HOW TO USE THIS MANUAL
(Overview of Chapter Contents)

This Manual is organized into 2 major sections, *Design and Application Guidelines* and *Product Details*. The *Design and Application Guidelines* segment is intended to provide the user with practical guidance for installation and sizing of Seismic Restraint components. The *Product Details* segment identifies various products and their features, functions and benefits for use in various applications.

It is important to recognize that not all portions of this Manual will be of interest or even of practical use to most users. Instead Architects, Designers, Structural Engineers, HVAC or Plumbing Contractors, Inspectors and/or Code officials will likely be keyed into specific areas relating to their particular field of interest. To that end, the Manual includes adequate redundancy within the Chapters to allow each one to (as much as possible) stand individually.

As an aid to the user, the following section offers general guidance as to what is in each chapter of the manual. When confronted with a design issue or installation problem, the first step of researching a solution would be to quickly review the summaries below. From this, the segment of the manual appropriate to the issue at hand can be identified and a further data can be located quickly and easily.

Section D
Design and Application Guidelines

The Design and Application section is broken into several chapters, each dealing with a somewhat different subject area. Below you will find a listing of these Chapters and immediately after the listing, there is a summary of the material in each Chapter.

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Kinetics Seismic Engineering (D1)

The first chapter (D1) addresses in detail the Design Analysis of Seismic restraint systems as performed by Kinetics Noise Control. The chapter is Analytical in nature and will be of considerably more interest to Designers and Engineers in reviewing the design details of the project than it will be to installation contractors.

Discussed are the items addressed by Kinetics Noise Control in a standard analysis, the items excluded, input information required and interpreting the output.

Purpose, Extent and Limitations of Analysis (D1.1)

This document describes details of exactly what a Seismic Analysis performed by Kinetics Noise Control addresses, what it does not address and why there are limitations. It also indicates the information required from other parties to generate a successful installation and why these independent parties must be involved.

Referenced Standards (D1.2)

This document identifies the various codes and standards used to compile this manual and used as a basis for the calculations and recommendations offered by Kinetics Noise Control.

Overview of the Analytical Methods Used (D1.3)

This segment briefly goes through the procedures used by Kinetics Noise Control to determine the distribution of Seismic loads from the effective center of mass of the restrained system to the various restraint locations. It is not an all-inclusive "cookbook" and as such, does not provide detailed computation instructions. It is intended as an overview to aid in the understanding of the process for Engineers and other design professionals.

Static versus Dynamic Modeling Techniques (D1.4)

This is a commentary on the Pros and Cons of Static versus Dynamic modeling of equipment restraint systems. Appropriateness for various types of applications will also be addressed.

Required Calculation Input (D1.5)

In order to obtain appropriate output from an Analysis, the proper input data is necessary. Listed here is the material needed by Kinetics Noise Control to perform an accurate analysis. Also discussed here are what input data is mandatory and where assumptions can be made to expedite the analytical process. Of necessity, any assumptions made will be conservative. This paper also addresses the potential impact that these assumptions can have on the overall design of the restraint system.

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Understanding Standard Calculation Output (D1.6)

The bulk of Kinetics Noise Control performed calculations are done using a proprietary program that yields standardized output. This paper guides the reader through the output document identifying the locations on the document where input parameters are identified as well as how to understand the output results and how to apply this to "real world" applications.

Understanding Non-Standard Calculation Output (D1.7)

Because not all equipment can be fit into a configuration that can be handled by the proprietary analysis program listed above, this segment will address analyses for various "non-standard" equipment arrangements. Identified are the input and output parameters that must appear in some format to ensure that all appropriate factors are addressed as well are the proper output factors that must be present to ensure selection of the appropriate restraint components.

General Qualifications and Disclaimer (D1.8)

This is simply a copy of the Standard Kinetics Noise Control Seismic disclaimer appropriate for all seismic calculations performed by Kinetics Noise Control. It identifies in detail the extent of the analysis performed by Kinetics Noise Control and it employees. It also lists factors that are beyond the scope of the Kinetics Noise Control analysis and which must be addressed by others.

Seismic Building Code Review (D2)

The second chapter (D2) addresses various Building Codes and details of their requirements. Every attempt has been made in this section to weed out portions of the various codes that are not appropriate for the restraint of non-structural components and mechanical equipment and to convert the remainder of the language into something that can be more easily understood.

This chapter will be of interest to designers, specifiers, estimators and others who are looking to identify areas where seismic restraint is or is not required.

Understanding the IBC Code (D2.1)

This document is a rewording of the 2000 IBC Code focussing on non-structural components and simplified to make it more readily understood by the typical user. It includes references back to the IBC document should anyone reading the section be interested in the exact verbiage in the code.

Pipe Restraint Requirements (IBC) (D2.2)

Pipe restraint requirements as defined by the 2000 IBC code are addressed in detail in this document. This does not include any sizing or installation guidance. It simply defines those pipes that require restraints and those that for one reason or another, can be exempted from this requirement.

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Duct Restraint Requirements (IBC) (D2.3)

Duct restraint requirements as defined by the 2000 IBC code are addressed in detail in this document. Again it does not include any sizing or installation guidance. It simply defines those ducts that require restraints and those that for one reason or another, can be exempted from this requirement.

Pipe Restraint Requirements (SBC, BOCA) (D2.4)

Pipe restraint requirements as defined by both 1997 SBC and the 1996 BOCA codes are addressed in detail in this document.

Duct Restraint Requirements (SBC, BOCA) (D2.5)

Duct restraint requirements as defined by both 1997 SBC and the 1996 BOCA codes are addressed in detail in this document.

Pipe Restraint Requirements (97UBC) (D2.6)

Pipe restraint requirements as defined by the 1997 UBC code is addressed in detail in this document.

Duct Restraint Requirements (97UBC) (D2.7)

Duct restraint requirements as defined by the 1997 UBC code is addressed in detail in this document.

Evaluating Seismic Requirements in Specs (D2.8)

This paper addresses the IBC, UBC, SBC, BOCA and TI-809-04 Requirements. It is an overview document intended to offer insight to estimators and others interested in roughly determining what componentry may be needed to meet Seismic requirements for particular Projects.

National Building Code of Canada Requirements (D2.9)

Non-structural design issues required by the 1995 Canadian Building Code are collected and identified in this document.

Other Referenced Standards (OSHPD, VISCMA, SMACNA) (D2.10)

An overview of other commonly identified standards and design guides are referenced in this paper. These are discussed without going into significant detail on any of them, but do offer the reader some other references and points of view.

Product/Design Overview (D3)

The third chapter of this manual (D3) is more practically oriented than the previous chapters. It is geared toward identifying problems and issues routinely encountered in the field and offers guidance and/or recommendations for resolving them with minimal effort. This section offers the most value if read early in a project as many of the

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recommendations impact design or installation philosophies that once set, can be difficult to modify. It is recommended reading for any group involved in locating, supporting or installing mechanical systems in structures.

10 Biggest Seismic Problems Dealt with by Contractors (D3.1)

This document identifies 10 items that routinely cause problems for installation contractors. Included are identification of the problems as well as alternate less costly designs and possible solutions if the problems are unavoidable.

Cables vs Struts for Ceiling Mounted Pipe/Duct/Conduit Restraint (D3.2)

This is a cautionary document intended only as a warning that Cable and Strut restraint systems behave very differently and different rules must be applied. More detail is available in the Piping, Duct and Conduit sections of the manual.

When to Use Combination Isolator/Restraints (D3.3)

Benefits of using combination Isolator/Restraint components and common applications are addressed here from a design standpoint.

When to Use Separate Isolator/Restraints (D3.4)

Benefits of using separate Isolator/Restraint components and common applications are reviewed from a design standpoint.

High Capacity Restraint Configurations (D3.5)

As the codes have changed and required restraint capacities have increased, older more conventional restraint designs have been found to be insufficient for many applications. This section is an overview of the issues faced when selecting restraints for the more severe applications found today and what avenues are open to optimize the installation.

Hybrid Isolator/Restraints (FMS) (D3.6)

In an effort to provide a more suitable restraint system better tailored to current requirements, KINETICS Noise Control has developed the FMS family of Isolator/Restraints. These components can be mixed and matched to provide a broad range of capacities. In addition, they can be used either as separate restraints or in combined isolator/restraint applications. This section addresses the uses and benefits of the FMS components for many potential applications.

Roof Mounted Equipment Applications (D3.7)

Roof mounted equipment applications have always involved challenges not experienced with indoor applications. These range from wind and weather considerations to variations in structural attachment. Because new code requirements have greatly increased the design force levels at the roof, the design for these applications has become more complicated. This section offers an overview of what is involved.

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Applying Restraint Capacity Ratings (D4)

Chapter D4 of this manual provides a significant level information with regard to the selection of appropriately sized, Seismically rated components for particular applications. Differences between the ASD and LRFD rating systems are addressed as well as how to read, understand and interpret the Seismic rating charts which accompany each Seismic component submittal.

This Chapter includes information critical to anyone involved in making decisions relating to sizing or locating restraints in the field, particularly with regard to piping, duct or conduit installations. The installation of restraints on these systems often requires that design decisions be made in the field. This is the result of issues relating to access, modifications, inaccurate drawing details or a myriad of other reasons that result in the initial drawings not matching the installation. Understanding this information will allow the user to safely size restraints if alternate restraint components or locations are found to be necessary.

The section is recommended reading for Design Professionals or any group responsible for sizing or evaluating the appropriateness of particular restraint devices.

ASD (Applied Stress Design) vs LRFD (Load Resistance Factor Design) (D4.1)

Older Codes have historically used ASD values when sizing components. New Codes have switched to LRFD. When evaluating ratings, all load and capacity data must be converted into the same units or the resulting mismatch can invalidate the analysis. This paper discusses the differences between the two and when a conversion is required to properly size components.

Horizontal/Vertical Seismic Load Capacity Envelopes (Constant) (D4.2)

The most common way of expressing the Seismic Capacity of a Restraint or seismically rated isolator is with a Horizontal/Vertical load capacity chart. This Section explains these charts and how to use them.

Horizontal/Vertical Seismic Load Capacity Envelopes (Variable) (D4.3)

In some combination Isolator/Restraint devices, the supported load affects the seismic rating. Depending on the load or the device, it could increase or decrease the restraint capacity. Charts used to evaluate these kinds of restraints are slightly different than the charts mentioned above and this section explains them and their application.

Force Class (for Hanging Piping, Ductwork, Conduit and Equipment) (D4.4)

Because of the significant number of variables involved, rating cable and strut restraint systems are typically more complicated that rating conventional stand alone restraints. In an effort to simplify sizing these components, Kinetics Noise

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Control has developed the “Force Class” Rating System. In it, A restraint location is assigned a “Force Class” load requirement (I-VI) based on Seismic Zone, Code, Length of Run, Weight per foot of suspended system and Location in the structure. Hardware is also assigned a “Force Class” capacity based on Size, Anchorage and Worst case geometry. These values are such that a “Force Class” I component can generate sufficient capacity to with stand a “Force Class” I Load. It is then a simple matter to select components appropriate to the load. This section describes in detail and provides necessary data to use this system. It is of critical interest to those involved in evaluating pipe, duct or conduit restraint systems.

Force Class Load Determination Table (Sample) (D4.5)

A Sample “Force Class” load rating Table is presented in this document. As these are customized for each installation, this example cannot be used for design without being tailored to the application in question, but if offers a typical example of what might be encountered in practice.

Maximum Restraint Spacing, Run Offset and Drop Length (D4.6)

This is a collection of Tables that allow a user to quickly select appropriate maximum spacing for both lateral and axial restraints as well as determine allowable unrestrained drop lengths maximum allowable offsets. It is appropriate for piping, ductwork and conduit.

Hanger Rod, Strut and Stiffener Tables (D4.7)

When subjected to Seismic Loads (either in Strut of Cable restrained system) Uplift forces are generated in hanger rods. Depending on the magnitude of the force and the length and diameter of the hanger rod, a rod stiffener is often required. This section provides guidance as to how big a stiffener to use and when it is needed.

Cable and Anchorage Ratings (D4.8)

“Force Class” ratings for and application information for various Cable and Cable Anchorage Components are addressed in this section.

Force Class Examples (D4.9)

This section works through some typical “Force Class” applications and sample problems.

Floor & Wall Mounted Equipment (D5)

Design information relative to the anchorage of floor mounted equipment, whether hard mounted or isolated, or wall mounted equipment is provided in this Chapter (D5). Offered are both a technical review of the issues involved as well as more practical installation considerations and options.

This section is recommended reading for Design Professionals or any group responsible

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for sizing or evaluating the appropriateness of particular restraint devices.

Floor Mounted Section

Floor Mounted Equipment Primer (D5.1.1)

This section provides a technical overview of the forces encountered by all floor mounted equipment in seismic applications.

Forces Transferred between Equipment and Restraints (D5.1.2)

A summary of the details relating to the interface between Floor mounted equipment and the restraint is addressed in this document. Items such as impact and load sharing for different restraint arrangements are discussed.

Attachment of Equipment to Restraints (D5.1.3)

In some cases, the direct connection between equipment and restraint is obvious. In others it is not. Issues that need to be understood relative to this connection are highlighted in this paper.

Attachment of Restraints to the Structure (D5.1.4)

There is a wide range of structures to which restraints can be attached. Variations in these structures as well as in the restraints, can significantly impact the capacity of the system.

Oversized Baseplate Section

Oversized Baseplates – How they work and why to use them (D5.2.1)

When connecting to concrete, the brittle nature of the concrete requires that the load capabilities of the hardware be significantly de-rated. As a result, the restraint device normally has considerably more capacity than does the connection. In these cases, an adapter plate can significantly increase the capacity of the system.

Oversized Baseplates – Capacities and Selection Guide (D5.2.2)

This section offers guidance on selecting an appropriate oversized baseplate for a given application.

Wall Mounted Section

Forces Transferred between Wall Mounted Equipment and Restraints (D5.3.1)

The addition of gravity loads increases the requirements for restraint hardware in wall mounted equipment. A brief review of the appropriate factors is addressed in this document.

Attachment of Wall Mounted Equipment to Structure (D5.3.2)

As wall structures are frequently very different from ceiling or floor construction, the

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detail of equipment attachment must also be adapted. This section addresses this interface.

Curb Mounted Equipment (D6)

Design information relative to the connection of curb mounted equipment, whether hard mounted or isolated, is provided in this Chapter (D6). It offers a technical review of curbs and equipment/curb interfaces as well as more practical installation considerations.

This chapter is recommended reading for Design Professionals or any group responsible for sizing or evaluating the appropriateness of curbs and curb mounted restraint devices and curbs themselves. The is also more practical guidance as to how to increase the capacity of non-seismically rated curb assemblies.

Seismic Forces Acting on Curb Mounted Equipment (D6.1)

This section provides a technical overview of the forces encountered by curb mounted equipment in seismic applications.

Sheet Metal Curb Section

Basic Primer for Sheet Metal Curbs (D6.2.1)

An overview of curbs and curb issues is the key goal of this document. It offers the reader a basic understanding of the issues involved.

Attachment of Equipment to Sheet Metal Curbs (D6.2.2)

Making structural connections to sheet metal structures is often difficult. It is the intent of this paper to offer make the reader aware of key factors needed to have a successful installation.

Transferring Seismic Forces through Sheet Metal Curbs (D6.2.3)

Methods of increasing the seismic capacity of unrated sheet metal curbs are addressed in this document.

Attachment of Sheet Metal Curbs to the Building Structure (D6.2.4)

Similar to the equipment connection, making structural connections to sheet metal structures is often difficult. It is the intent of this paper to offer make the reader aware of key factors needed to securely anchor curbs to the supporting structure.

Limitations of Sheet Metal Curbs in Seismic Applications (D6.2.5)

Guidance as to when a sheet metal curb may be appropriate and when it isn't is covered in this paper.

Rules for Using Sheet Metal in Seismic Applications (D6.2.6)

This document is a summary of the previous (D6.2) documents in this chapter

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offering basic guidance without going into detail.

Structural Curb Section

Basic Primer for Structural Curbs (D6.3.1)

An overview of curbs and curb issues is the key goal of this document. It offers the reader a basic understanding of the issues involved.

Attachment of Equipment to Structural Curbs (D6.3.2)

Access, weatherproofing, and secure attachment all make connecting equipment to curbs more difficult than it would be in an interior environment It is the intent of this paper to offer make the reader aware of key factors needed to have a successful installation.

Transferring Seismic Forces through Structural Curbs (D6.3.3)

Methodologies used to maximize the seismic capacity of structural curbs are addressed in this document.

Attachment of Structural Curbs to the Building Structure (D6.3.4)

Because of the long narrow footprint of each of the curb walls, making structural connections to the parent structure is often difficult. It is the intent of this paper to offer make the reader aware of key factors needed to securely anchor curbs to the supporting structure.

Limitations of Structural Curbs in Seismic Applications (D6.3.5)

Guidance as to when structural curbs are suitable and when they are not, are covered in this paper.

Rules for Using Structural Curbs in Seismic Applications (D6.3.6)

This document is a summary of the previous (D6.3) documents in this chapter offering basic guidance without going into detail.

Piping Systems (D7)

This section comprehensively addresses the restraint of Piping systems for seismic applications. It is extremely practical in nature. It avoids the basic sizing of components (which is explained in Chapter D4) and focuses on layout, hardware arrangements, installation options and other issues critical to the installation contractor. Addressed in the section are floor mounted, suspended and vertically oriented systems.

This chapter is recommended reading for Installation contractors, design support for contractors and field inspection personnel.

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Seismic Forces Acting on Piping Systems (D7.1)

This section provides a brief overview of the forces encountered by piping systems exposed to seismic forces and how they generate loads in restraint systems.

Basic Primer for the restraint of Piping (D7.2)

This section addresses different kinds of piping systems, variations between them and provides some general direction in getting started with a restraint plan.

Pros and Cons of Struts versus Cables (D7.3)

While Struts and Cables are often used to perform the same restraint function and because they appear similar to the casual observer, there are significant differences between them that need to be accounted for in the field. This section addresses these issues.

Layout Requirements for Pipe Restraint Systems - Definitions and Locations (D7.4.1)

The basic installation “Rules” for the appropriate restraint of piping systems along with basic definitions of terms used in later sections of this manual make up this section of the manual.

Ceiling Supported Pipe Restraint Arrangements (D7.4.2)

Illustrated here are widely ranging options for the installation of both lateral and axial restraint arrangements acceptable for use on piping systems. Isolated, non-Isolated, single pipe and multiple trapezed pipes are all addressed in this section.

Floor or Roof supported Pipe Restraint Arrangements (D7.4.3)

This section is similar to the one above except that it covers piping that is supported from below, either on floors or for roof mounted applications.

Pipe Restraint Arrangements for Vertical Piping Runs (D7.4.4)

The focus on this section is risers or other vertical runs of piping. Support and restraint arrangements and guidelines for these kinds of applications are addressed in detail in this segment.

Axial Restraint of Steam and High Temp Piping (D7.4.5)

Because of expansion/contraction issues, the axial restraint of steam and other high temperature piping systems can be extremely difficult. This section addresses these areas and includes recommendations to resolve these issues.

Attachment Details - Transferring Forces (D7.5.1)

A key element in the effectiveness of a restraint is the details of the connection. Basic parameters required to ensure that these connections are appropriate for seismic applications are included in this paper.

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Attachment Details – Cable Clamps (D7.5.2)

There are several end connection details that are suitable for cable restraints. Both appropriate and inappropriate connections are identified in this section along with proper installation techniques.

Attachment Details – Piping Attachment (D7.5.3)

The connection between the cable or strut and a piping system can be accomplished in a wide variety of ways and through the use of a wide variety of hardware. A wide variety of acceptable arrangements applicable to a broad variety of possible applications are shown and discussed in this section.

Attachment Details – Attachment to Structure (D7.5.4)

Similar to the connection between the cable or strut and a piping system is the connection between the cable or strut and the structure. Cautions are required to ensure that the structure is not weakened by the connection and that the connection is adequate to transfer the design load. As in the section above, this segment illustrates a wide variety of acceptable arrangements that can accomplish this feat.

Non-Moment Generating Connections (D7.5.5)

Under some conditions, restraints can be avoided if the pipe hanger rod is fitted with a "Non-Moment" generating connection. Additional input on this subject is available in this section.

Connection options for Awkward Situations (D7.6)

Virtually every application will have situations where the basic connection arrangements won't fit or simply are not suitable. This section illustrates several typical "Awkward" situations and offers guidance on possible configurations to incorporate restraints in these areas.

Ductwork (D8)

This section comprehensively addresses the restraint of Ductwork for seismic applications. It is extremely practical in nature. It avoids the basic sizing of components (which is explained in Chapter D4) and focuses on layout, hardware arrangements, installation options and other issues critical to the installation contractor. Addressed in the section are floor mounted and suspended systems.

This chapter is recommended reading for Installation contractors, design support for contractors and field inspection personnel.

Seismic Forces Acting on Ductwork (D8.1)

This section provides a brief overview of the forces encountered by ductwork exposed to seismic forces and how they generate loads in restraint systems.

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Basic Primer for the restraint of Ductwork (D8.2)

This section addresses different kinds of duct systems, variations between them and provides some general direction in getting started with a restraint plan.

Pros and Cons of Struts versus Cables (D8.3)

While Struts and Cables are often used to perform the same restraint function and because they appear similar to the casual observer, there are significant differences between them that need to be accounted for in the field. This section addresses these issues.

Layout Requirements for Duct Restraint Systems - Definitions and Locations (D8.4.1)

The basic installation "Rules" for the appropriate restraint of duct systems along with basic definitions of terms used in later sections of this manual make up this section of the manual.

Ceiling Supported Duct Restraint Arrangements (D8.4.2)

Illustrated here are widely ranging options for the installation of both lateral and axial restraint arrangements acceptable for use on Ductwork. Isolated, non-Isolated, single and multiple trapezed ducts are all addressed in this section.

Floor or Roof supported Duct Restraint Arrangements (D8.4.3)

This section is similar to the one above except that it covers ductwork that is supported from below, either on floors or for roof mounted applications.

Attachment Details - Transferring Forces (D8.5.1)

A key element in the effectiveness of a restraint is the details of the connection. Basic parameters required to ensure that these connections are appropriate for seismic applications are included in this paper.

Attachment Details – Cable Clamps (D8.5.2)

There are several end connection details that are suitable for cable restraints. Both appropriate and inappropriate connections are identified in this section along with proper installation techniques.

Attachment Details – Duct Attachment (D8.5.3)

The connection between the cable or strut and a duct can be accomplished in a wide variety of ways and through the use of a wide variety of hardware. A wide variety of acceptable arrangements applicable to a broad variety of possible applications are shown and discussed in this section.

Attachment Details – Attachment to Structure (D8.5.4)

Similar to the connection between the cable or strut and the ductwork is the connection between the cable or strut and the structure. Cautions are required to

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ensure that the structure is not weakened by the connection and that the connection is adequate to transfer the design load. As in the section above, this segment illustrates a wide variety of acceptable arrangements that can accomplish this feat.

Non-Moment Generating Connections (D8.5.5)

Under some conditions, restraints can be avoided if the duct support hanger is fitted with a "Non-Moment" generating connection. Additional input on this subject is available in this section.

Connection options for Awkward Situations (D8.6)

Virtually every application will have situations where the basic connection arrangements won't fit or simply are not suitable. This section illustrates several typical "Awkward" situations and offers guidance on possible configurations to incorporate restraints in these areas.

Electrical Distribution Systems (D9)

This section comprehensively addresses the restraint of Conduit and Cable Trays for seismic applications. It is extremely practical in nature. It avoids the basic sizing of components (which is explained in Chapter D4) and focuses on layout, hardware arrangements, installation options and other issues critical to the installation contractor.

Addressed in the section are floor mounted and suspended systems.

This chapter is recommended reading for Installation contractors, design support for contractors and field inspection personnel.

Seismic Forces Acting on Conduit and Cable Trays (D9.1)

This section provides a brief overview of the forces encountered by electrical distribution systems exposed to seismic forces and how they generate loads in restraint systems.

Basic Primer for the restraint of Cable Trays & Conduit (D9.2)

This section addresses different kinds of Distribution systems, variations between them and provides some general direction in getting started with a restraint plan.

Pros and Cons of Struts versus Cables (D9.3)

While Struts and Cables are often used to perform the same restraint function and because they appear similar to the casual observer, there are significant differences between them that need to be accounted for in the field. This section addresses these issues.

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Layout Requirements for Electrical Distribution Restraint Systems - Definitions and Locations (D9.4.1)

The basic installation "Rules" for the appropriate restraint of conduit and cable trays along with basic definitions of terms used in later sections of this manual make up this section of the manual.

Ceiling Supported Conduit/Tray Restraint Arrangements (D9.4.2)

Illustrated here are widely ranging options for the installation of both lateral and axial restraint arrangements acceptable for use on Electrical Distribution systems.

Floor supported Conduit/Tray Restraint Arrangements (D9.4.3)

This section is similar to the one above except that it covers conduit and cable trays that are supported from below, typically in floor mounted applications.

Attachment Details - Transferring Forces (D9.5.1)

A key element in the effectiveness of a restraint is the details of the connection. Basic parameters required to ensure that these connections are appropriate for seismic applications are included in this paper.

Attachment Details – Cable Clamps (D9.5.2)

There are several end connection details that are suitable for cable restraints. Both appropriate and inappropriate connections are identified in this section along with proper installation techniques.

Attachment Details – Conduit/Tray Attachment (D9.5.3)

The connection between the cable or strut and conduit or cable trays can be accomplished in a wide variety of ways and through the use of a wide variety of hardware. A wide variety of acceptable arrangements applicable to a broad variety of possible applications are shown and discussed in this section.

Attachment Details – Attachment to Structure (D9.5.4)

Similar to the connection between the cable or strut and the distribution system is the connection between the cable or strut and the structure. Cautions are required to ensure that the structure is not weakened by the connection and that the connection is adequate to transfer the design load. As in the section above, this segment illustrates a wide variety of acceptable arrangements that can accomplish this feat.

Non-Moment Generating Connections (D9.5.5)

Under some conditions, restraints can be avoided if the conduit support is fitted with a "Non-Moment" generating connection. Additional input on this subject is available in this section.

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Connection options for Awkward Situations (D9.6)

Virtually every application will have situations where the basic connection arrangements won't fit or simply are not suitable. This section illustrates several typical "Awkward" situations and offers guidance on possible configurations to incorporate restraints in these areas.

Suspended Equipment (D10)

This section comprehensively addresses the restraint of Suspended Equipment in seismic applications. It is extremely practical in nature. It avoids the basic sizing of components (which is explained in Chapter D4) and focuses on layout and hardware issues.

This chapter is recommended reading for Installation contractors, design support for contractors and field inspection personnel.

Seismic Forces Acting on Suspended Equipment (D10.1)

This section provides a brief overview of the forces encountered by suspended equipment exposed to seismic forces and how they generate loads in restraint systems.

Basic Primer for the restraint of Suspended Equipment (D10.2)

This section addresses different kinds of by suspended equipment, variations between them and provides some general direction in getting started with a restraint plan.

Pros and Cons of Struts versus Cables (D10.3)

While Struts and Cables are often used to perform the same restraint function and because they appear similar to the casual observer, there are significant differences between them that need to be accounted for in the field. This section addresses these issues.

Suspended Equipment - Definitions and Locations (D10.4.1)

Basic installation "Rules" along with basic definitions of terms used in later sections of this manual make up this section of the manual.

Suspended Equipment Arrangements (D10.4.2)

Illustrated here are a wide range of options for the installation of Restraints suitable for use on suspended equipment.

Attachment Details - Transferring Forces (D10.5.1)

A key element in the effectiveness of a restraint is the details of the connection. Basic parameters required to ensure that these connections are appropriate for seismic applications are included in this paper.

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Attachment Details – Cable Clamps (D10.5.2)

There are several end connection details that are suitable for cable restraints. Both appropriate and inappropriate connections are identified in this section along with proper installation techniques.

Attachment Details – Suspended Equipment (D10.5.3)

The connection between the cable or strut and the equipment can be accomplished in a wide variety of ways and through the use of a wide variety of hardware. A wide variety of acceptable arrangements applicable to a broad variety of possible applications are shown and discussed in this section.

Attachment Details – Attachment to Structure (D10.5.4)

Similar to the connection between the cable or strut and the suspended equipment is the connection between the cable or strut and the structure. Cautions are required to ensure that the structure is not weakened by the connection and that the connection is adequate to transfer the design load. As in the section above, this segment illustrates a wide variety of acceptable arrangements that can accomplish this feat.

Connection options for Awkward Situations (D10.6)

Virtually every application will have situations where the basic connection arrangements won't fit or simply are not suitable. This section illustrates several typical "Awkward" situations and offers guidance on possible configurations to incorporate restraints in these areas.

Architectural Element Restraint Design and Applications (D11)

Most projects include a significant number of non-structural architectural elements that under some conditions require restraint as well. This section relates specifically to vibration-isolated elements and restraint requirements for them.

The most likely audience for this section would be Architects and Structural Engineers responsible for the integrity of the structure.

Floating Floor Restraint Design (D11.1)

This section addresses the basic parameters required to ensure the performance of a floating floor restraint system. Internal forces in the slab as well as appropriate restraint techniques are addressed.

Floating Floor Perimeter Restraint (D11.1.1)

Pros and cons of perimeter restraints are covered in detail in this section.

Floating Floor Internal Restraints (D11.1.2)

In many cases perimeter restraint is either not possible or impractical. For these

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cases internal restraint elements are needed. Information on appropriate internal restraints is available in this section.

Isolated Ceiling Restraint Design (D11.2)

This section addresses the basic parameters required to ensure the performance of an isolated-ceiling restraint system.

Isolated Ceiling Perimeter Restraint (D11.2.1)

Pros and cons of perimeter restraints are covered in detail in this section.

Isolated Ceiling Internal Restraints (D11.2.2)

In many cases perimeter restraint is either not possible or impractical. For these cases internal restraint elements are needed. Information on appropriate internal restraints is available in this section.

Isolated Wall Restraint Design (D11.3)

This section addresses the basic parameters required to ensure the performance of an isolated-ceiling restraint system.

Isolated Walls Restrained at the Top and Bottom (D11.3.1)

Pros and cons of perimeter restraints are covered in detail in this section.

Isolated Wall Internal Restraints (D11.3.2)

In many cases top and bottom restraint is either not possible or impractical. For these cases internal restraint elements are needed. Information on appropriate internal restraints is available in this section.

Kinetics Seismic Specification (D12)

Recommended long format Specifications

Long Form Specification (D12.1)

Comprehensive long form specifications as appropriate for inclusion in contract documents.

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