and cause.
5. Check condition of gaskets and/or putty for deformation and deterioration, including any cracking.
6. Check general appearance and condition of metal frames for indications of excessive corrosion, pitting, scaling, checking, warping, and finish loss.
7. Check condition of wood frames for indications of wood rot, cracked and broken sections, and finish failure.
8. Check condition of glazing for cracked and broken sections, scratches, shrinkage, deflection, and deformation.
9. If roof leaks are extensive, perform flood test. See Section 1.3 for description. Flood surface to determine actual extent of leak problems.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladder

INSPECTION METHODS - STANDARD

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INSPECTION METHODS - NON-STANDARD

Non-Standard methods for Roofing include primarily non-visual inspection techniques based on external testing. The primary testing methodology Include Nuclear, Capacitance and Inflated tests. TABLE TWO illustrates evaluation methods recommended for different assemblies Cole sampling, (destructive testing), is also considered as a non-standard testing method For further information see Section 1; Subsection 1.3.1 Testing Methods.

TABLE TWO

	Evaluation Methods		
	Capacitance	Nuclear	Infrared
Conventional BURs			
BUR (no Insulation)	.	0	
Insulation type	.		
Fiberboard	.	.	.
Perlite Board	.	.	.
Fiberglass	.	.	.
Urethane/Perlite composite	.	.	.
Urethane	.	.	.
Extruded polystyrene	–		
Beadboard	.	.	.
(expanded polystyrene)			
Cellular glass (foam glass)	.		
Lightweight concrete			
All-weathercrete	.		
Urethane with foil backing		•	•
Sprayed-on urethane			•
Single-Ply Membrane Systems			
(with commonly used Insulations eg EPS, urethane)			
Neoprene, ballasted	o	0	
Neoprene, unballasted	o	o	0
PVC, ballasted	o	0	
PVC, unballasted	o	0	0
CPE, ballasted	o	o	
CPE, unballasted	o	o	0
CSPE, ballasted	o	o	
CSPE, unballasted	o	o	0
PIB, ballasted	o	0	
PIB, unballasted	o	o	0
EPDM, ballasted		o	
EPDM, unballasted		0	0
Inverted roofs of membrane assembly system			

Source: Preventive Maintenance of Buildings; Matulionis and Freitalt.

Legend: • Represents good value O Represents limited value, Represents no value

INSPECTION METHODS - NON-STANDARD

GUIDE SHEETS

The following Guide Sheets outline an overview of inspection methods and requirements used in providing a general non-standard roof inspection. For these non-standard inspections, it is assumed that all standard inspections will be completed in order to determine non-standard methodology (However, non-standard methods may be implemented as a non-contingent option.) Non-standard Guide Sheets have been developed for each major membrane type and associated assembly components as follows:

TABLE THREE

Assembly/Component	Control Number
Built-Up Membrane	GSNS 0.05.01
Single Ply Membrane	GSNS 0.05.02
Metal Roofing Systms	GSNS 0.05.03
Coated Foam Membrane	GSNS 0.05.04
Shingles	GSNS 0.05.05
Tiles	GSNS 0.05.06
Parapets	GSNS 0.05.07
Roof Drainage System	GSNS 0.05.08
Roof Specialties	GSNS 0.05.09
Skylights	GSNS 0.05.10

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: BUILT-UP MEMBRANE
CONTROL NUMBER: GSNS 0.05.01

APPLICATION

This guide applies to all non-standard Inspection procedures for built-up bituminous roofing systems with associated insulation.

SPECIAL INSTRUCTIONS

1 Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions.
3. Review any roofing warranties for special requirements.
4 Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets. (See GSNS 0.05.07)
2. Inspect downspouts, gutters, and/or as potential sources for deficiencies in the roofing systems, (See GSNS 0.05.09)
3. Inspect all roof penetrations.
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.01.

INSPECTION ACTIONS

Based on results of GSS 0.05.01 and/or as directed, proceed to non-standard inspections. Points include:

1. The three non-destructive methods employed for defining wet areas in the roofing system include capacitance metering, nuclear metering, and infrared scanning (aerial or surface). Perform infrared scans at night for most accurate readings. Both wet and dry areas should be checked and all problem areas clearly marked. (See Non-Standard Inspection Methods, TABLE TWO, pg. 3.1-25 for appropriate test selection.)
2. Based on Testing Methods employed under Step 1, take core sample(s) for analysis to determine roof system deterioration. Analysis should include environmental testing to determine extent of external environmental conditions on the in-site roof material. Check with roofing manufacturer's warranty before taking a core sample to ensure compliance. Patch all cores at once.
3. Perform an environmental data analysis to determine the effects of external environmental conditions on the roof materials.
4. Cut and remove membrane test sections to inspect the insulation and/or deck Patch and repair all cuts immediately. Check with roof manufacturer's warranty before cutting roof to ensure compliance. This test is an option if core sampling fails to locate problems or deficiencies and larger sections of the roof require analysis.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: BUILT-UP MEMBRANE (Continued)
CONTROL NUMBER: GSNS 0 05 01

TOOLS & MATERIALS

1. Standard Tools - Basic
2. Ladder
3. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: SINGLE-PLY MEMBRANE
CONTROL NUMBER: GSNS 0.05.02

APPLICATION

This guide applies to all non-standard inspection procedures tor single-ply/IRMA membrane roofing systems with associated insulation.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions.
3. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
4. Use secure line with belt if necessary.
5. Review any roofing warranties for special requirements.
6. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets. (See GSNS 0.05.07)
2. Inspect downspouts, gutters, and/or roof drains as part of overall problems that could enhance roofing systems deficiencies
3. Inspect all roof penetrations.
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.02.

INSPECTION ACTIONS

Based on results of GSS 0.05.02 and/or as directed, proceed to non-standard inspections. Points include:

1. The three non-destructive methods employed for defining wet areas in the roofing system include capacitance metering, nuclear metering, and infrared scanning (aerial or surface). Perform infrared scans at night for most accurate readings. Both wet and dry areas should be checked and all problem areas clearly marked. (See Non-Standard Inspection Methods, TABLE TWO, pg. 3.1-25 for appropriate test selection.)
2. Based on Testing Methods employed under Step 1, take core sample(s) for analysis to determine Roof System deterioration. Analysis should include environmental testing to determine extent of external environmental conditions on the in-site roof material. Check with roofing manufacturer's warranty before taking a core sample to ensure compliance. Patch all cores at once.
3. Perform an environmental data analysis to determine the effects of external environmental conditions on the roof materials.
4. Cut and remove test sections of membrane to inspect the insulation and/or deck for excessive moisture and corrosion of metal decking. Patch and repair all cuts immediately. Check with roof manufacturer's warranty before cutting roof to ensure compliance. This test is an option if core sampling fails to locate problems or deficiencies and larger sections of the roof require analysis.

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: SINGLE-PLY MEMBRANE (Continued)
CONTROL NUMBER: GSNS 0.0502

TOOLS & MATERIALS

1. Standard Tools - Basic
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: METAL ROOFING SYSTEMS
CONTROL NUMBER: GSNS 0.05.03

APPLICATION

This guide applies to all non-standard inspection procedures for metal roofing systems with associated insulation.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions.
3. Review any roofing warranties for special requirements.
4. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets. (See GSNS 0.05.07)
2. Inspect downspouts, gutters, and/or roof drains as potential sources for deficiencies in the roofing systems. (See GSNS 0.05.09)
3. Inspect all roof penetrations.
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.03.

INSPECTION ACTIONS

Based on results of GSS 0.05.03 and/or as directed, proceed to non-standard inspections. Points include:

1. Welded joints of metal roofing systems can be X-rayed or ultrasonic tested to determine degree of deterioration and material thickness.
2. Magnetic particle testing can be employed to test for surface flaws
3. Perform an environmental data analysis to determine the effects of external environmental conditions on the roof materials. This should include analysis of any corrosion to determine cause and type.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

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INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: COATED FOAM MEMBRANE
CONTROL NUMBER: GSNS 0 05 04

APPLICATION

This guide applies to all non-standard inspection procedures for coated foam membranes with associated insulation.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions.
3. Review all historical data on the roof system to be inspected including inspection reports, previous problems, and corrective actions.
4. Review any roofing warranties for special requirements.
5. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets. (See GSNS 0.05.07)
2. Inspect downspouts, gutters, and/or roof drains as potential sources for deficiencies in the roofing systems. (See GSNS 0.05.09)
3. Inspect all roof penetrations.
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.04.

INSPECTION ACTIONS

Based on results of GSS 0.05.04 and/or as directed, proceed to non-standard inspections. Points include:

1. The three non-destructive methods employed for defining wet areas in the roofing system include capacitance metering, nuclear metering, and infrared scanning (aerial or surface). Perform infrared scans at night for most accurate readings. Both wet and dry areas should be checked and all problem areas clearly marked.
2. Based on Testing Methods employed under Step 1, take core sample(s) for analysis to determine Roof System deterioration. Analysis should include environmental testing to determine extent of external environmental conditions on the in-site roof material. Check with roofing manufacturer's warranty before taking a core sample to ensure compliance. Patch all cores at once.
3. Roofing system can be X-rayed or ultrasonic tested to determine degree of deterioration and material thickness.
4. Perform an environmental data analysis to determine the effects of external environmental conditions on the roof materials.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

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INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: SHINGLES
CONTROL NUMBER: GSNS 0.05.05

APPLICATION

This guide applies to all non-standard inspection procedures for shingled roofing systems with associated insulation.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions.
3. Review any roofing warranties for special requirements.
4. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets. (See GSNS 0.05.07)
2. Inspect downspouts, gutters, and/or roof drains as potential sources for deficiencies in the roofing systems. (See GSNS 0.05.09)
3. Inspect all roof penetrations.
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.05.

INSPECTION ACTIONS

Based on results of GSS 0.05.05 and/or as directed, proceed to non-standard inspections. Points include:

1. The non-destructive methods employed for defining wet areas in the roofing system include nuclear metering, and infrared scanning (aerial or surface). Perform infrared scans at night for most accurate readings. Both wet and dry areas should be checked and all problem areas clearly marked. These methods are not as reliable with this type of roofing system.
2. Perform an environmental data analysis to determine the effects of external environmental conditions on the roof materials.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

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INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: TILES
CONTROL NUMBER: GSNS 0.05.06

APPLICATION

This guide applies to all non-standard inspection procedures for tile roofing systems with associated insulation.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions.
3. Review any roofing warranties for special requirements.
4. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect parapets. (See GSNS 0.05.07)
2. Inspect downspouts, gutters, and/or roof drains as potential sources for deficiencies in the roofing systems. (See GSNS 0.05.09)
3. Inspect all roof penetrations.
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.06.

INSPECTION ACTIONS

Based on results of GSS 0.05.06 and/or as directed, proceed to non-standard inspections. Points include:

1. The three non-destructive methods employed for defining wet areas in the roofing system include capacitance metering, nuclear metering, and infrared scanning (aerial or surface). Perform infrared scans at night for most accurate readings. Both wet and dry areas should be checked and all problem areas clearly marked. These methods are not as reliable with this type of roofing system.
2. Perform an environmental data analysis to determine the effects of external environmental conditions on the roof materials.
3. Roofing system can be X-rayed or ultrasonic tested to determine degree of deterioration and material thickness.
4. Remove a test tile or section to inspect the condition of all anchors or ties. Replace tiles immediately after inspection.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

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INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: PARAPETS
CONTROL NUMBER: GSNS 0.05.07

APPLICATION

This guide applies to all non-standard inspection procedures for parapet systems.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions
3. Review any roofing warranties for special requirements.
4. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect roof systems.
2. Inspect downspouts, gutters, and/or roof drains as potential sources for deficiencies in the roofing systems. (See GSNS 0.05.09)
3. Inspect all roof penetrations.
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.07.

INSPECTION ACTIONS

Based on results of GSS 0.05.07 and/or as directed, proceed to non-standard inspections. Points include:

1. The three non-destructive methods employed for defining wet or leaking areas in the parapets include capacitance metering, nuclear metering, and infrared scanning (aerial or surface). Scan or test flashing and coping joints to locate all cracks or breaks. Perform infrared scans at night for most accurate readings. Both wet and dry areas should be checked and all problem areas cracks, and breaks clearly marked. These methods are not as reliable with this type of assembly and results will vary with type of material. These methods should be done concurrently with the roofing system.
2. Parapet assemblies can be X-rayed or ultrasonic tested to determine degree of deterioration and material thickness.
3. Perform an environmental data analysis to determine the effects of external environmental conditions on the roof materials.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

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INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: ROOF DRAINAGE SYSTEM
CONTROL NUMBER: GSNS 0.05 08

APPLICATION

This guide applies to all non-standard inspection procedures for roof drainage systems with associated insulation.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions
3. Review any roofing warranties for special requirements.
4. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect roof systems.
2. Inspect parapets. (See GSNS 0.05.07)
3. Inspect all roof penetrations.
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.08.

INSPECTION ACTIONS

Based on results of GSS 0.05.09 and/or as directed, proceed to non-standard inspections. Points include:

1. Perform an environmental data analysis to determine the effects of external environmental conditions on the drainage system materials.
2. Welded joints on metal components of drainage system can be X-rayed or ultrasonic tested to determine degree of deterioration and material thickness.
3. Magnetic particle testing can be employed to test for surface flaws in material.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

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INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: ROOF SPECIALTIES
CONTROL NUMBER: GSNS 0.05.09

APPLICATION

This guide applies to all non-standard inspection procedures for roof specialties Including roof hatches, scuttles, fire/smoke hatches and associated work.

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2 Schedule this inspection prior to heating and cooling seasons during dry conditions
3. Review any roofing warranties for special requirements.
4. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect roof systems.
2. Inspect parapets. (See GSNS 0.05.07)
3. Inspect downspouts, gutters, and/or roof drains as potential sources for deficiencies in the roofing systems. (See GSNS 0.05.09)
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.09.

INSPECTION ACTIONS

Based on results of GSS 0.05.08 and/or as directed, proceed to non-standard inspections. Points include:

1. Perform an environmental data analysis to determine the effects of external environmental conditions on the roof materials.
2. Welded joints on metal components of drainage system can be X-rayed or ultrasonic tested to determine degree of deterioration and material thickness.
3. Magnetic particle testing can be employed to test for surface flaws in material.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

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INSPECTION METHODS - NON-STANDARD

GUIDE SHEET

SYSTEM/COMPONENT: SKYLIGHTS
CONTROL NUMBER: GSNS 0 05 10

APPLICATION

This guide applies to all non-standard inspection procedures for all skylights and associated work

SPECIAL INSTRUCTIONS

1. Review manufacturer's or installer's instructions.
2. Schedule this inspection prior to heating and cooling seasons during dry conditions
3. Review any roofing warranties for special requirements.
4. Refer to references and glossaries as needed.

CONCURRENT ACTIONS

1. Inspect roof system.
2. Inspect parapets. (See GSNS 0.05.07)
3. Inspect downspouts, gutters, and/or roof drains as potential sources for deficiencies in the roofing systems. (See GSNS 0.05.09)
4. Inspect all service walkways, if applicable.
5. Inspect underside of roof deck and structure for dampness, stains, rust, or any other signs of damage or deterioration.
6. Complete inspection requirements listed in GSS 0.05.10.

INSPECTION ACTIONS

Based on results of GSS 0.05.10 and/or as directed, proceed to non-standard inspections. Points include:

1. The three non-destructive methods employed for defining cracks or leaks in roof specialties include capacitance metering, nuclear metering, and infrared scanning (aerial or surface). Perform infrared scans at night for most accurate readings. Test skylights in conjunction with the roof system.
2. Welded joints on metal components of drainage system can be X-rayed or ultrasonic tested to determine degree of deterioration and material thickness.
3. Magnetic particle testing can be employed to test for surface flaws in material.
4. Perform an environmental data analysis to determine the effects of external environmental conditions on the roof materials.

TOOLS & MATERIALS

1. Standard Tools - Basic
2. As required for the type of test being performed

INSPECTION METHODS - NON-STANDARD

END OF SUBSECTION

DATA COLLECTION METHODS

GENERAL

The heart of the CAS System is built around the hand-held data collection device and the CAIS software that supports it. As discussed in the Introduction, this is a “new way” of seeing and recording specific standardized information. Several phases are involved in the CAS inspection process They include.

PHASE I — PRESURVEY

- Facility managers review assets and assign each an Asset Determinant Factor (ADF) to define the level and type of inspection to be accomplished (see Subsection 1 .1 for definition).
- Facility managers assign specific assets to CAS inspectors.
- The CAS Inspector reviews existing asset data (including as-builts and past repair reports) and the Work Breakdown Structure (WBS) systems requiring inspection, which are then subdivided as necessary. (For example, a large roof may be subdivided into four (4) WBS items such as North, South, East and West sections.)
- The inspector establishes the Inspection Units (IU) to be surveyed based on the WBS (or multiple WBS). IUs may also be added in the field.
- Facility manager and/or staff downloads asset data into the hand-held data collection device.

PHASE 2 — SURVEY

- Conduct CAS inspection.
- Upload data into PC-based CAIS.
- Review raw data “universal” reports

PHASE 3 — **POSTSURVEY**

- Correct data, as necessary, issue final “universal” report, and create other required reports for facility managers.
- Data and reports are created and issued through DOE hierarchy (see Introduction).

DATA COLLECTION METHODS

ENTERING DATA: DATA COLLECTION MENU

SURVEY STEP: **LOGIN** SCREEN 1.0

The screen contains identification data including the inspector's name, ID number, and discipline to be inspected. This data may be input or preloaded. From this screen, several information and help pop-up aids can be accessed. Help functions would provide screen-specific instructions, and information functions would list special management instructions and/or schedules specifically for the inspector.

SURVEY STEP: **ASSET** IDENTIFICATION SCREEN 2.0

Asset identification including class, type, ADF number (see subsection 1.1 for ADF description), and asset ID numbers are captured on this screen. Pop-up screens with preformatted picklists (for type and class) are provided for the inspector's review and selection. Additional support screens include ASSET DIMENSIONS indicating key elements required for inspection (such as asset gross square footage, perimeter, height, etc.); and ASSET DESCRIPTION for recording asset name and address. Such information would be entered (or verified) by the inspector prior to the actual asset CAS inspection.

SURVEY STEP: WBS SELECTION SCREEN 3.0

This screen displays the preselected systems and WBS listings based on the ADF selected for the particular asset. Although all WBS assemblies for a system will be listed, the inspector selects only assemblies applicable to the specific asset. For example, although all system 0.05 Roof WBS categories are listed, the inspector would eliminate all non-applicable categories by "de-selecting" non-applicable items. Once this process is complete, the inspector can re-sort the included WBS items. Columns are also provided that indicate the survey status for each WBS item.

At this point, the inspector can subdivide the WBS. For example, the inspector may elect to split a large roof into four sections, each as a separate WBS, or isolate a pump from a WBS containing several pumps. This feature will allow the inspector to logically build his survey based on the unique properties and requirements of each asset.

Finally, while most WBS structuring will be accomplished prior to the CAS inspection, WBS subdivision can also be done in the field.

DATA COLLECTION METHODS

ENTERING DATA: DATA COLLECTION MENU (Contmued)

SURVEY STEP: INSPECTION UNIT (IU) SELECTION SCREEN 4.0

While screen 3.0 defines the WBS structure, screen 4.0 concerns selecting the IU for each WBS category In the CAIS software. the base CAS (see subsection 1 .1 for definition) is preset at the assembly level tor all systems. For example, a WBS Roof System, Built-up Membrane Roofing (0.05.01), is set at the assembly level. At this point the inspector would select the type of assembly based on a preselected picklist. (Such a picklist at the assembly level might include various roof assembly groupings: eg.. 3 to 5-ply asphalt with gravel coating and composite insulation.) If a more detailed inspectton is required, the inspector would “de-select” the base CAS assembly level by crossing through the LVL Box “Assy.” This action would bring up the next level “component.” In our roof example, this would mean that the inspector would now assess the membrane, flashing, and insulation as separate components. As with the assembly level, the inspector would choose a type from a selected picklist for each component. Although IUs are usually determined prior to the survey, multiple IUs may also be developed during the inspection. For example, a WBS of the south quadrant built-up roof may be divided into two IUs (eg., sw corner and remaining roof) if the inspector chooses to highlight and isolate some abnormal conditions from the main IU.

Additional information developed on this screen would include the percentage of WBS served by the IU, the estimated quantity (this figure will also be independently generated by CAIS status (see subsection 1.1), estimated life remaining useful without repair (WOR), and estimated age.

SURVEY STEP: DEFICIENCY ASSESSMENT SCREEN 4.1

With the WBS and IU established, the inspector now conducts the CAS inspection for each WBS IU. As the inspector surveys the asset, a preformatted picklist containing all deficiencies that may affect the particular WBS IU is reviewed. The default setting shows a zero in each coverage block, indicating no deficiencies. As the survey proceeds, the inspector “de-selects” this normal setting by entering a percentage of coverage under condition categories listed (light, moderate, severe, and fail). For example, inspector entries for WBS roofing, IU built-up membrane, deficiency “splitting” of 10% light, 0% moderate, 0% severe, 0% fail, would be interpreted by CAIS software as 90% normal, and light splitting occurring over 10% of the membrane. If the inspector cannot determine the condition using standard inspection methods, he can indicate the need for a non-standard inspection (NSIP) by de-selecting the “NO” in the NSIP column, To complete the inspection, the aforementioned procedures would be carried out for each deficiency noted by the Inspector.

DATA COLLECTION METHODS

ENTERING DATA: DATA COLLECTION MENU (Continued)

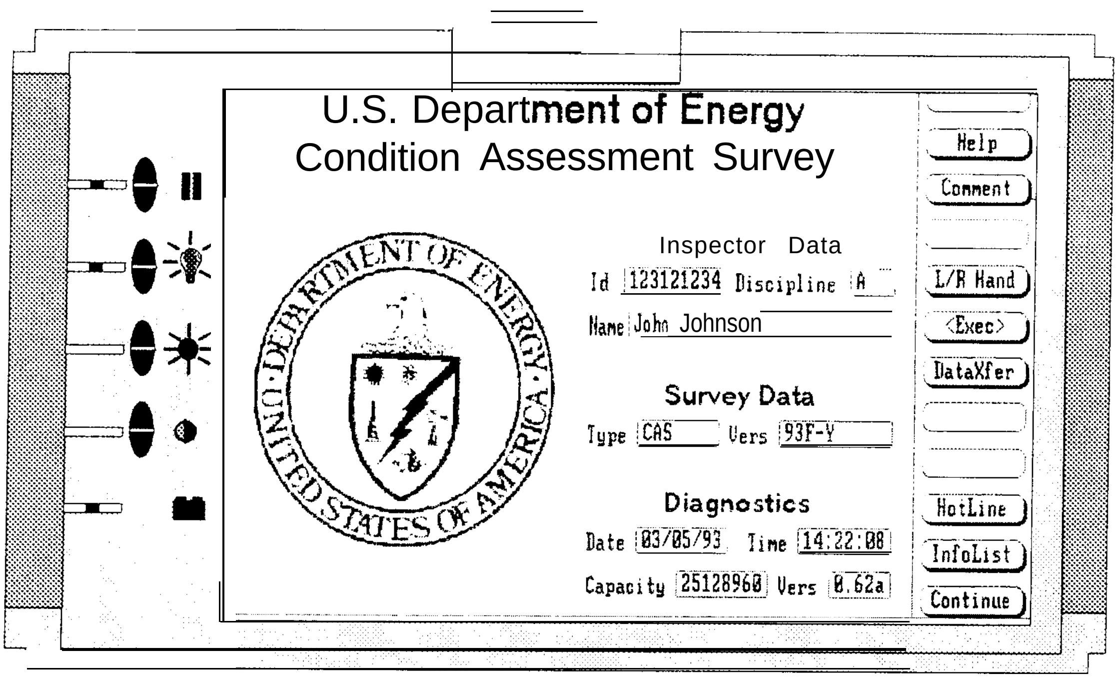
SURVEY STEP: SUMMARY CONDITION ASSESSMENT SCREEN 5.0

This final screen summarizes the WBS IU in three major categories urgency, purpose, and condition. In each category, the inspector will call up a picklist and select the category he feels is most appropriate for the WBS IU surveyed. (For the purpose category, the inspector may select multiple headings.) Additionally. the inspector may elect to enter an estimated cost and/or quantity (This is optional as CAIS will generate these data based on the inspector's survey information.) The inspector will also enter an estimated remaining life post-reparr. As an option, a work order may be generated based on the CAS survey information. This option is generated by selecting the WORK ORDER function key and filling out pertinent data. Finally, the inspector may choose to describe the repair more fully by selecting the REPAIR CHARACTER key.

After completing all WBS IUs, the CAS inspection for the system is complete. This procedure is repeated for each applicable system. Once all systems for the asset are complete, the rnformation is uploaded to the PC-based CAIS program for data analysis and report generation.

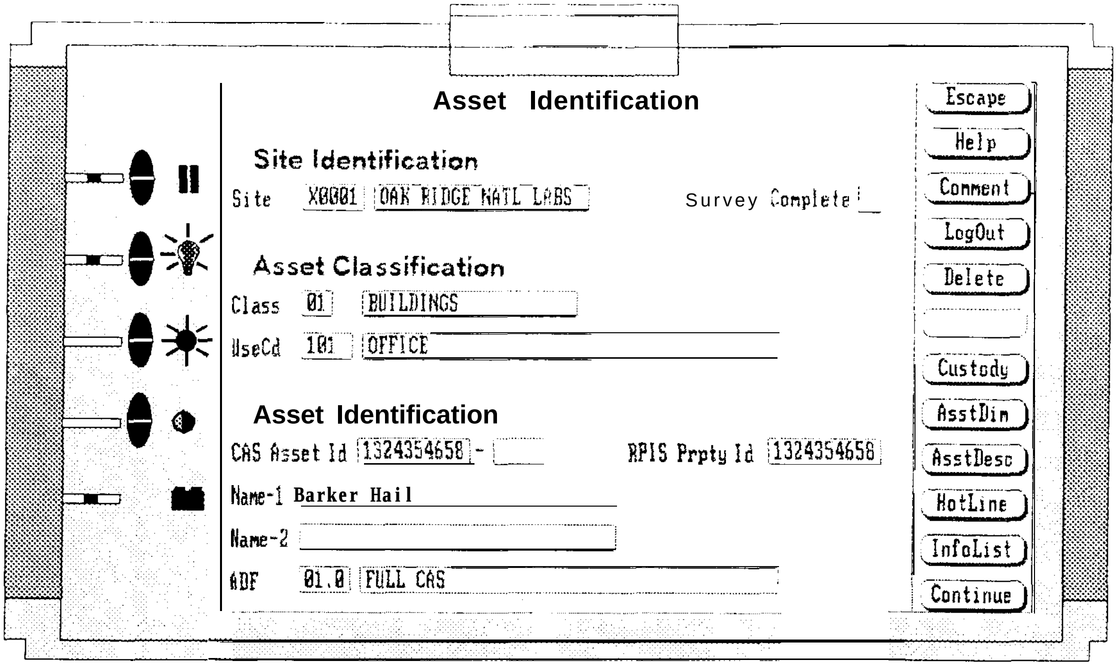
In the remainder of this subsection, actual data screens, as they will appear to the inspector, are displayed to illustrate a typical inspection. As previously noted, five main screens are used in the system supported by numerous "pop-up" lists, information, comment, and other auxiliary screens. In our examples, main screens are numbered 1.0 - 5.0; secondary screens are labeled 1.1, 1.2, etc.; and general support screens use the series 99.0. Key inspector actions on each screen are highlighted. Support function keys are listed below these main functions.

SURVEY STEP LOGIN Screen 1.0



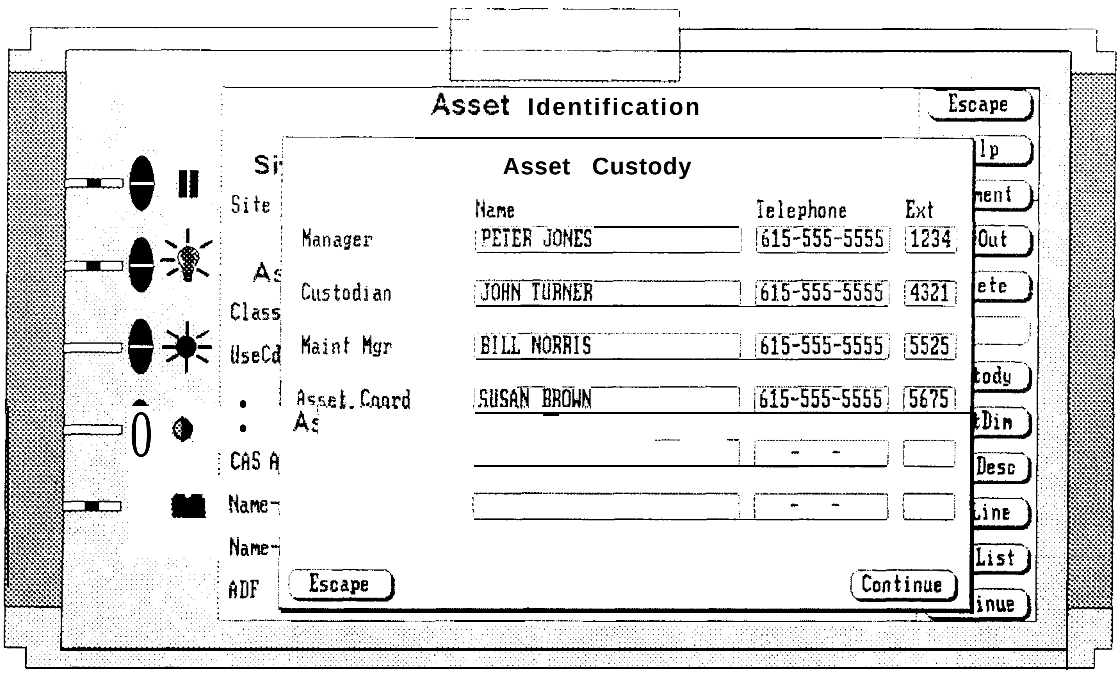
SCREEN	ACTION	COMMENT
1.0	1. Enter Name and Employee Id #	May be preloaded for security
	2. Tap "Discipline" title for picklist, cursor select or enter by pen	Picklist preformatted A=Arch, C=Site/Civil, E=Elec, M=Mech
	3. Tap "Type" and "Vers" title under Survey Data for picklist curser select or enter by pen	Picklist preformatted for type of survey to be performed and version date for record
	4. Diagnostics data is system generated and far information purposes only	N/A
	5. Press (Continue) to go to Screen 2.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information.
(Help)	Press to bring up screen help	Screen 99.1
(Comment)	Press to bring up screen for entering inspector comments	Screen 99.2
(LH/RH)	Press to change screen between Left or Right Hand use	N/A
(<Exec>)	Press to exit to the Grid System Menu	This option can be password protected
(DataXfer)	Press to transfer data to site computer	Used for data upload/download procedures
(Hotline)	Press for important contacts and telephone numbers	Screen 99.3
(InfoList)	Press to bring up information/directions preloaded for inspector	Screen 99 4

SURVEY STEP ASSET IDENTIFICATION Screen 2.0



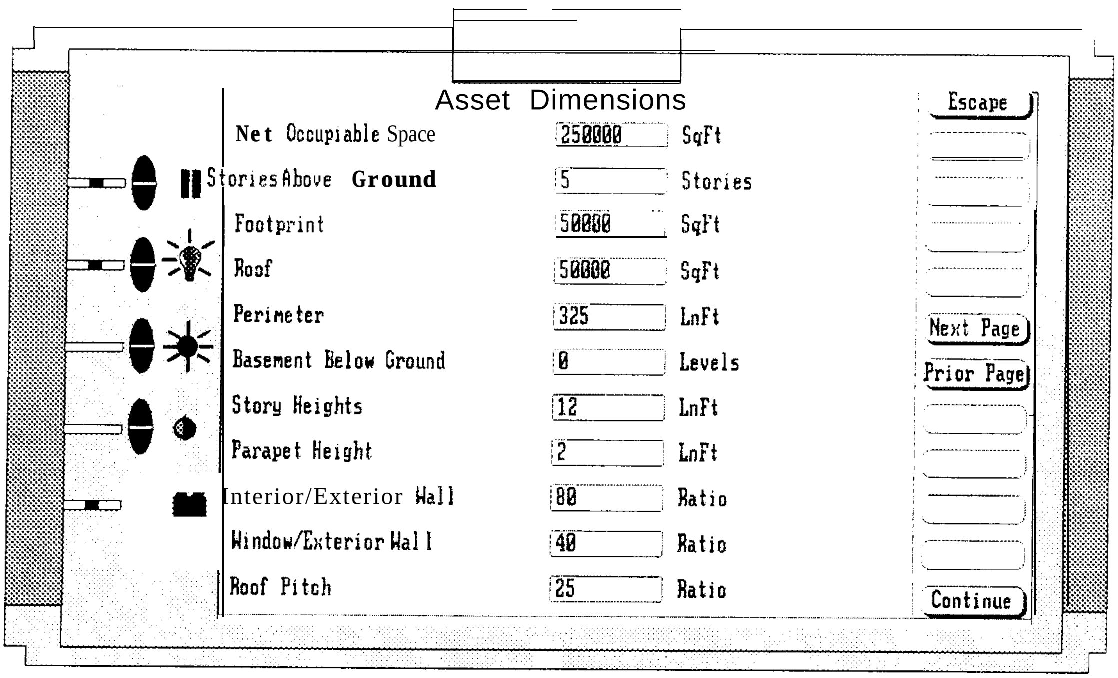
SCREEN	ACTION	COMMENT
2.0	1. Tap "Site" title for picklist Cursor select or enter by pen	Picklist can be preloaded, site code appears automatically to match name selected
	2 Tap "Class" title for pi&fist Cursor select or enter by pen or skip to item 4	Picklist preformatted based on RPIS categories
	3. Tap "Use Cd" title for picklist Cursor select or enter by pen or skip to item 4	Picklist preformatted based on RPW categories
	4. Enter Asset Identification information by selecting "CAS Asset Id" corresponding "RPIS Prpty Id" and "Name-l or Name-2" will be generated	This data can be preloaded
	5. Enter a Split Asset by creating an extension to "CAS Asset ID" and selecting a new name	This data can be preloaded or created by inspector
	6. Enter Asset Determinant Factor "ADF" provided by Site Mgr.	Determined by Site Manager prior to survey
	7. Press box next to Survey Complete upon completion of Asset survey	N/A
	8. Press (Continue) to go to Screen 3.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information
(Escape)	Press to return to Screen 1 .O	By pressing (Escape) information is not verified and any changes made are lost
(Help)	Press to bring up screen help	Screen 99.1
(Comment)	Press to bring up screen for entenng inspector comments	Screen 99.2
(Logout)	Press to save all data entered and leave survey	N/A
(Custody)	Press to bring up asset contact names	Screen 2.1 This data can be preloaded
(AssetDim)	Press to bring up screen for entering or verifying key asset dimensions	Screen 2.2 This data can be preloaded
(AssetDes)	Press to bring up screen for entering or verifying asset name, address and descriptions	Screen 2.3 This data can be preloaded
(HotLine)	Press for important contacts and telephone numbers	Screen 99.3
(InfoList)	Press to bring up informationldtrections preloaded for inspector	Screen 99.4

SURVEY STEP ASSET CUSTODY SCREEN **Screen 2.1**



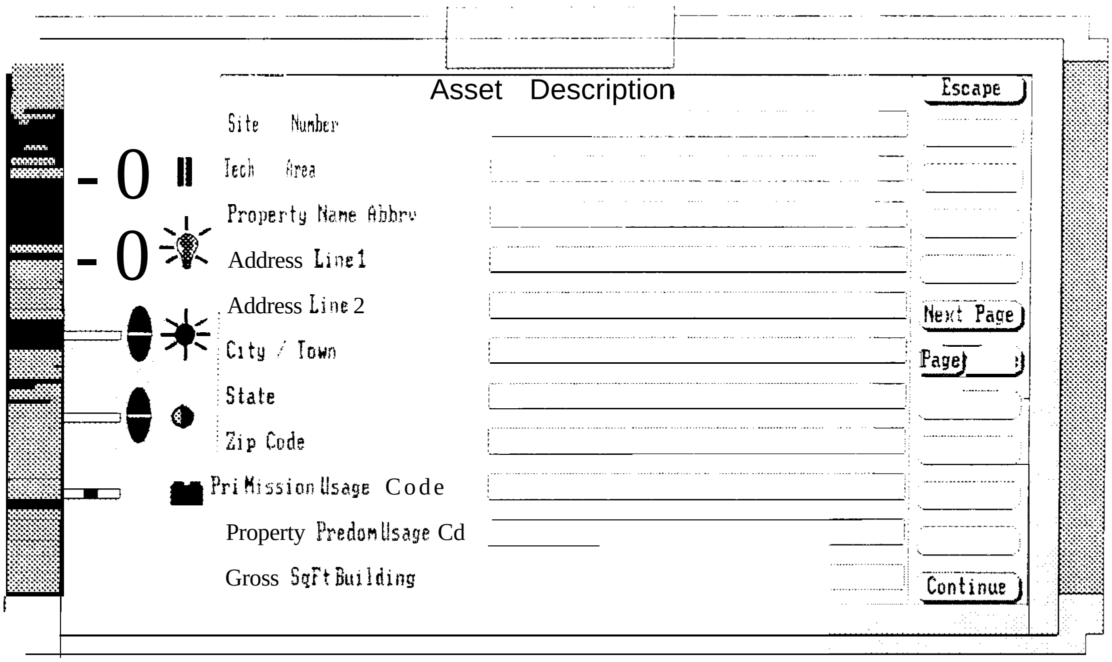
SCREEN	ACTION	COMMENT
2.1	1. Pop up window displays important names and numbers for asset. Cross through data and make any changes	Data can be either preloaded or inspector generated.
	2. Press (Continue) to return to Screen 2.9	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information.
(Escape)	Press to return to Screen 2.0	By pressing (Escape) information is not verified and any changes made are lost.

SURVEY STEP ASSET DIMENSIONS Screen 2.2



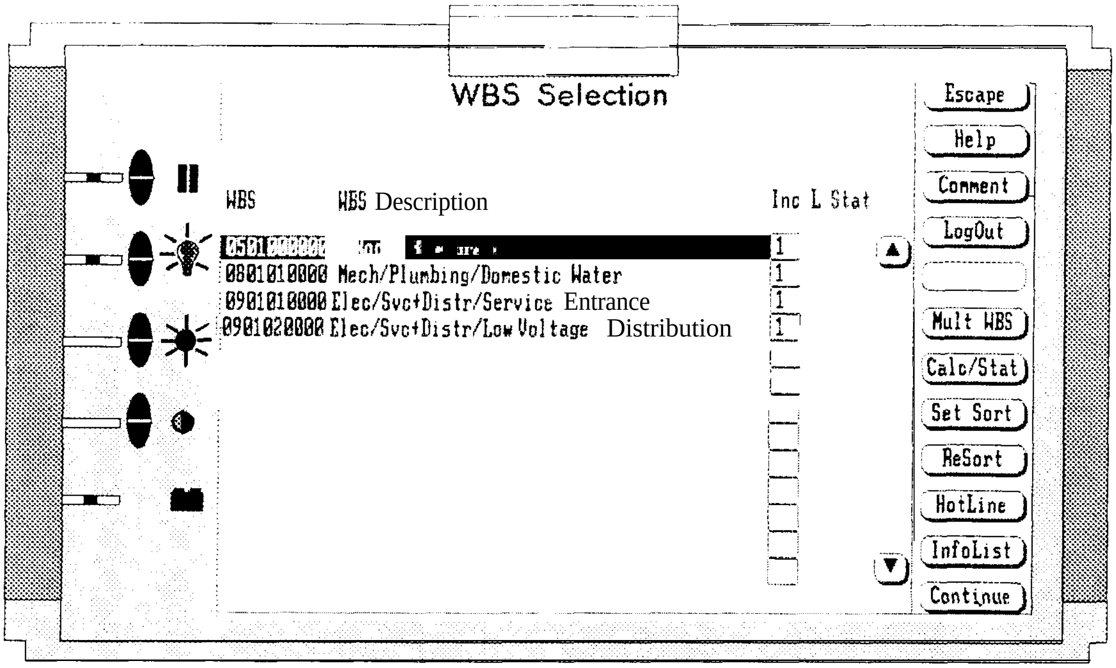
SCREEN	ACTION	COMMENT
I - - - - - -	1. Screen displays important dimension related to the asset verify data or cross through data and make any changes	Data can be either preloaded or inspector generated.
	2. Press (Continue) to return to Screen 2.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information.
(Escape)	Press (Escape) to return to Screen 2.0	By pressing (Escape) information is not verified and any changes made are lost.
(NextPage)	Press to bring up next screen of important dimensions	Data can be either preloaded or inspector generated.
(PriorPage)	Press to return to previous asset dimension screen	Data can be either preloaded or inspector generated.

SURVEY STEP ASSET DESCRIPTION Screen 2.3



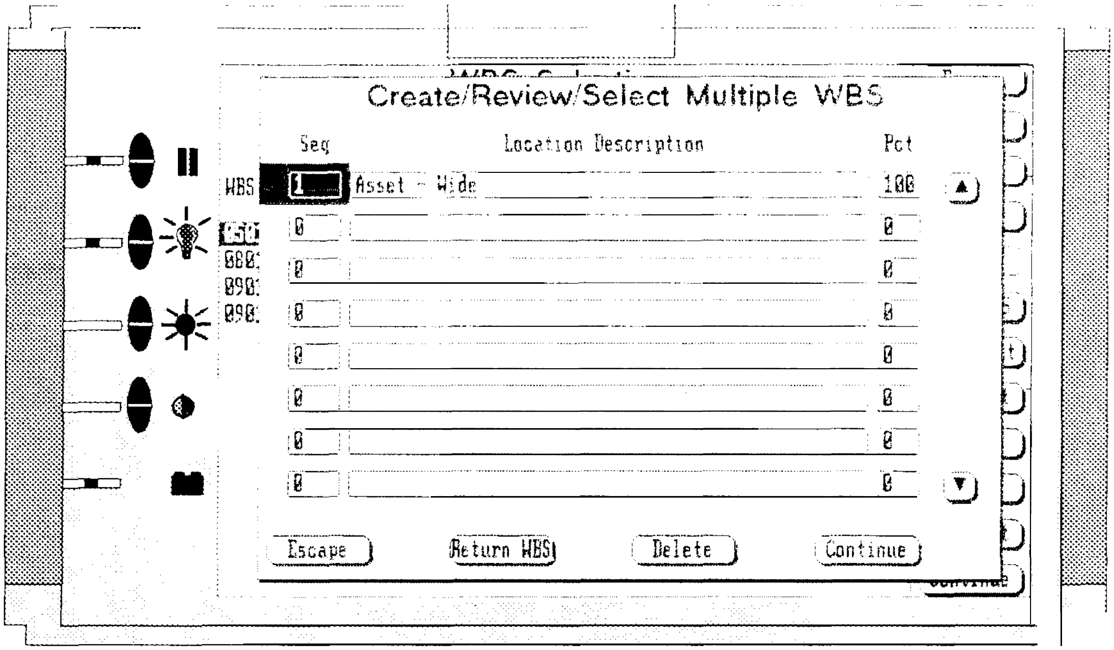
SCREEN	ACTION	COMMENT
2.3	1. Screen displays important asset description information verify data or cross through and make changes	Data can be either preloaded or inspector generated
	2, Press Continue to return to Screen 2.0	By pressing Continue information is verified; corrections made by crossing through data and entering new information
Escape	Press to return to Screen 2.0	By pressing -information is not verified and any changes made are lost
NextPage	Press to bring up next screen of important descriptions	Data can be either preloaded or inspector generated
PriorPage	Press to return to previous asset description screen	Data can be either preloaded or inspector generated

SURVEY STEP WBS SELECTION Screen 3.0



SCREEN	ACTION	COMMENT
3.0	1. Select WBS item to inspect from picklist	Picklist preformatted and is presorted by ADF numbers. Columns at end of WBS list show; 'inc" (included) by sort order 1,2,3...; "M" (multiple items); and "Stat" (Status) (In Progress, Complete, or Not Started [*])
	2. Afl WBS for ADF included on screen; cross through number in "inc" column to deselect	By crossing through "inc" number, WBS item is deselected
	3. Press (Continue) to go to Screen 4.0	By pressing (Continue) information is verified and inspections units under the selected WBS are loaded
Escape	Press to return to Screen 2.0	By pressing (Escape) information is not verified and any changes made are lost.
Help	Press to bring up screen help	Screen 99.1
Comment	Press to bring up screen for entering inspector comments	Screen 99.2
Logout	Press to save all data entered and leave survey	N/A
Multi WBS	Press to create. view or select multiple WBS and locations	Screen 3.1
CalcSort	Press to re-calculate the status of or number of multiple locations	N/A
SetSort	Resets the sort sequence of systems, etc. by accessing a pop-up window	N/A
Resort	Press to resort list in order of priority of WBS items selected	N/A
HotLine	Press for important contacts and telephone numbers	Screen 99.3
InfoList	Press to bring up information/directions preloaded for inspector	Screen 99.4
▲	Press Scroll Up button	Used to scroll up through information.
▼	Press Scroll Down button	Used to scroll down through information.

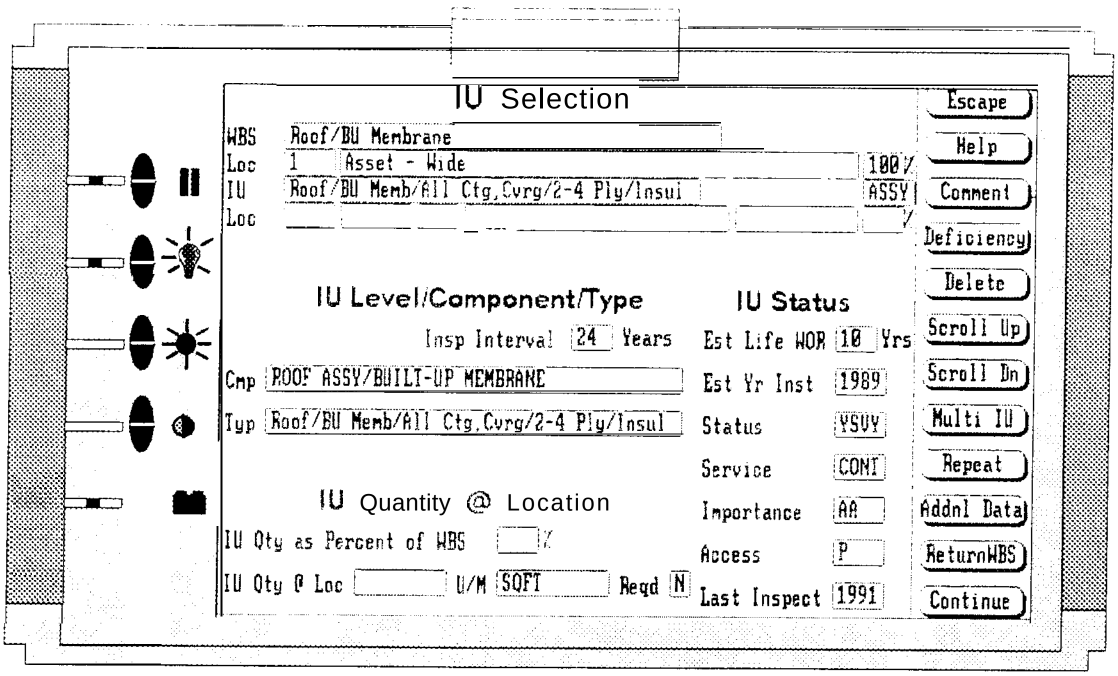
SURVEY STEP CREATE/REVIEW/SELECT MULTIPLE WBS Screen 3.1



SCREEN	ACTION	COMMENT
3.1	1. Define locations of multiple WBS. Could be multiple systems or multiple parts of single system.	Inspector developed
	2. Define percentage of Asset serviced by WBS section	Inspector developed
	3. Press (Continue) after selecting multiple WBS locations from list and continue to Screen 4.0 to select inspection Unit (IU).	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information or selecting another item
(Escape)	Press to return to Screen 3.0	By pressing (Escape) information is not verified and any changes made are lost
(RtrnWBS)	Press to return to WBS selection screen to make additional selections	N/A
(Delete)	Press to delete a highlighted entry on screen	N/A
▲	Press scroll up button	Used to scroll up through Information.
▼	Press scroll down button	Used to scroll down through information

SURVEY STEP IU SELECTION

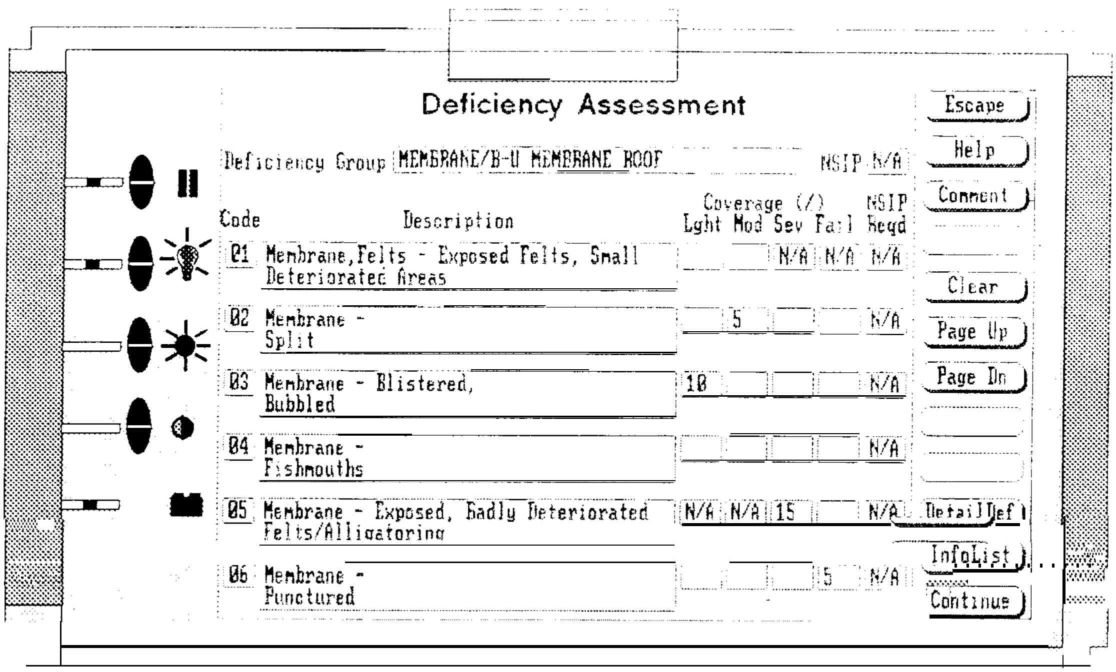
Screen 4.0



SCREEN	ACTION	COMMENT
4.0	1. Tap "Cmp" title far component picklist Cursor select or enter by pen	Picklist is prebrmatted
	2. Tap "Jyp" title for type of component pfcklist Cursor select or enter by pen	Picklist is preformatted
	3. Press (Deficiency) to bring up deficiency assessment screen	Screen 4.1 brings up deficiency picklist for WBS IU
	4. Enter estimated life without repair	Inspector generated
	5. Enter estimated year "IU" installed	Inspector generated
	6. Tap "Status" title for picklist Cursor select or enter by pen	Picklist is preformatted
	7. Tap "Service" title for picklist Cursor select or enter by pen	Picklist is preformatted
	8. Tap "Importance" title for picklist	Picklist is preformatted
	9. Tap "Access" title for picklist Cursor select or enter by pen	Picklist is preformatted
	10. Enter year "IU" last inspected	Inspector generated
	11. Enter percentage of WBS served by inspection unit	Inspector generated
	12. Enter quantity of inspection unit at location as required	Inspector generated
	13. Press (Continue) to go to Screen 5.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information
Escape	Press to return to Screen 3.0	By pressing (Escape) information is not verified; and any changes made are lost
Help	Press to bring up screen help	Screen 99.1
Comment	Press to bring up screen for entering inspector comments	Screen 99.2
Delete	Press to delete an inspection unit record	N/A
Scroll Up	Press to scroll up thru inspection units selected	N/A
Scroll Dn	Press to scroll down thru inspection units selected	N/A
Multi IU	Press to create, view, or select multiple IU's and locations	Screen 4.2
Repeat	Press to repeat or copy inspection unit selection data as a new entry	N/A
AddnlData	Press to bring up Additional Data screen and enter boiler plate information	Screen 4.3 - Inspector generated
RtrnWBS	Press to save data entered and go to Screen 3.0 for next selection	By pressing (RtrnWBS) information is verified; corrections made by crossing through data and entering new information

SURVEY STEP DEFICIENCY ASSESSMENT

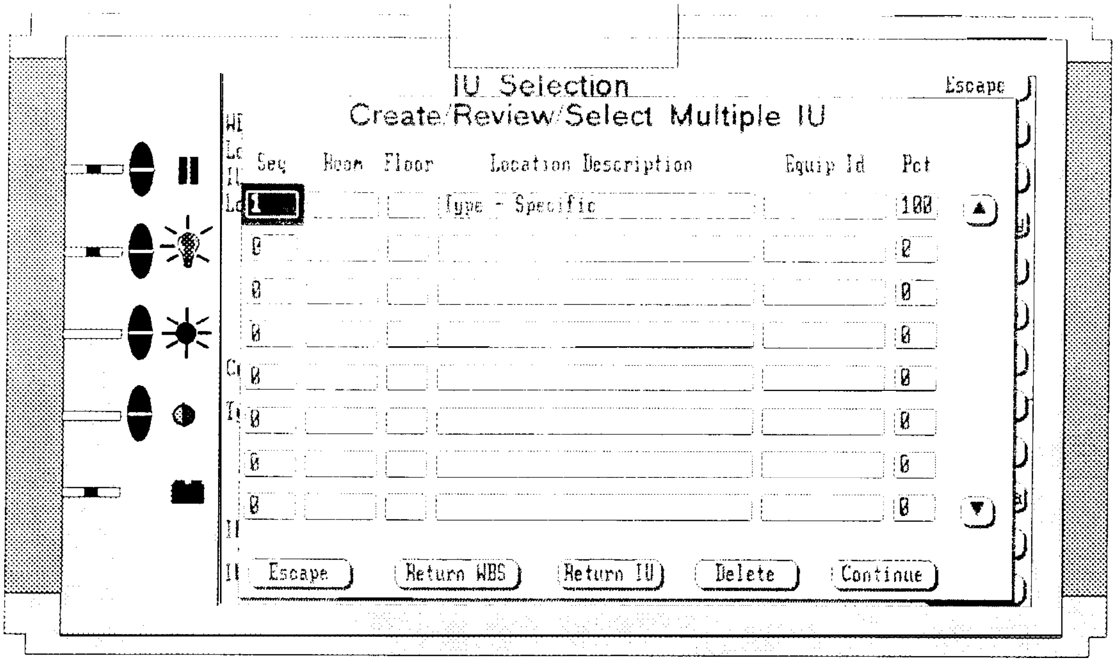
Screen 4.1



SCREEN	ACTION	COMMENT
4.1	1. Select deficiency from list	Picklist preformatted
	2. Select degree of severity of deficiency	Inspector developed
	3. Enter percentage of coverage under selected severity	Inspector developed
	4. Indicate whether non-standard inspection/test procedures are required or recommended	Inspector choice, **preset** at “No’: line through to deselect
	5. Press (Continue) to go to Screen 5.0	By pressing ‘Continue’, information is verified; corrections made by crossing through data and entering new information
Escape	Press to return to Screen 4.0	By pressing Escape information is not verified and any changes made are lost
Help	Press to bring up screen help	Screen 99.1
Comment	Press to bring up screen for entering inspector comments	Screen 99.2
Clear	Press to unselect a deficiency	N/A
Page Up	Press to scroll up though data by page	N/A
Page Dn	Press to scroll down through data by page	N/A
Detail Def	Press to bring up long description of selected deficiency	N/A
InfoList	Press to bring up information/directions preloaded for inspector	Screen 99.4

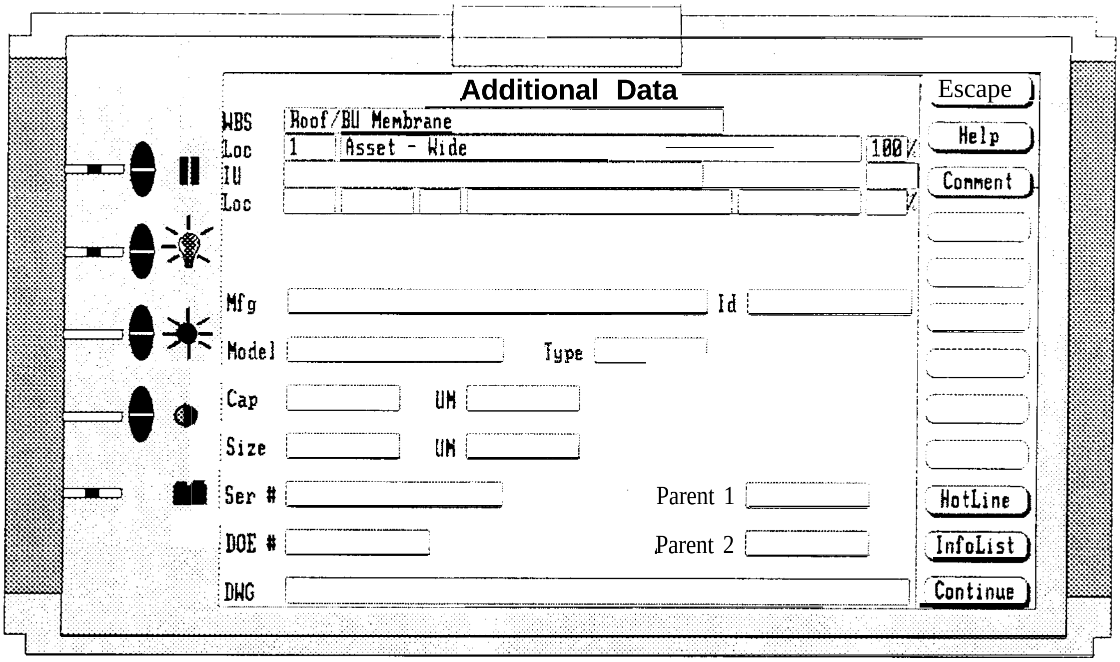
SURVEY STEP CREATE/REVIEW/SELECT MULTIPLE IU

Screen 4.2



SCREEN	ACTION	COMMENT
4.2	1. Define locations of Multiple IU's by room, floor and/or location description - optional equipment identification number can be added	Inspector developed
	2. Define percentage of Asset or WBS serviced by IU	Inspector developed
	3. Press Continue after selecting Multiple IU location from list and continue to Screen 4.1 to select deficiencies	By pressing Continue information is verified; corrections made by crossing thru data and entering new information or selecting another item
Escape	Press to return to Screen 4.0	By pressing Escape information is not verified and any changes made are lost
RtrnWBS	Press to return to Screen 3 0	N/A
RtrnIU	Press to return to Screen 4.0	N/A
Delete	Press to delete a highlighted entry on screen	N/A
▲	Press scroll up button	Used to scroll up through information
▼	Press scroll down button	Used to scroll down through information

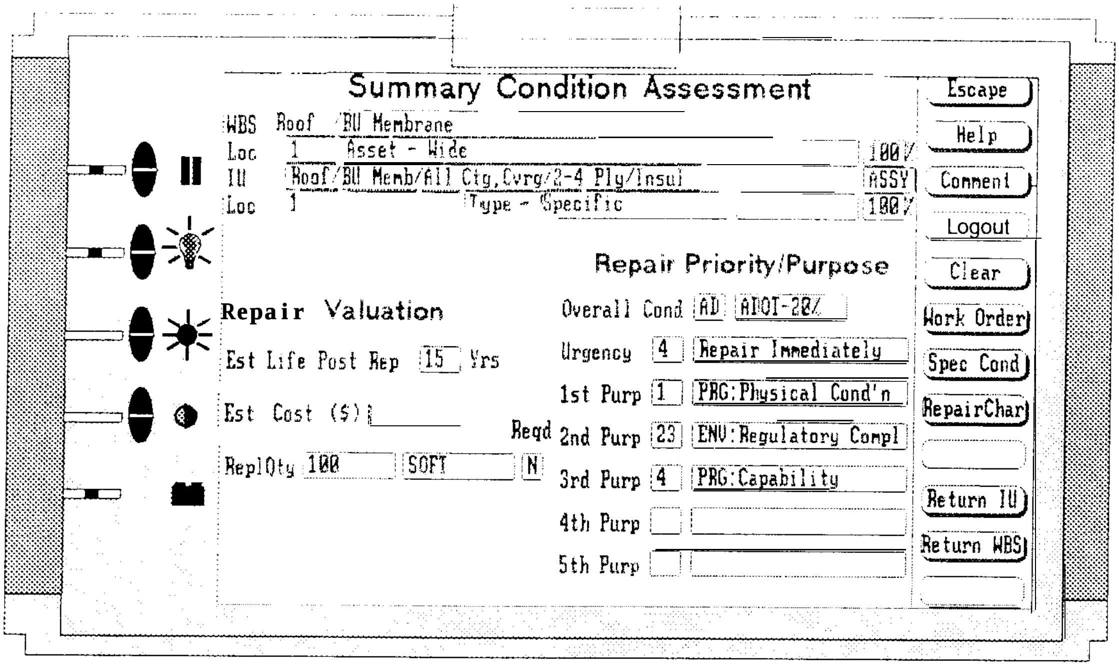
SURVEY STEP ADDITIONAL DATA Screen 4.3



SCREEN	ACTION	COMMENT
4.3	1. Enter boiler plate data about component being inspected	Inspector generated from data on the component, drawing specifications or determined in the field. This data can be used for inventorying inspection units
	2 Press (Continue) to go to Screen 4.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information
(Escape)	Press to return to Screen 4.0	By pressing (Escape) information is not verified; and any changes made are lost
(Help)	Press to bring up screen help	Screen 99.1
(Comments)	Press to bring up screen for entering inspector comments	Screen 99.2
(Hotline)	Press for important contacts and telephone numbers	Screen 99.3
(InfoList)	Press to bring up information/directions preloaded for inspector	Screen 99.4

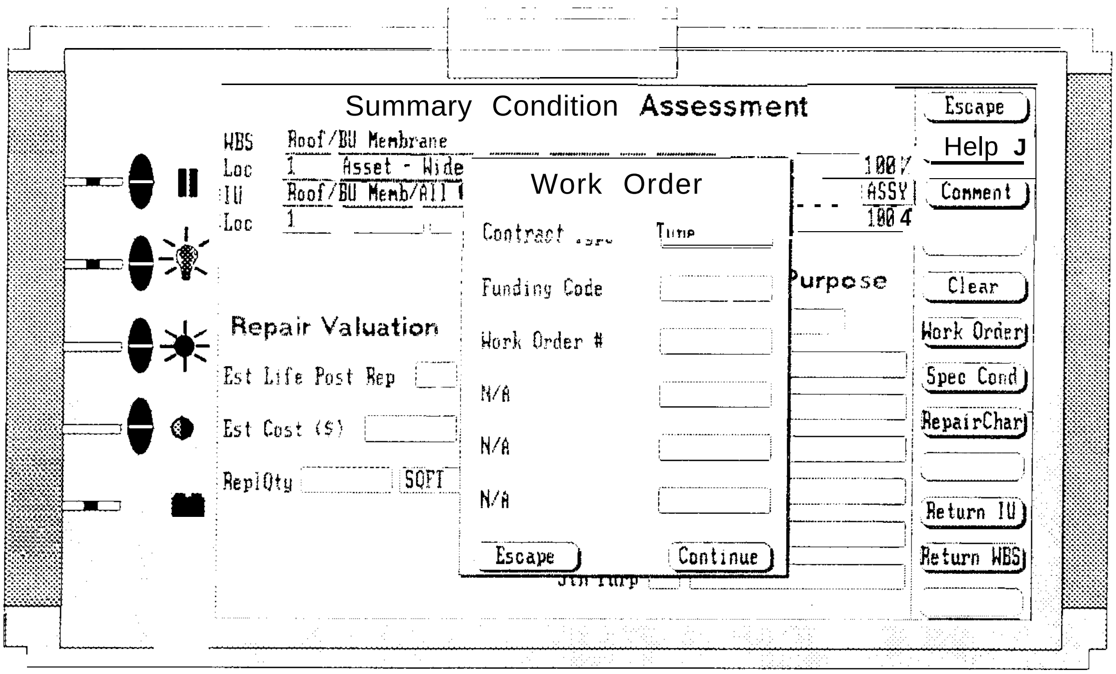
SURVEY STEP SUMMARY CONDITION ASSESSMENT

Screen 5.0



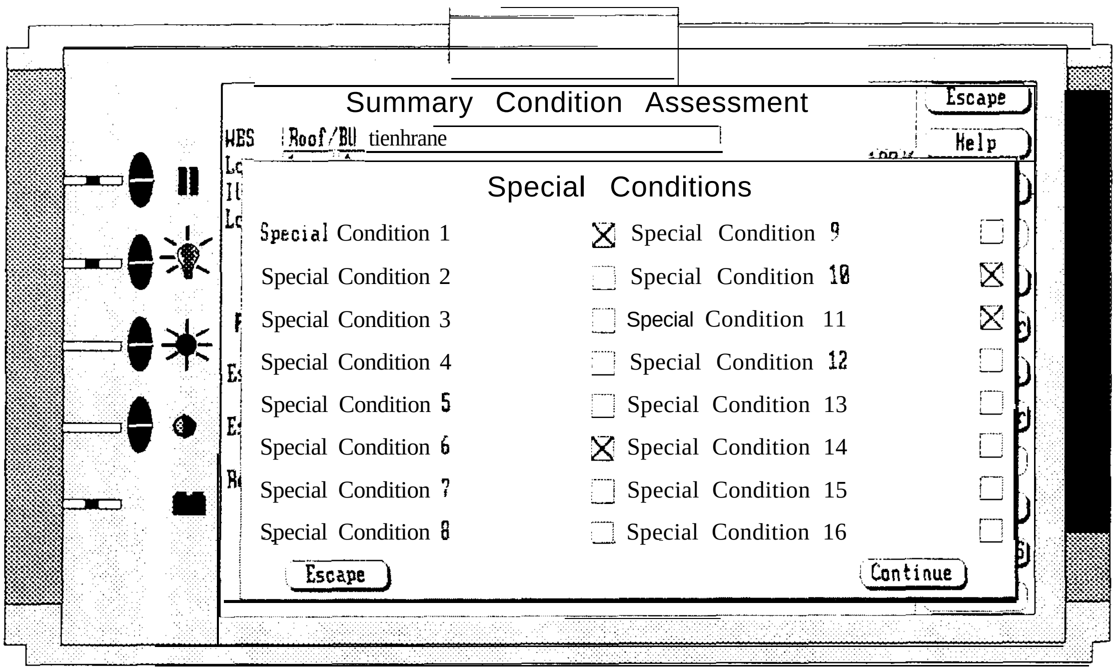
SCREEN	ACTION	COMMENT
5.0	1. Tap "Overall Condition" title for picklist Cursor select or select by pen	Picklist preformatted, inspector determined
	2. Tap "Urgency" title for picklist Cursor select or enter by pen	Picklist preformatted, inspector determined
	3. Tap "Purp" title for picklist Cursor select or enter by pen Multiple purposes can be specified	Picklist preformatted inspector determined
	4. Enter estimated life of IU after repairs in years	Inspector determined
	5. Enter an estimated cost for repairs (optional)	Inspector determined
	6. Enter repair quantity as required	Inspector determined
	7. Press to save data entered and go to Screen 4.0 for next selection	By pressing (ReturnIU) information is verified; corrections made by crossing through data and entering new information
	8. Press to save data entered and go to Screen 3.0 for next sdectfon	By pressing (ReturnWBS) information is verified; corrections made by crossing through data and entering new information
Escape	Press to return to Screen 4.0	By pressing (Escape) information is not verified and any changes made are lost
Help	Press to bring up screen help	Screen 99.1
Comment	Press to bring up screen for entering Inspector comments	Screen 99.2
Logout	Press to save all data entered and leave survey	N/A
Clear	Press to clear or delete an entry	N/A
Work Order	Press to bring up work order screen pop-up	Screen 5.1
Spec Cond	Press to bring up special condition screen pop-up	Screen 5.2
Repair Char	Press to bring up special repair characteristics screen pop-up	Screen 5.3

SURVEY STEP WORK ORDER GENERATION Screen 5.1



SCREEN	ACTION	COMMENT
5.1	1. Enter data to define Work Order number to tag repair to create a job estimate for repair	Inspector generated as determined by Site Manager prior to survey
	2. Press Continue to go to Screen 5.0	By pressing Continue information is verified; corrections made by crossing through data and entering new information
	3. Press Escape to return to Screen 5.0	By pressing Escape information is not verified; and any changes made are lost

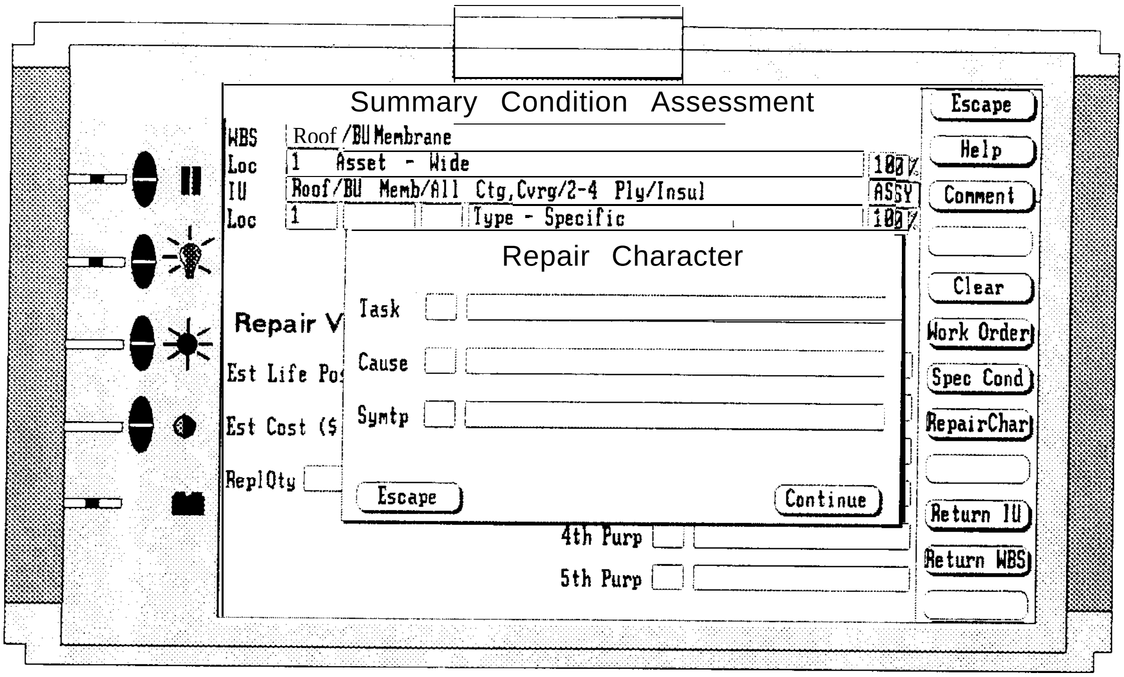
SURVEY STEP SPECIAL CONDITIONS SELECTION Screen 5.2



SCREEN	ACTION	COMMENT
5.2	**1. Press box next to special condition to select**	Picklist IS preloaded by site. Selections determined by Site Manager prior to survey
	2. Press Continue to go to Screen 5.0	By pressing Continue information is verified; corrections made by crossing through data and entering new information
	3. Press Escape to return to Screen 5.0	By pressing-information is not verified; and any changes made are lost

SURVEY STEP REPAIR CHARACTER DOCUMENTATION

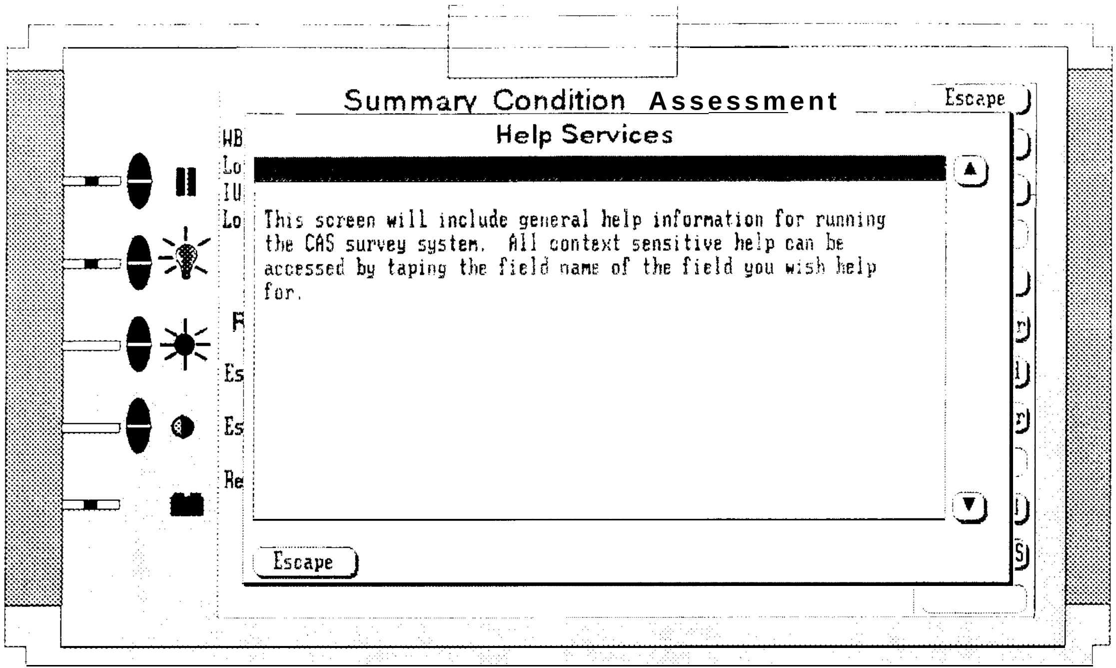
Screen 5.3



SCREEN	ACTION	COMMENT
5.3	1. Enter repair characteristics for tracking related deficiencies	Inspector generated from input of asset users to document what is deficient, what caused deficiency and any symptoms. Picklist can be preformatted
	2. Press (Continue) to go to Screen 5.0	By pressing (Continue) information is verified; corrections made by crossing through data and entering new information
	3. Press-to return to Screen 5.0	By pressing (Escape) information is not verified; and any changes made are lost

SURVEY STEP HELP

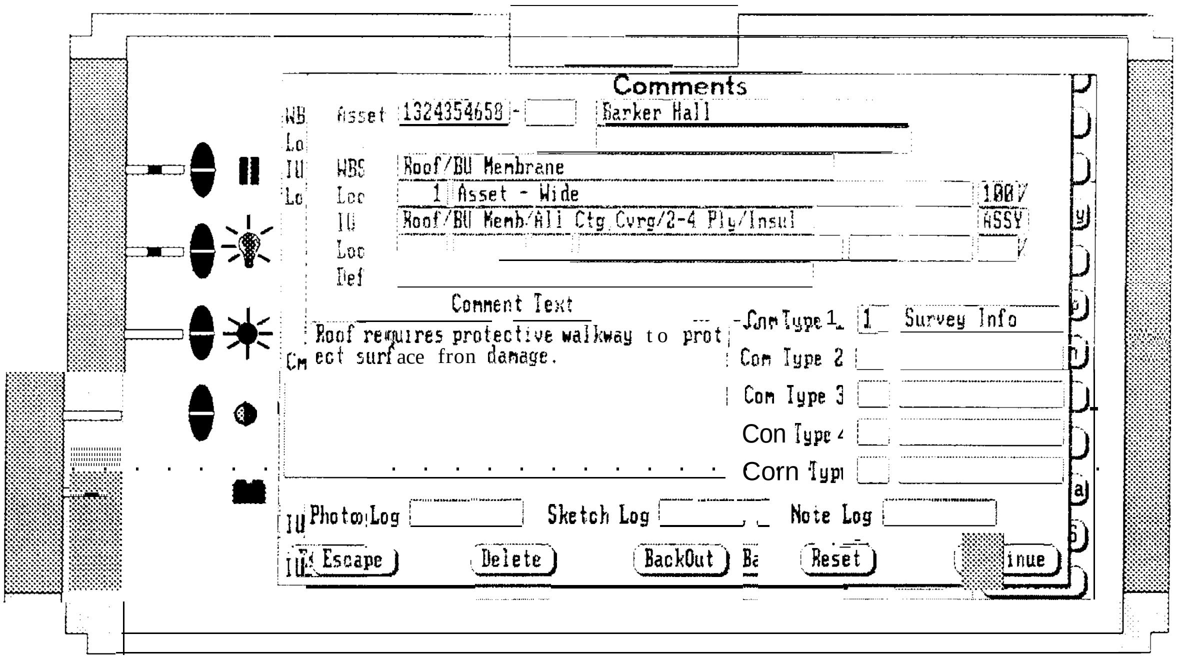
Screen 99.1



SCREEN	ACTION	COMMENT
99.1	N/A	Screen pop-up help information Dynamic help for locations selected Screen data cannot be changed
(Escape)	Press to exit Help Screen and return to previous screen	N/A
▲	Press scroll up button	Used to scroll up through information
▼	Press scroll down button	Used to scroll down through information

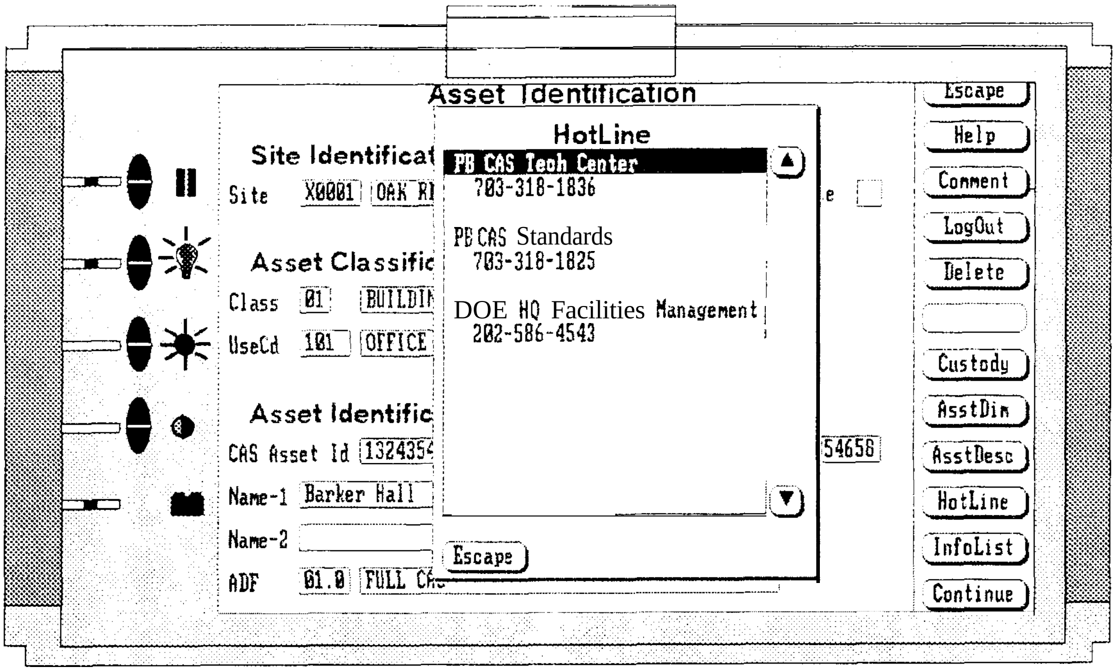
SURVEY STEP COMMENT SCREEN

Screen 99.2



SCREEN	ACTION	COMMENT
99.2	1. Select a Comment Type Selection	Picklist preformatted
	2. Enter Comment inside comment text field (QWERTY keyboard can be called in to use)	Text field expands as required
	3. Enter a Photo, Sketch, or Note Log tag number	Can be standardized or inspector generated
	4. Press Continue to return to previous screen	By pressing Continue information is verified; corrections made by crossing thru data and entering new information
Escape	Press to exit comment screen and return to previous screen	By pressing Escape information is not verified and any changes made are lost
Delete	Press to delete a selected comment	N/A
Backout	Press to move backwards through the navigation screen at top	This option allows an inspector to move backwards to enter or change a comment tagged to a previous screen
Reset	Press to move forward through the navigation screen at top	This option allows an inspector to move forward after entering a comment on a previous screen to continue the inspection

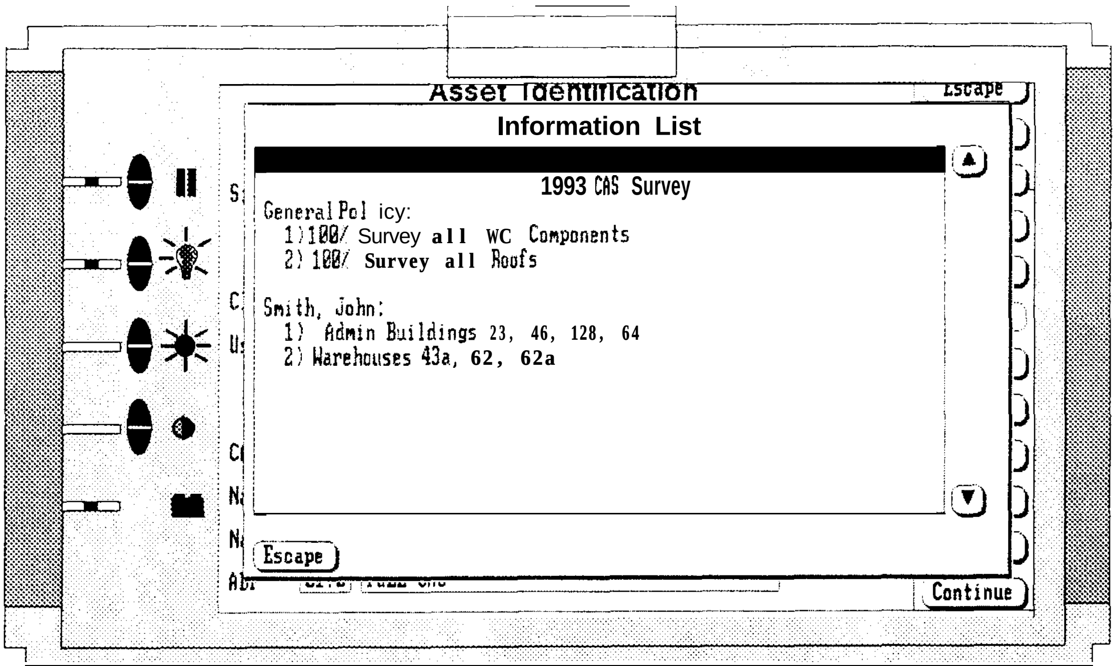
SURVEY STEP HOTLINE SCREEN Screen 99.3



SCREEN	ACTION	COMMENT
09.3	N/A	Screen pop-up for important contacts art4 telephone numbers Preformatted and adjusted by Site Manager. Screen data cannot be changed by inspector
(Escape)	Press to exit Hotline screen and return to previous screen	N/A
▲	Press scroll up button	Used to scroll up through information
▼	Press scroll down button	Used to scroll down through information

SURVEY STEP INFO SCREEN

Screen 99.4



SCREEN	ACTION	COMMENT
99.4	1. CAS inspection parameters & schedules as inputted by site manager	Cannot be changed by inspector
Escape	Press to exit InfoList screen and return to previous screen	N/A
▲	Press scroll up button	Used to scroll up through information
▼	Press scroll down button	Used to scroll down through information

DATA COLLECTION METHODS

END OF SUBSECTION

FEDERAL SPECIFICATIONS

FEDERAL SPECIFICATION	TITLE
HH-I-524C	Insulation Board, Thetmal (Polystyrene)
HH-I-526C	Insulation Board, Thermal (Mineral Fiber)
HH-I-5296	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 Polyrsocyanurate
HH-R-595B	Roofing Felt Coal-Tar and Asphalt-Saturated Organic Felts, Rolls
LLL-I-535	Insulation Board, Thermal (Cellulosic Fiber) Blocks
QQ-T-201	Terneplate, for Roofing and Roofrng Products
SS-A-666D	Asphalt, Petroleum (Built-Up Roofing, Waterproofing and Dampproofing)
SS-A-694D	Asphalt, Petroleum (Primer, Roofing and Waterproofing)
SS-A-701	Asphalt, Petroleum (Primer, Roofing and Waterproofing)
SS-C-450A	Cloth, Impregnated (Woven Cotton Cloth, Asphalt Impregnated, Coal-Tar Impregnated)
SS-R-501 D	Roofing Felt, Asphalt-Prepared, Smooth Surfaced
SS-R-630D	Roofing Felt, (Roll, Asphalt-Prepared, Mineral-Surfaced)
TT-S-227E	Cant Strip

FEDERAL SPECIFICATIONS

END OF SUBSECTION

NATIONAL STANDARDS

AMERICAN SOCIETY FOR TESTING & MATERIALS (ASTM)

C 208	Insulating Board (Cellulosic Fiber), Structural and Decorative
C 552	Cellular Glass Block and Pipe Thermal Insulation
C 578	Pretormed, Cellular Polystyrene Thermal Insulation
C 726	Mineral Fiber, Rigid Cellular Polyurethane Composite Roof Insulation Board
C 728	Perlite Thermal Insulation Board
c 957	Elastomeric Coating
C 984	Perlite Board, Rigid Cellular Polyurethane Composite Roof Insulation
c 1050	Rigid Cellular Polyurethane Composite Roof Insulation
D 41	Asphalt Primer Used in Roofing. Dampproofing and Waterproofing
D 43	Creosote Primer Used in Roofing, Dampproofing and Waterproofing
D 173	Bitumin/Saturated Cotton Fabric
D 224	Smooth-Surfaced Asphalt Roll Roofing (Organic Felt)
D 226	Asphalt-Saturated Organrc Felt Used in Roofing and Waterproofing
D 227	Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
D 249	Asphalt Roll Roofing (Organrc Felt) Surfaced with Mineral Granules
D 312	Asphalt Used in Roofing
D 450	Coal-Tar Pitch Used in Roofing, Dampproofing and Waterproofing
D 836	Fluid Applied Elastomer
D 1079	Definition of Terms Relating to Roofing, Waterproofing and Bituminous Materials
D 1227	Emulsified Asphalt Used as a Protective Coating for Built-Up Roofing
D 1327	Bitumen-Saturated Woven Burlap Fabrics Used in Roofing and Waterproofing
D 1668	Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
D 1863	Mineral Aggregate Used on Built-Up Roofs
D 1187	UH-Reinforced Bituminous Emulsion
D 2178	Asphalt Glass Felt Used in Roofing and Waterproofing
D 2626	Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing
D 2822	Asphalt Roof Cement
D 2823	Asphalt Roof Coatings
D 2824	Aluminum-Pigmented Asphalt Roof Coatings
D 2829	Recommended Practice for Sampling and Analysis of Built-Up Roofs
D 3617	Practice for Sampling and Analysis of New Built-Up Roof Membranes
D 3672	Venting Asphalt-Saturated and Coated Inorganic Felt Base Sheet Used in Roofing
D 3909	Asphalt Roll Roofing (Glass Felt) Surfaced with Mineral Granules
D 4022	Coal-Tar Roof Cement
D 4434	Poly(vinyl chloride) Sheets
D 4479	Asphalt Roof Coatings - Asbestos Free
D 4586	Asphalt Roof Cement - Asbestos Free
D 4601	Asphalt-Coated Glass Fiber Base Sheet Used in Roofing

NATIONAL STANDARDS

END OF SUBSECTION

INDUSTRY PUBLICATIONS

PUBLICATION	PUBLISHER
The NRCA Roofing & Waterproofing Manual	National Roofing Contractors Association 6250 River Road Rosemont IL 60018
Index of Federal Specifications, Standards and Commercial Item Descriptions	General Services Administration Office of Federal Supply and Services 7th & D Streets, SW 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

INDUSTRY PUBLICATIONS

END OF SUBSECTION

OTHER RELATED REFERENCES

BAKER, Maxwell C. 1980. Roofs: Design. Application and Maintenance. Montreal, Quebec, Canada, Multiscience Publications Ltd.

DELL'ISOLA, Alphonse J. and Kirk, Stephen J Life Cycle Cost Data. New York, NY: McGraw-Hill

GRIFFIN, C.W. *1970.* Manual of Built-Up Roofing Systems. New York, NY: McGraw-Hill.

PHILLIPS, Cushing Jr. "Facilities Renewal: The Formula Approach." In *Proceedings of the Seventy-Third Annual Meeting of the* Association *of* Physical P/ant Administrators *of Universities* and Colleges. Alexandria, Virginia: APPA, 1986.

Preventive Maintenance of Buildings. 1991. New York, NY: Van Nostrand Reinhold

A Professional's Guide to Single-Ply Roofing Specifications. 1984. Glenview, IL: Single Ply Roofing Institute.

Roof Maintenance. 1989. Englewood, CO: The Roofing Industry Education Institute

Roofing: Design Criteria, Options, Selection. 1989. Kingston, MA: R.S. Means Company.

Magazine Articles:

First Aid for Plant Roofs. Maintenance Technology. August 1988

Inspecting Plant Roofs. Plant Engineering. May 24, 1984.

Roof Inspection and Maintenance. AIPE Facilities Management, Operations & Engineering. May/June 1989.

Roof Maintenance Guidelines. Maintenance Technology. March 1989.

A Systematic Approach to Roofing. School and College. October 1989.

OTHER RELATED REFERENCES

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
AWWA	American Water Works Association

APPENDIX A

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)
BRB	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
CCTV	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
DAC	Derived Air Concentration
DARCOM	U.S. Army Development, Acquisition and Readiness Command

APPENDIX A

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
Equlp	Equipment
ERDA	Energy Research and Development Administration (precursor to DOE)
ESF	Engineered Safety Feature
Est	Estimated
Ext	Exterior
°F	Degrees Fahrenheit
F M	Federal Aviation Administration

APPENDIX A

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/l b	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
CPM	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
Hvy	Heavy
HW	Hot Water
Hyd	Hydraulic
HX	Heat Exchanger

APPENDIX A

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
Klp	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
MA	Management and Administration (U.S. DOE)
mA	milliAmpre
MAA	Material Access Area
Mach	Machine
Malnt	Maintenance

APPENDIX A

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
mln	Minimum
Mlsc	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
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

APPENDIX A

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
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

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Pkg	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
SCS	U.S. Department of Agriculture, Soil Conservation Service
SDI	Steel Deck Institute, Steel Door Institute
SDWA	Safe Drinking Water Act
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

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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
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
UMC	Uniform Mechanical Code
UO_2	Uranium dioxide
UO_3	Uranium trioxide

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UPA	Unit Process Area
UPC	Uniform Plumbing Code
UPHF	Uranium Processing and Handling Facility
UPS	Uninterruptible Power Supply
URF	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

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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

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END OF SUBSECTION

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GLOSSARY

Abrasion Resistance: The capacity of a surface to resist the erosive effects of foot traffic and other abrasions.

Adhesion: The binding together of membrane and substrate

Aggregate: (1) Crushed stone, crushed slag or water worn gravel used for surfacing a built-up roof; (2) any granular mineral material such as sand. Aggregate is classified by size and gradation.

Alligatoring: The cracking of the surfacing bitumen on a built-up roof, producing a pattern of cracks similar to an alligator's hide; the cracks may or may not extend through the surfacing bitumen.

Alloy: A homogeneous mixture of two or more metals in order to achieve certain desirable properties.

Ambient Temperature: The temperature of the environment surrounding an object.

Application Rate: The quantity (mass, volume or thickness) of material applied per unit area.

Area Divider: A raised, double wood member attached to a properly flashed wood base plate that is anchored to the roof deck. It is used to relieve thermal stresses in a roof system with no expansion joints provided.

Asbestos: A group of natural, fibrous, impure silicate materials. Formerly used for fireproofing and insulation.

Asphalt: A dark brown to black cementitious material in which the predominating constituents are bitumens, which occur in nature or are obtained in petroleum processing.

Dead-Level Asphalt:
A roofing asphalt conforming to the requirements of ASTM Specification D312, Type I.

Flat Asphalt:
A roofing asphalt conforming to the requirements of ASTM Specification D312, Type II.

Steep Asphalt:
A roofing asphalt conforming to the requirements of ASTM Specification D312, Type III.

Special Steep Asphalt:
A roofing asphalt conforming to the requirements of ASTM Specification D312, Type IV.

Asphalt, Air Blown: An asphalt produced by blowing air through molten asphalt at an elevated temperature to raise its softening point and modify other properties.

Asphalt Felt: An asphalt-saturated felt or an asphalt coated felt

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Asphalt Mastic: A mixture of asphaltic material and graded mineral aggregate that can be poured when heated but requires mechanical manipulation to apply when cool

Asphalt, Steam Blown: An asphalt produced by blowing steam through molten asphalt to modify its properties.

Asphaltene: A high molecular weight hydrocarbon fraction precipitated from asphalt by a designated paraffinic naphtha solvent at a specified temperature and solvent-asphalt ratio.

NOTE - The asphaltene fraction should be identified by the temperature and solvent asphalt ratro used.

Atactic: A natural or synthetic compound with a high molecular weight.

Atactic PolyPropylene (APP): A bitumen modifying polymer used in built-up roofing.

Backnailing: The practice of blind-nailing roofing felts to a substrate in addition to hot-mopping to prevent slippage. (See Blind Nailing.)

Base Flashing: (See Flashing.)

Base Ply: The lowermost ply of roofing material in a roof membrane assembly.

Base Sheet: A saturated or coated felt placed as the first ply in some multi-ply built-up roof membranes.

Batten: A strip of wood, steel, or aluminum placed over boards or roof structure members to provide a base for the application of shingles or tiles, prevent wind uplift in single ply membranes or a raised seam in a metal roof.

Bitumen: (1) A class of amorphous, black or dark colored (solid, semi-solid or viscous) cementitious substances, natural or manufactured, composed principally of high molecular weight hydrocarbons, soluble in carbon disulfide, and found in asphalts, tars, pitches and asphaltites; (2) a generic term used to denote any material composed principally of bitumen.

Bituminous: Containing or treated with bitumen. Examples: bituminous concrete, bituminous felts and fabrics, bituminous pavement.

Bituminous Emulsion: (1) A suspension of minute globules of bituminous material in water or in an aqueous solution; (2) a suspension of minute globules of water or an aqueous solution in a liquid bituminous material (invert emulsion).

Bituminous Grout: A mixture of bituminous material and fine sand that will flow into place without mechanical manipulation when heated.

Blackberry: A small bubble or blister in the flood coating of a gravel-surfaced roof membrane.

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Blind Nailing:	The practice of nailing the back portion of a roofing ply in a manner that the fasteners ate not exposed to the weather in the finished product.
Blister:	An enclosed pocket of air mixed with water or solvent vapor, trapped between impermeable layers of felt, or between the felt and substrate.
Blocking:	Wood built into a roofing system above the deck and below the membrane and flashing to stiffen the deck around an opening, to act as a stop for insulation or to serve as a nailer for attachment of the membrane or flashing.
Bond:	The adhesive and cohesive forces holding two roofing components in intimate contact.
Brooming:	Embedding a ply of roofing material by using a broom to smooth out the ply and ensure contact with the adhesive under the ply.
British Thermal Unit (BTU):	The heat energy required to raise the temperature of 1 pound of water 1 degree Fahrenheit.
Built-Up Roof Membrane:	A continuous, semi-flexible roof membrane assembly, consisting of plies of saturated felts, coated felts, fabrics or mats between which alternate layers of bitumen are applied, generally surfaced with mineral aggregate, bituminous materials or a granule-surfaced roofing sheet. (Abbreviation: BUR.)
Butyl Rubber:	An elastomer with low gas and water vapor permeability used in low-temperature applications.
Cant **Strip:**	A beveled strip used under flashing to modify the angle at the point where the roofing or waterproofing membrane meets any vertical element.
Cap Flashing:	(See Flashing.)
Cap Sheet:	A granule-surfaced coated sheet used as the top ply of a built-up roof membrane or flashing.
Capillarity:	The action by which the surface of a liquid (where it is in contact with a solid) is elevated or depressed, depending upon the relative attraction of the molecules of the liquid for each other and for those of the solid.
Caulking:	A composition of vehicle and pigment, used at ambient temperatures for filling joints, that remains plastic for an extended time after application.
Chlorinated Polyethylene (CPE):	A thermoplastic “uncured” elastomer used as a single-ply member.
Chlorosulfonated Polyethylene (CSPE):	A single-ply roofing material that is neither thermosetting or thermoplastic.
Closure strip:	Material used to fill in gaps between metal panel ribs.

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Coal Tar:	A dark brown to black, sem-solid hydrocarbon obtained as resrdue from the partial evaporation or distillation of coal tat
Coal-Tar Felts:	A felt that has been saturated with refined coal tar
Coal-Tar Pitch:	A coal tar used as the waterproofing agent in dead-level or low sloped built-up roof membrane, conforming to ASTM Specification D450, Type I.
	Coal-Tar Waterproofing Pitch: A coal tar used as the dampproofing or waterproofing agent in below-grade structures, conforming to ASTM Specification D450, Type II.
	Coal-Tar Bitumen: A coal tar used as the waterproofing agent in dead-level or low slope built-up roof membrane, conforming to ASTM D450, Type III.
Coated Sheet Felt:	(1) An asphalt felt that has been coated on both sides with harder, more viscous asphalt; (2) A glass fiber felt that has been simultaneously impregnated and coated with asphalt on both sides.
Cold-Processing Roofing:	A continuous, semi-flexible roof membrane, consisting of plies of felts, mats or fabrics that are laminated on a roof with alternate layers of cold-applied roof cement and surfaced with a cold-applied coating.
Collector Box:	A device located between the gutter and downspout to help direct water runoff.
Condensation:	The conversion of water vapor or other gas to liquid as the temperature drops or the atmospheric pressure rises. (See Dew-Point.)
Coping:	The covering piece on top of a wall exposed to the weather, usually sloped to shed water.
Corrugation:	A parallel wave pattern molded into a flat surface to stiffen and provide strength.
Counterflashing:	Formed metal or elastomeric sheeting secured on or into a wall, curb, pipe, rooftop unit or other surface, to cover and protect the upper edge of a base flashing and its associated fasteners.
Course:	(1) The term used for each application of material that forms the waterproofing system or the flashing; (2) One layer of a series of materials applied to a surface (i.e., a five-course wall flashing is composed of three applications of mastic with one ply of felt sandwiched between each layer of mastic).
Coverage:	The surface area continuously covered by a specific quantity of a particular roofing material.
Crack:	A separation or fracture occurring in a roof membrane or roof deck, generally caused by thermal induced stress or substrate movement.

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Creep:	The permanent deformation of a roofing material or roof system caused by the movement of the roof membrane that results from continuous thermal stress or loading
Cricket:	A relatively small, elevated area of a roof constructed to divert water around a chimney, curb or other projection
Curb:	A frame that protrudes above the roof surface to help attach flashing.
Cure:	A change in physical or chemical propertres of an adhesive or sealant when mixed wrth a catalyst or subjected to heat or pressure
Curing Agent:	A substance that increases or decreases the curing process when added to a coating or sealant.
Cutback:	Solvent-thinned bitumen used in cold process roofing adhesives, flashing cements and roof coatings.
cutoff:	A detail designed to prevent lateral water movement into the insulation where the membrane terminates at the end of a day's work, or used to isolate sections of the roofing system. It is usually removed before the continuation of the work.
Dampproofing:	Treatment of a surface or structure to resist the passage of water in the absence of hydrostatic pressure.
Dead Level:	Absolutely horizontal, or zero slope. (See Slope.)
Dead-Level Asphalt:	(See Asphalt.)
Dead Loads:	Non-moving loads, such as the building structure mechanical equipment, air conditioning units and the roof deck itself.
Deck:	The structural surface to which the roofing or waterproofing system (including insulation) is applied.
Degradation:	Deterioration of a surface from heat, light, moisture or other elements.
Dehydration:	The loss of water through absorption or evaporation
Delamination:	Separation of the plies in a roof membrane system or separation of laminated layers of insulation.
Dew Point:	The temperature at which water vapor starts to condense in cooling air at the existing atmospheric pressure and vapor content.
Double-Pour:	The process of applying two layers of aggregate and bitumen to a built-up roof.
Drain:	A device that allows for the flow of water from a roof area.
Dropback:	A reduction in the softening point of bitumen that occurs when bitumen is heated in the absence of air. (See Softening Point Drift.)
Ductility:	A material's ability to resist stress by expanding but will not recover original shape upon removal of the stress.

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Eaves:	All portions of a roof that project beyond the outside walls of a structure and the bottom surface of sloping roofs.
Edge Sheets:	Felt strips that are cut to widths narrower than the standard width of the full felt roil, used to start the felt shingling pattern at a roof edge.
Edge Stripping:	Application of felt strips cut to narrower widths than the normal felt roll width to cover a joint between flashing and built-up roofing.
Edge Venting:	The practice of providing regularly spaced protected opening along a roof perimeter to relieve moisture vapor pressure.
Elastomer:	A macromolecular material that returns rapidly to its approxtmate initial dimensions and shape after substantial deformation by a weak stress and the subsequent release of that stress.
Elastomeric:	A rubber like synthetic polymer that will stretch when pulled and will return quickly to its original shape when released.
Elastoplastic:	A trade description referring to a resilient substance that returns to its original shape if stressed within certain limits.
Elongation:	The process by which a material lengthens to accommodate stress or movement.
Embedment:	(1) The process of pressing a felt, aggregate, fabric, mat or panel uniformly and completely into hot bitumen or adhesive; (2) the process of pressing granules into coating in the manufacture of factory prepared roofing.
Emulsion:	The intimate dispersion of an organic material and water achieved by using a chemical or clay emulsifying agent.
Envelope:	A continuous membrane edge seal formed at the perimeter and at penetrations by folding the base sheet or ply over the plies above and securing it to the top of the membrane. The envelope prevents bitumen seepage from the edge of the membrane.
Equilibrium Moisture:	(1) The moisture content of a material stabilized at a given temperature and relative humidity, expressed as percent moisture by weight; (2) The typical moisture content of a material in any given geographical area.
Equiviscous Temperature (EVT):	The temperature at which the viscosity is 75 centipoise for asphalt and 25 centipoise for coal tar products; the recommended temperature plus or minus 25°F at the time of application.
Ethylene Interpolymer Alloy (EIP):	A thermoplastic material used for single-ply roofing
Ethylene Propylene Diene Monomer (EPDM):	A thermosetting membrane used for single-ply roofing

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Expansion Joint:	A structural separation between two building elements that allows free movement between the elements without damage to the roofing or waterproofing system.
Exposure:	(1) The traverse dimension of a roofing element not overlapped by an adjacent element in any roof system. The exposure of any ply in a membrane may be computed by dividing the felt width minus 2 inches by the number of shingled plies; thus, the exposure of 36 inch-wide felt in a shingled, four-ply membrane should be 8.5 inches; (2) The time during which a portion of a roofing element is exposed to the weather
Extrusion:	Forcing a material through a die, by heat or pressure.
Fabric:	A woven cloth of organic or inorganic filaments, threads or yarns
Factory Mutual (FM):	An organization that classifies roof assemblies for their fire characteristics and wind uplift resistance for insurance companies in the United States.
Factory Square:	108 square feet of roofing material.
Fallback:	(See Dropback.)
Felt:	A flexible sheet manufactured by the interlocking of fibers through a combination of mechanical work, moisture and heat. Felts are manufactured principally from vegetable fibers (organic felts), asbestos fibers (asbestos felts) or glass fibers (glass fiber felts); other fibers may be present in each type.
Felt Layer:	A machine used for applying bitumen and built-up roofing felts.
Felt Mill Ream:	The mass in pounds of 480 square feet of dry, unsaturated felt; also termed "point weight."
Fibrated:	Having a fibrous content.
Fine Mineral Surfacing:	Water-insoluble, inorganic material, more than 50 percent of which passes the No. 35 sieve, used on the surface of roofing.
Fishmouth:	(1) A half-cylindrical or half-conical opening formed by an edge wrinkle; (2) In shingles, a half-conical opening formed at a cut edge.
flame-Spread:	The rate at which a flame moves across exposed decking or the extent to which a product contributes to the spread of fire.
Flashing:	The system used to seal membrane edges at walls, expansion joints, drains, gravel stops and other places where the membrane is interrupted or terminated. Base flashing covers the edge of the membrane. Cap flashing or counterflashing shields the upper edges of the base flashing.

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Flashing Cement:	A trowelable mixture of cutback bitumen and mineral stabilizers, including asbestos or other inorganic fibers
Flat Asphalt:	(See Asphalt.)
Flood Coat:	The top layer of bitumen into which the aggregate is embedded on an aggregate-surfaced built-up roof.
Fluid Applied:	An elastomeric material, fluid at ambient temperature, that dries or cures after application to form a continuous membrane Such systems normally do not incorporate reinforcement.
Flutter Fatigue:	The weakening that results from the wind uplift of a single-ply.
Gable:	The portion of the end of a structure that extends from the eaves upward to the peak or ridge.
Galvanize:	The process of coating iron or steel with zinc to prevent corrosion.
Gauge:	The numerically designated thickness of metal.
Glass Fiber Felt:	Glass fibers bonded into a sheet with resin and suitable for impregnation in the manufacture of bituminous waterproofing materials, roof membranes and shingles.
Glass Fiber Mat:	A thin mat composed of glass fibers with or without a binder.
Glaze Coat:	(1) The top layer of asphalt in a smooth surfaced built-up roof assembly; (2) A thin protective coating of bitumen applied to the lower plies or top-ply of a built-up roof membrane when application of additional felts or the flood coat and aggregate surfacing are delayed.
Grain:	A metric unit of weight; 7,000 grains equal 1 pound.
Gravel:	Course, granular aggregate, with pieces larger than sand grains, resulting from the natural erosion of rock.
Gravel Stop:	A flanged device, frequently metallic, designed to provide a continuous finished edge for roofing material and to prevent loose aggregate from washing off of the roof.
Gutter:	A shallow channel of wood, metal or PVC for the purpose of collecting and diverting water from a roof.
Headlap:	The minimum distance, measured at 90 degrees to the eaves along the face of a shingle or felt from the upper edge of the shingle or felt to the nearest exposed surface.
Heat Aging:	Subjecting a material to high temperatures over a period of time to determine any adverse conditions.
Holiday:	An area where a liquid applied material is missing.
“Hot Stuff” or “Hot”:	The roofer’s term for hot bitumen
Hygroscopic:	Attracting, absorbing and retaining atmospheric moisture.

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Hypalon: An elastomeric roof covering in liquid, sheet or putty-like (caulking) consistency in several different colors Hypalon roofing is mote resistant to thermal movement and weathering than Neoprene. Hypalon is a registered trademark.

Ice Dam: A mass of ice formed at the transition from a warm to a cold roof surface, frequently formed by refreezing meltwater at the overhang of a steep roof, causing ice and water to back up under roofing materials.

Impact Resistance: The ability of a material to resist dynamic loading

Incline: The slope of a roof expressed either in percent or in the number of vertical units of rise per horizontal unit of run

Inorganic: Being or composed of matter other than hydrocarbons and their derivatives, or matter that is not of plant or animal origin.

Insulation: (See Thermal Insulation.)

IRMA: Inverted Roofing Membrane Application: An elastomeric roof covering in liquid, sheet or putty-like (caulking) consistency with the membrane attached to concrete slabs with the insulation and ballast on top.

Job-Average Basis: A technique for determining the average dimensions or quantities of materials, by analysis of roof test cuts. The technique requires a minimum of three test cuts per roof area, plus one cut for each additional 10,000 square feet of roof area. Job-average basis is computed by dividing the sum of all measurements taken by the number of measurements taken. The results would describe the job-average for the quantity or dimension.

Knot: An imperfection or non-homogeneity in materials used in fabric construction, the presence of which causes surface irregularities.

Laminations: The process of bonding together several layers or sheets together to form a product or material.

Lap: A type of joint in which two materials are overlapped with one covering part of the other.

Leader: A downspout.

Live Loads: Moving roof installation equipment, wind, snow, ice or rain

Mansard Roof: A roof that changes slope on each of its four sides with the lower slope being steeper.

Manufacturer's Bond: A guarantee made or offered by a manufacturer to back its liability to finance repairs. Offered within set tie periods of 5, 10, 15 or 20 years.

Mastic: (See Flashing Cement or Asphalt Mastic.)

Membrane: A flexible or semi-flexible roof covering or waterproofing layer, whose primary function is the exclusion of water

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Membrane Reinforcement: Fabrics (woven or non-woven) that are saturated and embedded in coating to provide strength.

Mesh: The square opening of a sieve.

Metal Flashing: (See Flashing.) Metal flashing is frequently used as through-wall flashing, cap flashing, counterflashing or gravel stops.

Mil: A measurement of thickness. One Mil equals ,001 inch

Mineral Fiber Felt: A felt with mineral wood as its principal component

Mineral Granules: Opaque, natural or synthetically colored aggregate commonly used to surface cap sheets, granule-surfaced sheets and roofing shingles.

Mineral Stabilizer: A fine, water-insoluble inorganic material, used in a mixture with solid or semi-solid bituminous materials.

Mineral-Surfaced Rooting: Built-up roofing materials whose top ply consists of a granule-surfaced sheet.

Mineral-Surfaced Sheet: A felt that is coated on one or both sides with asphalt and surfaced with mineral granules.

Modified Bitumen: Composite sheets consisting of a copolymer modified bitumen often reinforced and sometimes surfaced with various types of films, foils and mats.

Modules of Elasticity: The unit of stress divided by the unit of strain of a material.

Mole Run: A meandering ridge in a roof membrane not associated with insulations or deck joints.

Monolithic: A single surface constructed without joints or seams.

Mop-and-Flop: An application procedure in which roofing elements (insulations boards, felt plies, cap sheets, etc.) are initially placed upside down adjacent to their ultimate locations are coated with adhesive and are then turned over and applied to the substrate.

Mopping: The application of hot bitumen with a mop or mechanical applicator to the substrate or to the felts of a built-up roof membrane.

Solid Mopping:
A continuous mopping of a surface, leaving no unmopped areas.

Spot Mopping:
A mopping pattern in which hot bitumen is applied in roughly circular areas, leaving a grid of unmopped, perpendicular bands on the roof.

Sprinkle Mopping:
A random mopping pattern in which heated bitumen beads are strewn onto the substrate with a brush or mop.

Strip Mopping:
A mopping pattern in which hot bitumen is applied in parallel bands.

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Nailing:	Exposed or concealed nailing to attach two or more materials.
Neoprene:	A synthetic rubber (polychloroprene) used in liquid-applied and sheet-applied elastomeric roof membranes or flashings.
Nineteen-Inch Selvage:	A prepared roofing sheet with a 17-inch granule surfaced exposure and a nongranule-surfaced 19-inch selvage edge This material is sometimes referred to as SIS or as Wide Selvage Asphalt Roll Roofing Material Surfaced with Mineral Granules.
Ninety-Pound:	A prepared organic felt roll roofing with a granule surfaced exposure that has a mass of approximately 90 pounds per 100 square feet.
Non-Oxidizing Material:	A material composed of substances that will not break down when exposed to oxygen.
Oil Canning:	The waving or buckling of formed sheet metal, such as roofing or siding.
Orange-Peeling:	A surface flaw on polyurethane foam (PUF) that leaves the finish pocked with tiny holes resembling citrus skins.
Organic:	Being or composed of hydrocarbons or their derivatives, or matter of plant or animal origin.
Parapet Wall:	That part of any wall entirely above the roof.
Perlite:	An aggregate used in lightweight insulating concrete and in preformed perlitic insulation boards, formed by heating and expanding siliceous volcanic glass.
Perm:	A unit of water vapor transmission defined as 1 grain of water vapor per square foot per hour per inch of mercury pressure difference (1 inch of mercury = 0.49 psi).
Permeance:	An index of a material's resistance to water vapor transmission. (See Perm.)
Phased Application:	The installation of a roof system or water proofing system during two or more separate time intervals.
Picture Framing:	A rectangular pattern of ridges in a roof membrane over insulation or deck joints.
Pitch:	(See Coal Tar and Incline.)
Pitch Pocket:	A flange, open-bottomed metal container placed around columns or other roof penetrations that is filled with hot bitumen or flashing cement to seal the joint. The use of pitch pockets is not recommended.
Plastic Cement:	(See Flashing Cement.)
Plastomeric:	A plastic like polymer consisting of any of various complex organic compounds produced by polymerization which are capable of being molded, extruded or cast into various shapes or films. Generally they are thermo plastic in nature, i.e., they will soften when heated and harden when cooled.

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Ply: A layer of felt in a built-up roof membrane system A four-ply membrane system has four plies of felt.

Point Weight: (See Felt Mill Ream)

Pond: A roof surface that is incompletely drained.

Positive Drainage: The drainage condition in which consideration has been made for all loading deflections of the deck, and additional roof slope has been provided to ensure drainage of the roof area within 48 hours of rainfall.

Primer: A thin, liquid bitumen applied to a surface to improve the adhesion of subsequent applications of bitumen.

Rake: The slope edge of a roof at the first or last rafter

Re-covering: The process of covering an existing roofing system with a new roofing system.

Re-entrant Corner: An inside corner of a surface, producing stress concentrations in the roofing or water-proofing membrane.

Reglet: A groove in a wall or other surface adjoining a roof surface for use in the attachment of counterflashing.

Reinforced Membrane: A roofing or waterproofing membrane reinforced with felts, mats, fabrics or chopped fibers.

Relative Humidity: The ratio of the weight of moisture in a given volume of air-vapor mixture to the saturated (maximum) weight of water vapor at the same temperature, expressed as a percentage. For example, if the weight of the moist air is 1 pound and if the air could hold 2 pounds of water vapor at a given temperature, the relative humidity (RH) is 50 percent.

Replacement: The practice of removing an existing roof system and replacing it with a new roofing system.

Re-roofing: The process of re-covering or replacing an existing roofing system. (See Re-covering and Replacement.)

Resilience: The ability of a substance to return to its original size or state following the application and removal of stress.

Resin: A natural or synthetic solid or semi-solid material which has a tendency to flow under stress.

Ridging: An upward, tenting displacement of a roof membrane frequently occurring over insulation joints, deck joints and base sheet edges.

Roll Roofing: Smooth-surfaced or mineral-surfaced coated felts.

Roof Assembly: An assembly of interacting roof components (including the roof deck) designed to weatherproof and, normally, to insulate a building's top surface,

Roof Cement: (See Flashing Cement.)

APPENDIX B

Roof System: A system of interacting roof components (not including the roof deck) designed to weather proot and, normally, to insulate a building's top surface.

Rubber: A highly resilient natural or synthetic material

Saddle: A small structure that helps channel surface water to drains, frequently located in a valley, and often constructed like a small hip roof or like a pyramid with a diamond shape base (See Cricket.)

Sag: The unwanted flow or running of roofing material after application.

Saturated Felt: A felt that has been partially saturated with low softening point bitumen.

Screen: An apparatus with circular apertures for separating sizes of materials.

Scuttle: A hatch that provides access to the roof from the interior of the building.

Seal: (1) A narrow closure strip made of bituminous materials; (2) to secure a roof from the entry of moisture.

Sealant: A mixture of polymers, fillers, and pigments used to fill and seal joints where moderate movement is expected; it cures to a resilient solid.

Selvage: An edge or edging that differs from the main part of (1) a fabric, or (2) granule-surfaced roll roofing material.

Selvage Joint: A lapped joint designed for mineral-surfaced cap sheets. The mineral surfacing is omitted over a small portion of the longitudinal edge of the sheet below in order to obtain better adhesion of the lapped cap sheet surface with the bituminous adhesive.

Shark Fin: An upward-curled felt side lap or end lap.

Shingle: (1) A small unit of prepared roofing material designed for installation with similar units in overlapping rows on inclines normally exceeding 25 percent; (2) to cover with shingles; (3) to apply any sheet material in overlapping rows like shingles.

Shingling: (1) The procedure of laying parallel felts so that one longitudinal edge of each felt overlaps and the other longitudinal edge underlaps, the adjacent felt. (See Ply.) Normally, felts are shingled on a slope so that the water flows over rather than against each lap; (2) the application of shingles to a sloped roof.

Sieve: An apparatus with apertures for separating sizes of material.

Slag: A hard, air-cooled aggregate that is left as a residue from blast furnaces, used as a surfacing aggregate.

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Slat Slab: A flat, horizontal or nearly so molded layer of reinforced concrete, usually of uniform but sometimes of variable thickness supported by beams, columns, walls or other framework with a thin, narrow strip of wood, metal or plastic.

Slippage: Relative lateral movement of adjacent components of a built-up membrane. It occurs mainly in roofing membranes on a slope, sometimes exposing the lower plies or even the base sheet to the weather.

Slope: (See Incline.)

Smooth-Surfaced Roof: A built-up roof membrane surfaced with a layer of hot-mopped asphalt, cold-applied asphalt clay emulsion, cold-applied, asphalt cutback or sometimes with an unmopped inorganic felt.

Softening Point: The temperature at which bitumen becomes soft enough to flow, as determined by an arbitrary, closely defined method.

Softening Point Drift: A change in the softening point of bitumen during storage or application. (See Dropback.)

Solid Mopping: (See Mopping.)

Special Steep Asphalt: (See Asphalt.)

Split: A membrane tear resulting from tensile strength.

Split Sheet: (See Nineteen-Inch Selvage.)

Spot Mopping: (See Mopping.)

Sprinkle Mopping: (See Mopping.)

Spudding: The process of removing the roofing aggregate and most of the bituminous top coating by scraping and chipping.

Square: The term used to describe 100 square feet of roof area.

Stack Vent: A vertical outlet in a built-up roof system designed to relieve the pressure exerted by moisture vapor between the roof membrane and the vapor retarder or deck.

Steep Asphalt: (See Asphalt.)

Strawberry: A blister in the coating of a gravel-surfaced roof membrane.

Strip Mopping: (See Mopping.)

Stripping or Strip-Flashing: (1) The technique of sealing a joint between metal and the built-up roof membrane with one or two plies of felt or fabric and hot-applied or cold-applied bitumen; (2) the technique of taping joints between insulation boards or deck panels.

Styrene-Butadiene Rubber (SBR): A material used as a modified bitumen for built-up roofing.

Styrene-Butadiene-Styrene Block Copolymer (SBS): A material used as a modified bitumen for built-up roofing.

Substrate: The surface upon which the roofing or waterproofing membrane is applied (i.e., the structural deck or insulation)

Sump: An Intentional depression around a drain.

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Superimposed Loads:	Loads that ate added to existing loads For example, a large stack of insulation boards placed on top of a structural steel deck
Tapered Edge Strip:	A tapered insulation strip used to (1) elevate the roof at the perimeter and at curbs that extend through a root; (2) provide a gradual transition from one layer of insulation to another
Taping:	(See Stripping.)
Tar:	A brown or black bituminous material, liquid or semi-solid in consistency, in which the predominating constituents ate bitumens obtained as condensates in the processing of coal, petroleum, oil-shale, wood or other organic materials.
Tarred Felt:	(See Coal-Tar Felt.)
Test Cut:	A sample of the roof membrane that is cut from a roof membrane to: (a) determine the weight of the average interply bitumen moppings; (b) diagnose the condition of the exiting membrane (e.g., to detect leaks or blisters). Sample cut size is 4 inches by 40 inches.
Tetrahydrofuran (THF):	A solvent used in welding thermoplastic materials.
Thermal Conductance (C):	A unit of heat flow that is used for specific thicknesses of material or for materials of combination construction, such as laminated insulation.
Thermal Conductivity (k):	The heat energy that will be transmitted by conduction through 1 square foot of l-inch thick homogeneous material in one hour when there is a difference of 1 degree Fahrenheit perpendicularly across the two surfaces of the material.
Thermal Insulation:	A material applied to reduce the flow of heat.
Thermal Resistance (R):	An index of a material's resistance to heat flow; it is the reciprocal of thermal conductivity (k) or thermal conductance (C).
Thermal Shock:	The stress-producing phenomenon resulting from sudden temperature change in a roof membrane when, for example, a rain shower follows brilliant sunshine.
Through-Wall Flashing:	A water-resistant membrane or material assembly extending through a wall and its cavities, positioned to direct water entering the top of the wall to the exterior.
Tuck Pointing:	(1) Troweling mortar into a joint after masonry units are laid; (2) final treatment of joints in cut stonework. Mortar or a putty-like filler is forced into the joint after the stone is set.
Underwriters Laboratories (UL):	An organization that classifies roof assemblies for their fire characteristics and wind uplift resistance.
Vapor Migration:	The movement of water vapor from a region of high vapor pressure to a region of lower vapor pressure.
Vapor Retarder:	A material designed to restrict the passage of water vapor through a roof or wall.

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Vent:	An opening designed to convey water vapor or other gas from inside a building or a building component to the atmosphere, thereby relieving vapor pressure.
Vermiculite:	An aggregate used in lightweight insulating concrete, formed by the heating and consequent expansion of a micaceous mineral.
Water Cutoff:	(See Cutoff.)
Waterproofing:	Treatment of a surface or structure to prevent the passage of water under hydrostatic pressure.
Wind Uplift:	The upward force produced as wind blows around or across a structure or an object.
Wythe:	A masonry wall, one masonry unit, a minimum of two inches thick.

END OF SUBSECTION

APPENDIX C

TECHNICAL BULLETINS/UPDATES/ADVISORIES

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

APPENDIX C

TECHNICAL ADVISORY **T0501-1**

DATE:	10/91
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