

**CHAPTER D1**  
**SEISMIC BUILDING CODE REVIEW**  
**TABLE OF CONTENTS**

Purpose, Extent and Limitations of Analysis	D1.1
Referenced Standards	D1.2
Overview of Analytical Methods Used	D1.3
Static <u>vs</u> Dynamic Modeling Techniques	D1.4
Required Calculation Input	D1.5
Understanding Standard Calculation Output	D1.6
Understanding non-Standard Calculation Output	D1.7
General Assumptions and Disclaimer	D1.8

**TABLE OF CONTENTS (Chapter D1)**

KINETICS SEISMIC ENGINEERING

RELEASE DATE: 10/1/03



DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA

Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

PAGE:

**D1.0**



## PURPOSE, EXTENT AND LIMITATIONS OF A SEISMIC ANALYSIS

The primary purpose for a seismic analysis with regard to equipment, piping, ductwork and conduit is to offer a degree of confidence to the Engineer of Record that a competent individual has reviewed the application, specified appropriate componentry and documented that, properly installed, it is in compliance with code and specification requirements.

There are many inherent limitations as to the extent of such an analysis. The primary limitation is that, by law, an Engineer can only take responsibility for those components over which he has direct control or knowledge. The typical items that are addressed in an analysis are the determination of design seismic forces, the resulting reactions at the restraint connections to the structure (if the equipment remains rigid) and the capabilities of the hardware and anchorage to resist those forces.

The capabilities of equipment to withstand seismic forces must be determined by either the equipment manufacturer or by an independent party that has access to all of the technical information relative the equipment. As to it's structural durability, all material strengths, thicknesses, geometry and operating loads must be accounted for and added to the seismic load requirements. The issue becomes more complex when continued operation of the equipment is mandated. As the ability of an independent party to obtain this information is extremely limited, the manufacturer must normally address the equipment durability issues.

There are also building structural issues that must be considered. These relate to the ability of the building structure to withstand the local seismic forces placed on it by the equipment. In a similar fashion to the equipment, to properly analyze these factors, a detailed knowledge of both the building structure and the loads anticipated in that structure during a seismic event must be considered. These must be added to the forces generated by the equipment. As there is no one else with access to this information, this analysis falls into the domain of the Structural Engineer of Record.

Finally, in order for the system to work, it is assumed that all of the componentry is properly installed. Critical information on the installation of the various parts is provided and frequently once installed, it is extremely difficult to determine if the appropriate procedures were followed. As a result, after the fact inspections are based only on what can be observed in the final installation and are not comprehensive. The responsibility for following the appropriate procedures falls to the installation contractor with possible oversight by an independent on site observer.

## PURPOSE, EXTENT AND LIMITATIONS OF A SEISMIC ANALYSIS

PAGE 1 OF 1

RELEASE DATE: 09/02/04



Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:  
**D1.1**  


## REFERENCED STANDARDS

Listed below are the significant documents referenced and or used in the creation of this manual.

ACI (American Concrete Institute) 318-02 *Building Code Requirements for Structural Concrete*, 2002

ASCE (American Society of Civil Engineers) 7-98 *Minimum Design Loads for Buildings and Other Structures*, 1998

ASCE (American Society of Civil Engineers) 7-02 *Minimum Design Loads for Buildings and Other Structures*, 2002

ASD (Allowable Stress Design) *National Design Specification for Wood Construction Manual* (American Forest and Paper Association / American Wood Council) 1999

ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) *HVAC Application Handbook*, 2003

ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) RP-812 *A Practical Guide to Seismic Restraint*, 1999

BOCA (Building Officials and Code Administrators) *National Building Code*, 1996 and Amendments

FEMA (Federal Emergency Management Agency) FEMA 412 *Installing Seismic Restraints for Mechanical Equipment*, 2002

FEMA (Federal Emergency Management Agency) FEMA 413 *Installing Seismic Restraints for Electrical Equipment*, 2004

FEMA (Federal Emergency Management Agency) FEMA 414 *Installing Seismic Restraints for Ducts and Pipe*, 2004

IBC (*International Building Code*) (International Code Council), 2000

IBC (*International Building Code*) (International Code Council), 2003

NFPA (National Fire Protection Association) NFPA 13 *Installation of Sprinkler Systems*, 1999

NRC-CNRC (National Research Council – Canada) *National Building Code of Canada*, 1995

## REFERENCED STANDARDS

PAGE 1 OF 2

RELEASE DATE: 9/24/03



Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:

D1.2



SBC (*Standard Building Code*) (Southern Building Code Congress International), 1997 and Amendments

TI-809-04 (US Army Corps of Engineers) *Seismic Design for Buildings*, 1998

UBC (*Uniform Building Code*) (International Conference of Building Officials), 1997 and Amendments

**REFERENCED STANDARDS**

PAGE 2 OF 2

RELEASE DATE: 9/16/04



**KINETICS**  
**Noise Control**

DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA

Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:  
**D1.2**



**VISCMA**  
MEMBER

## OVERVIEW OF ANALYTICAL METHODS USED

Unless otherwise specified, the analyses performed by Kinetics Noise Control are based on a worst case statically applied load and assume that the equipment being restrained is rigid. These assumptions are in compliance with code parameters and with the application of appropriate factors, address dynamic forces to the various structural elements involved as well.

Generally speaking, this analysis models a piece of restrained equipment as a rigid body with a lateral and possibly vertical load as defined by the code applied to its center of gravity. The application of these loads generates forces at the equipment restraints, which can eventually be reconciled to anchor loads. As the wave front angle for the earthquake is unknown, this analysis work must ensure that the design loads are applied in the directions which will generate the highest forces in the anchors.

There are several types of reactive loads that result from the analysis of a typical piece of equipment. A horizontal shear load, an imbalance load, a vertical uplift load, an overturning load and the static deadweight load. The interaction between these results in worst case combinations at each restraint point.

### SHEAR LOAD ANALYSIS

The most obvious restraint loading that occurs during a seismic event is the horizontal force that is generated by the lateral load. In its simplest case this results in the lateral load being split among the restraints. If the center of gravity of the equipment is aligned with the geometric center of the restraints, the split will be equal as shown in Figure 1.

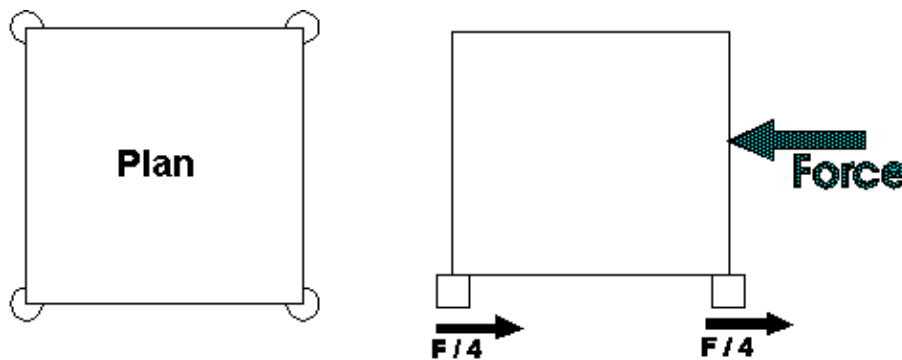


Figure 1

### IMBALANCED LOAD ANALYSIS

More frequently, the unit center of gravity is not aligned with the geometric center. When this is the case, an imbalanced load is generated which needs to be combined with the shear loads previously discussed. Figure 2 shows that the method of analyzing this

## OVERVIEW OF ANALYTICAL METHODS USED

situation is to treat the horizontal shear load at each restraint as a function of the mass that is associated with them.

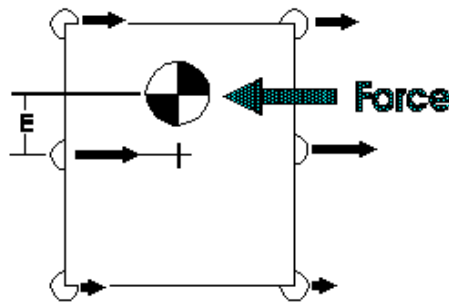


Figure 2

### OVERTURNING LOAD ANALYSIS

The accurate modeling of overturning forces is critical in determining the vertical forces to which the restraints are exposed. In the simple case where the center of gravity is coincident with the geometric center of the system and with four restraints, the vertical components are a simple function of the height of the center of gravity and the restraint spacing (Figure 3).

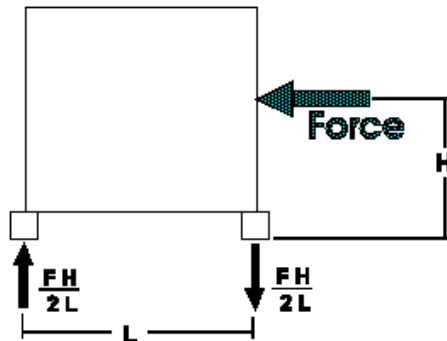


Figure 3

In the case of a system with more than four restraints, the number of points that can be considered to share the overturning load becomes a function of clearance that may be present. Note in Figure 4, that with no clearance, resistance to the overturning load will occur at every restraint location. The most common type of installation that exhibits this property is a rigidly bolted system.

## OVERVIEW OF ANALYTICAL METHODS USED

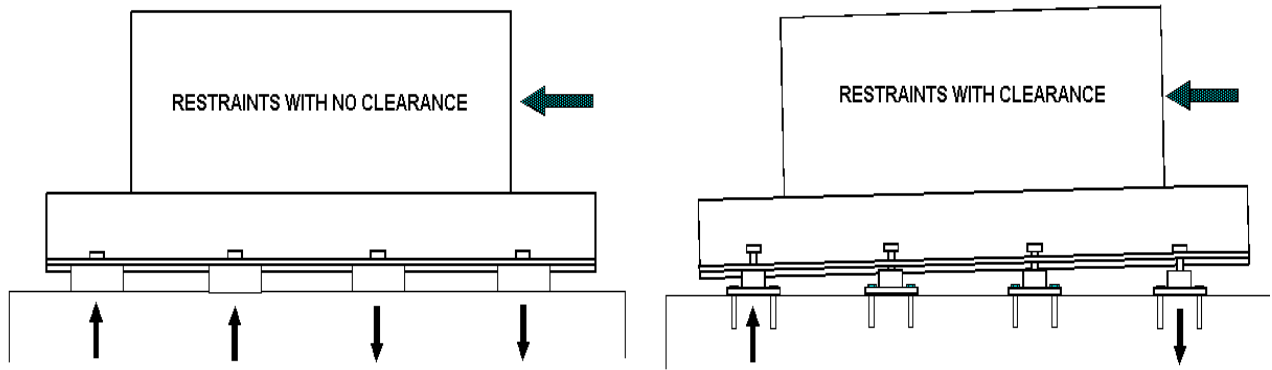


Figure 4

In systems that have more than four restraints and contain restraints that maintain an operating clearance, only the end restraints can be considered effective in resisting overturning loads. With this type of restraint, some elastomeric snubbing must be present to prevent impact loading and resulting force amplification. In some cases, if the snubbing pads are thick enough and the operating clearance small enough, some load sharing may be present, but in general this effect is minimal. This is clearly illustrated in Figure 4.

**LOAD DIRECTION ANALYSIS**

Because the direction of the seismic load is unknown, it is necessary to determine the worst case overturning load at each restraint point based on any possible load direction. The method used by Kinetics Noise Control is to set up a mathematical model of the equipment arrangement and then index the application angle of the design seismic force for the full 360 degrees of possible application angles in 1-degree increments. At each increment, the overturning load for each point is computed and the worst case load encountered at each restraint point is used in the analysis.

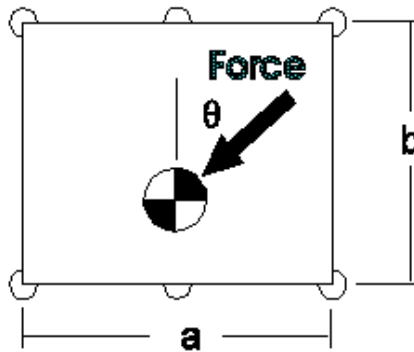


Figure 5

**OVERVIEW OF ANALYTICAL METHODS USED**



Toll Free (USA only): 800-959-1229  
 International: 614-889-0480  
 Fax: 614-889-0540  
 World Wide Web: www.kineticsnoise.com  
 Email: sales@kineticsnoise.com

DOCUMENT:  
**D1.3**  
 VISCMA  
 MEMBER

## OTHER SIGNIFICANT FACTORS

Before a mathematical model can be built, there are several other key hardware factors that need to be accounted for. These factors relate to specific snubber or system designs that can have a major impact on the final restraining loads.

## SINGLE DIRECTION SNUBBERS

Figure 6A shows a system using four single direction lateral restraints. Because this type of restraint only restrains a single direction lateral load, they must be used in sets of four. Some versions of these include a vertical snubbing pad for uplift loads. Although these are then biaxial restraints, they behave very similarly. It is important to note that since each restraint only works in a single direction, that any restraint must absorb the entire lateral force by itself.

## MULTI-DIRECTION SNUBBERS

In contrast to this, the same unit fitted with four multi-axial restraints will produce an average lateral load per restraint equal to 1/4 of the total load. This results in a series of restraints, which can be significantly smaller than what would be required for single direction components (Figure 6B).

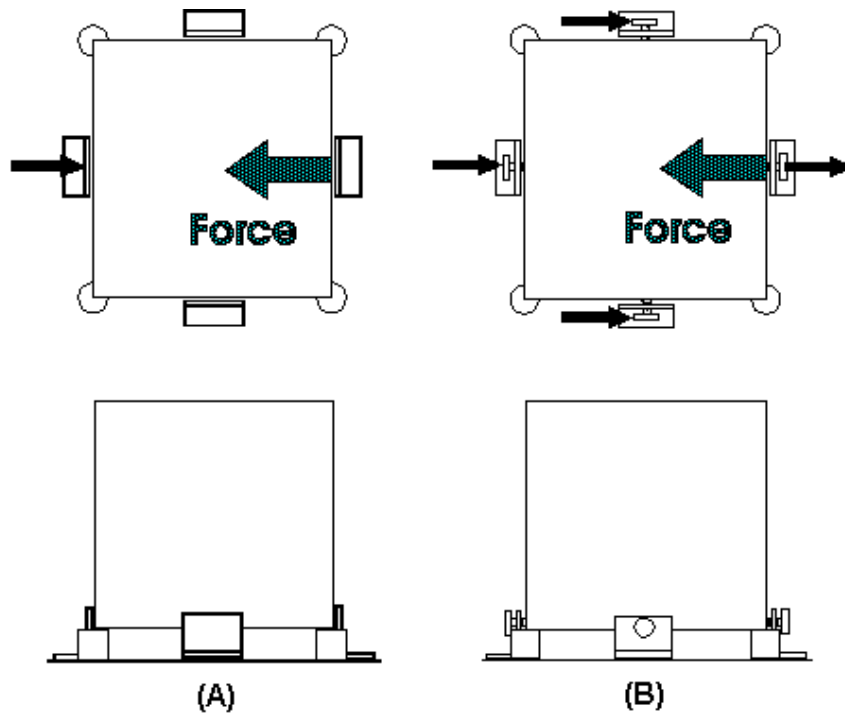


Figure 6

## OVERVIEW OF ANALYTICAL METHODS USED

PAGE 4 OF 6

RELEASE DATE: 9/24/03

## OPEN SPRING ISOLATORS

When restraining vertical loads, there are two distinct types of restraints that can be used. The first of these I will call an open or non-contained spring isolator. This is one in which the spring bears against the floor and the anchor bolts have the possibility of absorbing the spring load. An illustration of this is shown in Figure 7 (Labeled "OPEN").

## CONTAINED SPRING ISOLATORS

Another more common type of restrained spring isolator is one, which I will call a contained spring isolator. In this type, the spring load is contained within the restraint housing. The net result is that the anchor bolts, while still required to resist the equipment loading, do not have to absorb any additional loading that may be generated by the spring. This is shown in Figure 7 (Labeled "CONTAINED").

To illustrate this point more clearly, The first illustration in Figure 7 shows the two types of isolators under normal load. Note that in either case the anchors are effectively unloaded. If the equipment weight is now suddenly removed, the situation occurs that is illustrated in the second illustration. In this case nearly all the spring load is transferred directly to the anchor bolts in the open case, but the anchors are still unloaded in the contained one.

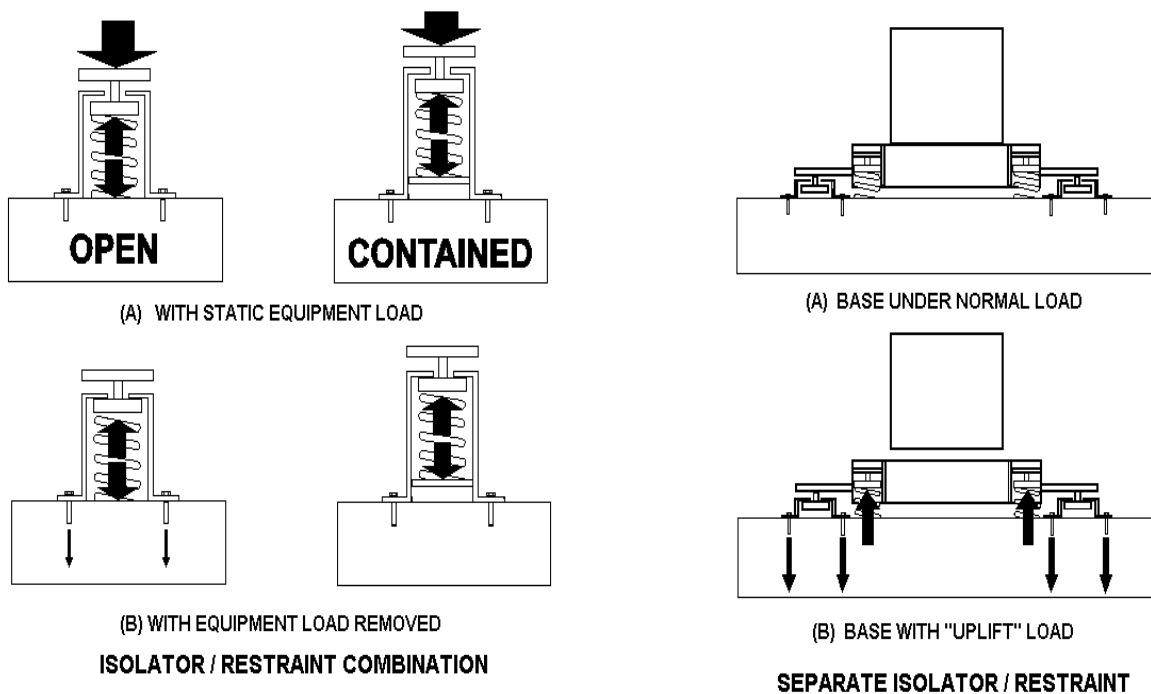


Figure 7

## OVERVIEW OF ANALYTICAL METHODS USED

## SEPARATE SNUBBERS

A quick review of systems which incorporate spring supports and independent snubbers will show that they perform in the same manner as those which use open spring isolators. These cases are illustrated in the right half of Figure 7.

## MODEL GENERATION

Two static models are set up for a given piece of equipment. One would be an X-axis model and the other a Y-axis version. In these models, all translational, vertical and overturning loads are accounted for including factors for the center of gravity offsets in each of the two major axes. The input load can be considered to be applied in any direction and X and Y components are extracted from it.

Using the above concept and generating loads for each restraint point based on the load angle discussed earlier. The angle is incremented from 0 to 360 degrees, generating the resulting forces at each restraint point for each angle. The worst case force at each restraint location is then stored and used for the evaluation of the restraint at that location.

## RESTRAINT ANALYSIS

Up to now, the analysis has been limited to the entire system. It now becomes necessary to use the loads developed for each restraint location to determine the adequacy of each restraint.

In general each restraint behaves like a small piece of equipment with its own horizontal, vertical and overturning components. Because these parameters are clearly defined for each restraint however, these factors can be boiled down to a capacity chart listing the maximum vertical, lateral and combined capacity of the restraint. These values are different for anchorage to concrete or attachment to steel. The previously computed forces are then compared to the restraint limits to ensure their adequacy.

## OVERVIEW OF ANALYTICAL METHODS USED

PAGE 6 OF 6

RELEASE DATE: 9/24/03



DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA

Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:

D1.3



## STATIC vs DYNAMIC MODELING

The basic format for tests and/or analyses of seismic resistant systems follow one of the following two primary paths, static or dynamic modeling. Within these major categories there are a myriad of detailed approaches that will not be addressed here. Instead, this document will focus on the significant differences between the static and dynamic models, what can be gained from each and when one might be preferred over another.

The static analysis involves applying a force either mathematically to a mathematically modeled system or to apply an actual force to a physical model. This force must be applied in the direction that will generate the largest possible static forces in the equipment, the equipment anchorage and the restraint. The force at that restraint is then measured or computed for comparison to the statically rated capacity of the restraint, the equipment, the anchorage device or the local load conditions on the structure. In order to use this analysis to address the forces that occur in a dynamic situation, like an earthquake, a factor (or series of factors) is then applied to the computed forces. These factors have been "fine tuned" with experience and currently offer a high degree of confidence. Unfortunately, these amplified factors can only be directly related to the structural performance of the system.

In a dynamic analysis, a time varying input force is used. The force is generated from historical ground acceleration data from an earthquake that has properties that are expected to be similar to those that would be experienced at the proposed project site. The amplitude of this profile is adjusted upward or downward to provide peaks that coincide with the seismic design values for the project.

In the case of equipment, if the study is done analytically, a model that not only addresses the basic geometry of the system, but also models the dynamic cushioning in the restraint device itself is needed. If an actual sample is tested, samples of the equipment, restraints and anchorage systems as well as a shake table large enough to mimic the appropriate seismic accelerations are necessary. In addition, the dynamic input forces must accurately portray not only the expected earthquake, but must also accurately account for the direction of the wave front and the impact of dynamic factors in the structure.

On the surface, it is obvious that a dynamic test will be considerably more expensive than would be a static one. In order for it to be justified in the practical world, there is a requirement that it offers a fair trade-off in value to the end user.

Dynamic modeling has been most commonly used with regard to building structures and with systems where failure can result in serious danger or loss of life (Nuclear facilities for example). With regard to the building structures themselves, there are several factors that allow dynamic models to offer easily justified benefits. First, the cost of the analysis, compared to the cost of the structure, is relatively low. In addition, since buildings are generally "one-offs", they normally include extensive individualized design work specific to

## STATIC vs DYNAMIC MODELING

PAGE 1 OF 3

RELEASE DATE: 9/16/04



DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA

Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:

D1.4



the application anyway and as such, frequently are already “modeled”. An additional factor specific to a structure is that the consequences of failure, from a life-safety standpoint, are significant. Finally, from a cost/benefit side, the use of a dynamic model can open the potential to reduce or simplify the structure and can actually reduce its cost.

With regard to those applications involving the potential for extremely hazardous material release, cost is not even an issue. It is critical to all concerned that the system is analyzed in absolutely the best way possible. Both static and dynamic modeling methods should be used and conservative factors applied to the result.

Hospitals and other facilities that must remain operational after a seismic event pose more of a dilemma. The dynamic analysis of the structure can often be justified as noted above, however the mechanical equipment inside can be a problem. Of primary concern is the current requirement identified in the IBC and TI-809-04 codes for critical equipment to remain operational. This means that not only must the equipment be structurally substantial enough to ride out an event, but also that its internals must be tough enough that the tremor will not generate internal mechanical failures. There is no practical way to model this statically. Instead, the individual equipment component parts must be designed to accept significant forces within allowable fatigue limits. This type of analysis is common for vehicles or other devices that are subject to dynamic loads, but is not commonly used in the design of static equipment. The only other option would be to perform substantial dynamic testing over a wide input spectrum (both in frequency and direction) on existing equipment. This would likely cost considerably more than the value of the equipment itself.

Note that the above also holds true for those pieces of equipment in non-critical structures, but who’s continued operation after a seismic event would be needed to ensure life-safety.

Benefits of a static analysis become clear in non-critical applications. Here, the use of static techniques and appropriate factors offer conservative, easily documented and repeatable results that can confirm the structural durability of the equipment and anchorage for minimal cost. In these cases (where continued operation of the equipment is not required), life safety can be addressed simply by applying a conservative static analysis.

In these applications, if the potential cost or downtime that might result from internal damage to this equipment is a significant issue, features could be added internally by the manufacturers for minimal cost that could increase the confidence level of continued operation greatly. The key here is that the cost to offer a 90% chance of success would only be a fraction of the cost that would be required to guarantee success.

Over the long term, it is likely that equipment designed to be installed in seismically active areas, will become more robust and will be designed to meet some reasonable fatigue

## STATIC vs DYNAMIC MODELING



Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:

D1.4



criteria. Once this becomes common practice, much of the need to perform detailed dynamic analyses or testing of this equipment will likely disappear.

Currently, the best “value” is to perform static analyses with the inclusion of appropriate factors on all equipment installations. The resulting forces can be used to validate the capability of the equipment to remain in place during an appropriate seismic event.

Where it is necessary to certify the continued operation of the equipment as well, current practice is that it be dynamically tested or analyzed. At best, this is not comprehensive and requires that all factors are appropriately accounted for, that the actual ground forces experienced are similar to those assumed in type, frequency and magnitude and that the unit in the field behaves at least as well as the unit in the lab.

Better than the dynamic qualification test however, is that the equipment should be “designed” to withstand all anticipated and factored forces expected on its internal components within the fatigue limits of the materials that make it up and with some reasonable additional safety factor.

## STATIC vs DYNAMIC MODELING

PAGE 3 OF 3

RELEASE DATE: 9/16/04



DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA

Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:

**D1.4**



## Required Calculation Input

There are several pieces of information that are required for Kinetics Noise Control to perform an analysis on an equipment installation. Some of this information is project and/or code related and some is equipment related. The input requirements will vary depending on the project building code.

The appropriate building code for the project is required and is the first piece of information to be determined, as it governs everything else. Since the codes vary with time and local jurisdiction, and because there are periods during which it may be possible to use different codes for the same project, it is critical that the code, and code version, used are consistent with the project requirements.

More recent codes require project site data that impacts the seismic design forces. This includes soil type and, in the 97 UBC, the type and proximity of the nearest fault. This data is not something that can be quickly pulled from a map, and as such is not something that it is available to anyone offsite who is attempting to perform an analysis.

The end use of the building also needs to be identified. Factors are assigned in the course of the analysis based on the end use, and the project impact (safety and/or cost) can be significant if the wrong factors are used.

Once the general information is identified, specific information relative to the equipment and system is required. Besides the obvious geometric and weight data for the equipment (height, width, length, weight, approximate center of gravity location, and locations of any mounting hardware), generic material as to what type of equipment it is and whether its continued function is needed for life safety must be determined. The 95 NBC (Canada), 97 UBC, 2000 IBC, 2003 IBC and TI-809-04 all require that the mounting elevation of the equipment relative to the roof height of the structure be known as well.

In some cases, some of the required data must be estimated. Kinetics Noise Control will attempt to do this conservatively, and in so doing the net result is a more conservative analysis and potentially costly installation. While attempts are made to make "reasonable" and "conservative" estimates, it remains the responsibility of others to compare these values to the actual equipment and indicate to Kinetics Noise Control if something appears to be inconsistent. All values used in the analysis are provided on the output; the responsibility to review this data will normally fall to the general contractor or the engineer of record.

To aid in collecting the appropriate information to perform analyses, the following checklist has been developed and should be filled out for each piece of equipment addressed by the project.

### REQUIRED CALCULATION INPUT

PAGE 1 OF 2

RELEASE DATE: 10/11/04



Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:

D1.5



## Seismic Checklist

### General Data:

Project: \_\_\_\_\_ Date: \_\_\_\_\_

Seismic Code:

- SBC     UBC     BOCA     UBC (Calif)     IBC  
 NBC-Canada     Other \_\_\_\_\_

Code Year of issue:

- 1993     1994     1995     1996     1997     2000  
 2003     Other \_\_\_\_\_

Accel factor or Proj location ( $A_v$ ,  $v$ ,  $Z$ , or  $S_{DS}$  (.2 Sec Response Accel)): \_\_\_\_\_

*Optional* Minimum "G" factors from Spec: \_\_\_\_\_ Horiz, \_\_\_\_\_ Vert

Building Use: \_\_\_\_\_

Total Occupancy: \_\_\_\_\_

### Addition data for 1997 UBC

If  $A_v = .4$ , provide distance to nearest fault and source type.

- $\leq 2$  km      $> 2$  km,  $< 10$  km      $> 10$  km  
 A (Frequent Lrg Magnitude)     B (Other)     C (Rare Sml Magnitude)

### Addition data for 2000 IBC, TI-809-04

Equipment Importance Factor ( $I_p$ ): \_\_\_\_\_

Failure of this Equipment will result in a life safety issue:

- Yes     No

### Addition data for 1997 UBC, IBC and TI-809-04 codes only:

Soil Type:

- $S_a$  (Hard Rock)      $S_b$  (Rock)      $S_c$  (Dense Soil/Soft Rock)  
  $S_d$  (Stiff Soil)      $S_e$  (Soft Soil)      $S_f$  (Other-Backfill, etc.)

Provide detail data on soil conditions if  $S_f$  selected.

### Addition data for the NBC-Canada Code only:

Foundation Factor:

Failure of this Equipment can release Hazardous Materials:     Yes     No

### Tag Data:

Equipment Location in Building:

- At or Below Grade  
 Above Grade  
 If 1997 UBC, IBC, TI-809-04 or NBC    Roof Elevation \_\_\_\_\_  
Equipment Mounting Elevation \_\_\_\_\_

Type of Equipment: \_\_\_\_\_

Equipment Weight: \_\_\_\_\_

Height from base of Equipment to Vertical CG: \_\_\_\_\_

The Equipment will be attached to:

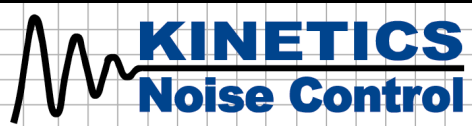
- Concrete Anchors     Through Bolt to Steel or Concrete     Welded  
 Bolt to Wood (Thickness, width, and type of wood required.) Include structural drawings if available showing unit location with respect to structural members.

Equipment Geometry (Include Drawing)

## REQUIRED CALCULATION INPUT

PAGE 2 OF 2

RELEASE DATE: 10/11/04



DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA

Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: www.kineticsnoise.com  
Email: sales@kineticsnoise.com

DOCUMENT:

D1.5



# UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT

Most of the seismic and wind certifications performed by Kinetics Noise Control will be done using proprietary analytical software and will generate a report in the format shown on the following pages. In cases that cannot be modeled using this software, the results will be obtained using customized spreadsheet documents that will vary in format depending on the analysis involved.

This section will provide insight and understanding of the data presented using the standardized computer-generated format.

There will always be at least one output sheet per seismic calculation. If special anchorage is required, a second sheet indicating the special anchorage requirements will be added. If wind is also an issue, and a wind analysis was requested, a third document (for standard anchorage) and possibly a fourth (for special anchorage) would be included as well.

In all cases, the output documents will have three portions. The upper half of the sheet indicates the information input into the program. The second segment indicates the program outputs, and the last segment lists special notes that are applicable.

Tag 1 (A)

KNC PO: XXXXX		KINETICS SEISMIC CERTIFICATION		
<b>Input Data</b>				
Project: Sample Project	Representative: Representative Name	PTC Number: XX-XXX-XX		
Date: 11-12-2003	Code sheet: 2000BC	Max Wind (ft): 38		
Issue Type: Equip 1	Tag: Tag 1	Max Wind (ft): 38		
Installation Type: Base Mounted, Common Support/Restraint Loc	Code (if ASIS): 29-08	(ft/s)		
Site Type: Sd (1.5)	Fastenings: no	Code (if ASIS): 1.70-04	(ft/s)	
		Minimum 5-Bolted Restraints/Supports; none other		
		are acceptable for the accuracy of the data		
		Input: 2000	(New Wind Code: 4230 N)	
		Geometry (ft):		
		Ag: 2.00	ft: 78	
		A: 1.00	ft: 2,501.00	
		A: 120.00	ft: 56.88	
		no	ft: 3.00	
		Impacts to Restraints:	25.00	
		Restraint Data:		
		Number of Restraints:	4	
		Restraint Location (ft):	2	
		Restraint Code on Bolt Area:	2	
		Restraint Code:	FRS (steel) or S (Steel)	
		Loc 1:	1-355015	
		Loc 2:	1-355005	
		Loc 3:	1-355015	
		Loc 4:	1-355005	
<b>Output Data</b>				
Certification Loads (Seismic) (lb)	Loc 1	Loc 2	Loc 3	Loc 4
Static Load	485	485	787	476
Max Uplift Load at Loc:	728	728	728	728
Max Horiz Load at Loc:	439	544	625	775
Effective Corner Wt	553	486	787	476
Calculated Restraint Safety Factors (Must be greater than or equal to 1)				
	Loc 1	Loc 2	Loc 3	Loc 4
Restraint SF if Bolted to Steel	2.04	1.86	1.73	1.53
Restraint SF if Bolted to Steel	2.04	1.86	1.73	1.53
Restraint SF if Bolted to Concrete	38	34	32	28
Anchor Attachment Bolt Size/Qty	0.375 / 2	0.375 / 2	0.375 / 2	0.375 / 2
Min Anchor Embedment Depth	3"	3"	3"	3"
<p>* Concrete anchorage is inadequate. See sheet B for details plus information and seismic safety factors.                      If welded, uplift anchor corner requires 1.5 nominal section of J5 weld.</p> <p>Note: Bolt Safety Factors Based on the capacity of Type A-307 hardware.                      To handle load after all four anchor bolts are accounted for.</p> <p>Safety Factors listed as 100 indicate 100% greater.</p> <p>For a detailed explanation of code items, please refer to the attached document file: Loc-Data-Code-Book.xls.</p> <p>KNC certifies that the restrengthening, repair, and/or replacement systems described in this sheet is adequate to meet the                      condition loads specified herein. The use of hardware other than that provided by KNC voids this certification.                      Conditions identified under "Special Notes" shall be observed. Conditions identified under "Special Notes" shall be observed.                      This certification is valid for a period of 10 years from the date of issue. This certification is not valid for use on any other project.                      This certification is not valid for use on any other project.</p>				

## Seismic Certification Document (A)

All standard seismic certifications will include the (A)-type document. It can be identified by the (A) in the top right corner and the word *Seismic* included in the title.

### Input Data

Looking first at the input data, there are several key areas that are grouped together as follows:

## UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT



Toll Free (USA only): 800-959-1229  
 International: 614-889-0480  
 Fax: 614-889-0540  
 World Wide Web: www.kineticsnoise.com  
 Email: sales@kineticsnoise.com

DOCUMENT:  
**D1-6**  
 VISCMA  
 MEMBER

KNC PO: XXXXX

**KINETICS SEISMIC CERTIFICATION**

(A)

Input Data			
Project: <b>Sample Project</b>	Representative: <b>Representative Name</b>	P.O. Number: <b>XX-XXX-XX</b>	
Date: <b>11-12-2003</b>	Code Used: <b>2000IBC</b>	Min Horiz G: <b>.30</b>	
Equip Type: <b>Equip 1</b>	Tag: <b>Tag 1</b>	Min Vert G: <b>.00</b>	
Installation Type: <b>Base Mounted, Common Support/Restraint Loc</b>		Code G (ASD): <b>.79/.08 (H/V)</b>	
Soil Type: <b>Sd (1.1)</b>	Fault Type: <b>n/a</b>	Fault Proximity: <b>n/a</b>	Conc Ancs(ASD): <b>1.70/.08 (H/V)</b>

Data used is derived from Customer input, others are responsible for the accuracy of this data.

Wgt(lb): **3000** Elev-Roof/Equip: **42/30 ft**

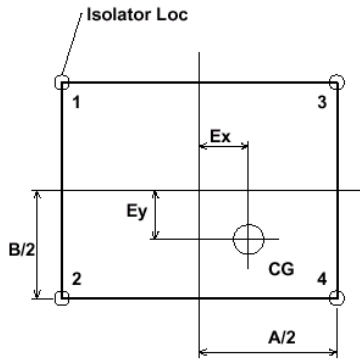
Geometry (in):

Ap: <b>2.50</b>	Ss: <b>.78</b>
l: <b>1.00</b>	Rp s/c: <b>2.50/1.00</b>
A: <b>120.00</b>	B: <b>56.00</b>
ex: <b>10.50</b>	ey: <b>3.00</b>

Hgt (CG to Restraint): **25.00**

Restraint Data

Total # of Restraints:	<b>4</b>
Restraints/Side on Lg Axis:	<b>2</b>
Restraints/Side on Sht Axis:	<b>2</b>
Restraint Type:	<b>FHS/Isolated\ &gt; 8 Dias.</b>
Loc 1:	<b>1-35/805</b>
Loc 2:	<b>1-35/805</b>
Loc 3:	<b>1-35/805</b>
Loc 4:	<b>1-35/805</b>



General project data is generally across the top of the document. Included is the reference purchase order number from Kinetics Noise Control in the top left-hand corner. Below this is the name assigned to the project by Kinetics Noise Control, the representative's name, reference to the representative's purchase order number, and the date that the certification was performed.

Also listed is the code used to perform the analysis and any overriding horizontal and vertical seismic design acceleration coefficients, if specified.

For some codes, the soil type, fault type, and fault proximity come into play and if they are applicable they are listed as shown above.

The next data segment is specifically related to the particular equipment installation being certified. In the figure below, the location of this information has been indicated.

For ease of reference, the tag data listed at the top right-hand corner as well as on the third line refers to the component being evaluated.

Within the body of the text a name for the equipment is listed along with the tag identification and below this is the mounting arrangement. In this case, the mounting is identified as *Base Mounted, Common Support/Restraint Loc*. This indicates that the equipment is mounted at its base (typically to the floor) and that the restraints and supports are at the same locations (meaning that if isolated, combination isolator/restraints are used, or if hard mounted, that the unit is bolted down and restrained

**UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT**



DUBLIN, OHIO, USA • MISSISSAUGA, ONTARIO, CANADA

Toll Free (USA only): 800-959-1229  
 International: 614-889-0480  
 Fax: 614-889-0540  
 World Wide Web: www.kineticsnoise.com  
 Email: sales@kineticsnoise.com

DOCUMENT:

**D1-6**



with the same hardware). Other options that may be listed are:

- Base Mounted, Different Support/Restraint Loc.* (for separate isolators & restraints)
- Base Mounted, 4 Isolators/2 Restraints* (where 2 restraints are located at the equipment centerline)
- Hanging, Common Support/Restraint Loc.* (where equipment is hung with 4 or more rods and is restrained at the same points)
- Hanging, Different Support/Restraint Loc.* (where equipment is hung with 4 or more rods and is restrained at different points)
- Hanging, 2 Supports/4 Restraints* (where equipment is hung on 2 hanger rods and is restrained with 4 restraint cables).

Tag 1

KNC PO: XXXXX **KINETICS SEISMIC CERTIFICATION** **(A)**

Input Data			
Project: <b>Sample Project</b>	Representative: <b>Representative Name</b>	P.O. Number: <b>XX-XXX-XX</b>	
Date: <b>11-12-2003</b>	Code Used: <b>2000IBC</b>	Min Horiz G: <b>.30</b>	
Equip Type: <b>Equip 1</b>	Tag: <b>Tag 1</b>	Min Vert G: <b>.00</b>	
Installation Type: <b>Base Mounted, Common Support/Restraint Loc</b>	Code G (ASD): <b>.79/.08 (H/V)</b>	Conc Ancs(ASD): <b>1.70/.08 (H/V)</b>	
Soil Type: <b>Sd (1.1)</b>	Fault Type: <b>n/a</b>	Fault Proximity: <b>n/a</b>	

Data used is derived from Customer input, others are responsible for the accuracy of this data.

Wgt(lb): **3000** Elev-Roof/Equip: **42/30 ft**

Geometry (in):

Ap: <b>2.50</b>	Ss: <b>.78</b>
I: <b>1.00</b>	Rp s/c: <b>2.50/1.00</b>
A: <b>120.00</b>	B: <b>56.00</b>
ex: <b>10.50</b>	ey: <b>3.00</b>
Hgt (CG to Restraint): <b>25.00</b>	

Restraint Data

Total # of Restraints:	<b>4</b>
Restraints/Side on Lg Axis:	<b>2</b>
Restraints/Side on Sht Axis:	<b>2</b>
Restraint Type:	<b>FHS\isolated\ &gt; 8 Dias.</b>
Loc 1:	<b>1-35/805</b>
Loc 2:	<b>1-35/805</b>
Loc 3:	<b>1-35/805</b>
Loc 4:	<b>1-35/805</b>

Listed on the right side of the certification are *Code G (ASD)* and *Conc Ancs (ASD)* values. These are the computed seismic force values used by the program to determine the forces at the restraint points expressed in ASD (Allowable Stress Design or Working Stress based) units. *Code G* is the basic design force and is used to evaluate component capacity and through-bolted anchorage. *Conc Ancs* includes additional factors that must be used to evaluate anchorage to concrete. The *(H/V)* terms are the horizontal and vertical force components.

Weight, geometry, and equipment specific seismic design factors are the last items that fall into this segment of the input data. *Wgt* (weight) is the operating weight of the equipment. *Elev-Roof/Equip* is the relative elevation of the equipment in the structure to the roof elevation and is required only by some codes.

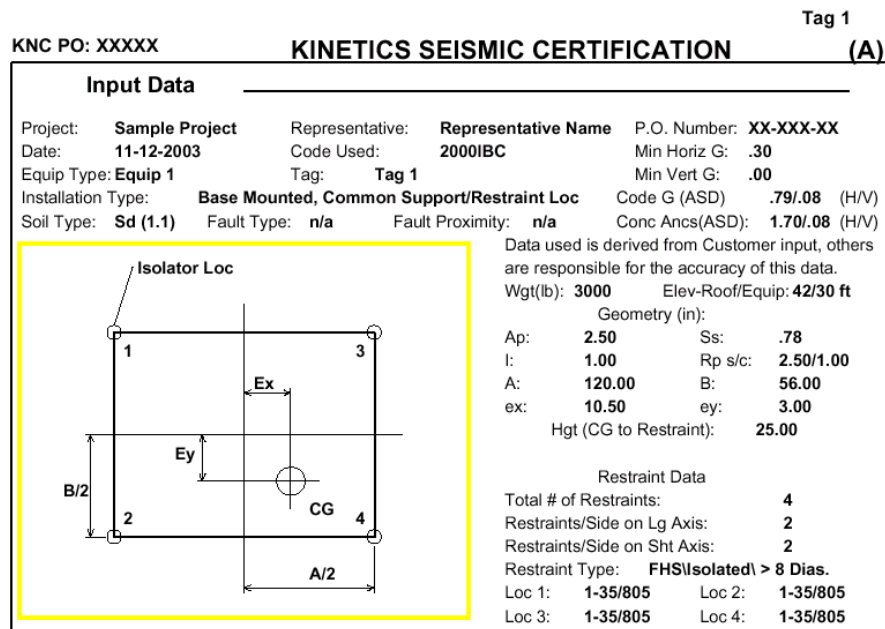
Seismic factors  $A_p$ ,  $S_s$ ,  $I$ ,  $R_p$  s/c are the factors drawn from the code and are used to

compute the previously discussed seismic force values. The names of these terms will vary from code to code, but they will always be found in this location on the certification document. Where *s/c* appears, this indicates that different values are used for through-bolted (*s* for steel) and anchored to concrete (*c* for concrete) connections.

Values for *A*, *B*,  $e_x$ , and  $e_y$  are identified in the schematic. These represent the spacing between the outermost restraint elements and the assumed offset in the center of gravity of the system. When the restraint components are independent of the supports, the values *a* and *b* will also be listed. In the sketch, support points are represented by *O* s and restraint points by *X* s.

The last item that relates to the equipment data is the height (*Hgt*). The value here is the vertical distance between the equipment center of gravity and the restraint contact point. With hanging equipment, two values will be listed. The first is the vertical distance between the equipment center of gravity and the restraint connection point and the second is the distance between the restraint connection point and the elevation at which the hanger rods connect to the equipment.

Moving on to the installation sketch:



The diagram represents schematically the general layout of the equipment. Restraint points are labeled 1, 2, 3, etc. and the previously discussed dimension locations are identified. If the equipment has more than 4 restraint points, the sketch will show added restraint locations at the midpoint of the long axis; however, the actual number of restraints will be listed under the restraint data heading.

In some cases, there may be 2 restraints grouped in each corner. If this is the case the

**UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT**



Toll Free (USA only): 800-959-1229  
 International: 614-889-0480  
 Fax: 614-889-0540  
 World Wide Web: www.kineticsnoise.com  
 Email: sales@kineticsnoise.com

DOCUMENT:

D1-6



schematic drawing will reflect that condition.

The last segment listed in the input data portion of the certification is the restraint data section.

Tag 1

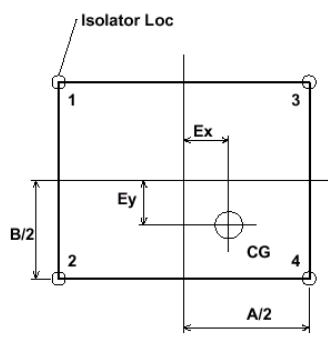
KNC PO: XXXXX **KINETICS SEISMIC CERTIFICATION (A)**

**Input Data**

Project: **Sample Project** Representative: **Representative Name** P.O. Number: **XX-XXX-XX**  
 Date: **11-12-2003** Code Used: **2000IBC** Min Horiz G: **.30**  
 Equip Type: **Equip 1** Tag: **Tag 1** Min Vert G: **.00**  
 Installation Type: **Base Mounted, Common Support/Restraint Loc** Code G (ASD): **.79/.08 (H/V)**  
 Soil Type: **Sd (1.1)** Fault Type: **n/a** Fault Proximity: **n/a** Conc Ancs(ASD): **1.70/.08 (H/V)**

Data used is derived from Customer input, others are responsible for the accuracy of this data.  
 Wgt(lb): **3000** Elev-Roof/Equip: **42/30 ft**

Geometry (in):  
 Ap: **2.50** Ss: **.78**  
 l: **1.00** Rp s/c: **2.50/1.00**  
 A: **120.00** B: **56.00**  
 ex: **10.50** ey: **3.00**  
 Hgt (CG to Restraint): **25.00**



**Restraint Data**

Total # of Restraints: **4**  
 Restraints/Side on Lg Axis: **2**  
 Restraints/Side on Sht Axis: **2**  
 Restraint Type: **FHS(Isolated) > 8 Dias.**  
 Loc 1: **1-35/805** Loc 2: **1-35/805**  
 Loc 3: **1-35/805** Loc 4: **1-35/805**

Listed here is information on the total number of restraints and the number visible on each side (or axis). Also identified is the restraint type and assumed anchor embedment depth (in bolt diameters) for concrete anchors.

Finally, by location (as shown on the sketch) the model of the restraint is identified. If more than 4 restraints, the smallest of the remaining restraints is listed after the heading *Other*. For hard-mounted applications, the restraints will be identified as *Solid*. If cable restrained, the cable quantity and size will be identified.

**Output Data**

This section of the certification is broken into 2 major subdivisions. First is a summary of the design loads used at each restraint location.

<b>Output Data</b>	Loc 1	Loc 2	Loc 3	Loc 4
Certification Loads (Seismic) (lb)				
Static Load	-552	-685	-787	-976
Max Uplift Load at Loc:	728	728	728	728
Max Horiz Load at Loc:	439	544	625	775
Effective Corner Wt	-553	-686	-787	-976
Calculated Restraint Safety Factors (Must be greater than or equal to 1)				
	Loc 1	Loc 2	Loc 3	Loc 4
Restraint SF if Welded to Steel	2.04	1.86	1.73	1.53
Restraint SF if Bolted to Steel	2.04	1.86	1.73	1.53
Restraint SF if Anchored to Concrete	.36	.34	.32	.29
Anchor/Attachment Bolt Size/Qty	0.375 / 2	0.375 / 2	0.375 / 2	0.375 / 2
Min Anchor Embedment Req'd	3"	3"	3"	3"

**UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT**



Toll Free (USA only): 800-959-1229  
 International: 614-889-0480  
 Fax: 614-889-0540  
 World Wide Web: www.kineticsnoise.com  
 Email: sales@kineticsnoise.com



If more than 4 restraints are used on a piece of equipment, a final column will appear labeled *Other*. The data displayed will be the worst-case condition of those restraints not listed as 1 through 4.

Listed here is the static load (deadweight), the worst-case uplift load condition, the worst-case horizontal load condition, and the effective corner weight used when considering overturning factors. If the system is a hanging system, the maximum tensile load in the cable (based on an angle of 45 degrees to the horizontal) is listed instead of the effective corner weight. All seismic forces as presented are based on the G-forces appropriate for through-bolted or welded connections. Higher G-forces, as noted at the top of the sheet, are, however, used by the program when appropriate if computing safety factors for concrete anchors.

*Note: If evaluating or independently analyzing special concrete anchorage conditions, where a 2:1 factor is required (IBC, 97 UBC, T1809-04), the forces listed must be increased as follows. Horizontal forces should be doubled. The effective corner weight should be subtracted from the maximum uplift force and the result added to the maximum uplift force to determine a new uplift component. In addition, the restraint geometry must be accounted for as the listed forces act at the snubbing location of the restraint and forces at the anchors can be considerably different. (This is only required for evaluating the anchorage.)*

The effective corner weight differs from the static load in that it is the force required at that corner to “lift” the equipment (if the equipment is assumed to be rigid). For example, it will take the same force to lift the corner of a table with 4 legs as it will to lift a corner of the same table if 10 legs are added somewhere in the middle. While the centrally located legs spread the load out from a support standpoint, they do not share the load when resisting rocking motions.

The lower section of the output data segment presents restraint and hardware capacity information as shown below.

<b>Output Data</b>				
Certification Loads (Seismic) (lb)	Loc 1	Loc 2	Loc 3	Loc 4
Static Load	-552	-685	-787	-976
Max Uplift Load at Loc:	728	728	728	728
Max Horiz Load at Loc:	439	544	625	775
Effective Corner Wt	-553	-686	-787	-976
Calculated Restraint Safety Factors (Must be greater than or equal to 1)				
	Loc 1	Loc 2	Loc 3	Loc 4
Restraint SF if Welded to Steel	2.04	1.86	1.73	1.53
Restraint SF if Bolted to Steel	2.04	1.86	1.73	1.53
Restraint SF if Anchored to Concrete	.36	.34	.32	.29
Anchor/Attachment Bolt Size/Qty	0.375 / 2	0.375 / 2	0.375 / 2	0.375 / 2
Min Anchor Embedment Req'd	3"	3"	3"	3"

This information will vary depending on the restraint components used, but in general it will present safety factors for the restraint component used, through-bolt size and quantity

**UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT**



Toll Free (USA only): 800-959-1229  
 International: 614-889-0480  
 Fax: 614-889-0540  
 World Wide Web: www.kineticsnoise.com  
 Email: sales@kineticsnoise.com



(if through bolted), anchor size, quantity and embedment (if anchored to concrete), and through-bolt/anchor safety factors. If a hanging system is used, the worst-case compressive load in the hanger rod is also identified.

Data presented in the “*Other*” column reflects worst-case loading in conjunction with the smallest “*Other*” restraint and as such is a worst-case condition for the remaining components.

All safety factors listed must exceed 1.0 to have a valid installation with the following exception. In cases where only the concrete anchor safety factor is less than 1.0, an oversized base plate can be provided to allow higher capacity. In these cases, a second certification sheet labeled (B) will be included and will address this condition.

**Notes**

The final segment of the certification document is comprised of general notes and the standard disclaimer.

The notes will vary with the restraint devices used and the application, but will in general offer the following added information.

\* Concrete anchorage is inadequate, See sheet B for adapter plate information and anchor safety factors  
If welded, each bracket corner requires 1.50 linear inches of .25 weld.

Note: Bolt Safety Factors based on the capacity of Type A-307 hardware  
to handle uplift after all horizontal loads are accounted for.

Safety Factors listed as 100 indicate 100 or greater

For a detailed summary of how these loadings were derived, contact KINETICS NOISE CONTROL, Inc.

KNC certifies that the seismic/wind isolation and or restraint system described on this sheet is adequate to resist the certification loads specified herein. The use of hardware other than that provided by KNC voids this certification. This certification addresses the load path from the equipment point connection to the connection point of the structure. Others must verify the ability of the equipment or structure to resist these loads. See also the included disclaimer. Certification void if disclaimer and Certification Cover Sheet not included. In connection with this certification and the application of the certification design loads to the project, KINETICS NOISE CONTROL, Inc guarantees that we will use that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession to determine restraint loadings and Safety Factors based on customer supplied input data. No other warranty, expressed or implied, is made or intended. 09/30/2003

Weld sizes that can be used as an option to bolting when appropriate for the restraint devices are listed.

When one or more of the concrete anchor safety factors is less than 1.0, a note indicating that Sheet B will be included and information addressing the need for an oversized baseplate will appear.

Additional notes relating to allowable cable angles, A-307 hardware requirements, and edge distances for concrete anchors are also included when appropriate.

**General Comments on Document (A)**

Often, due to a lack of comprehensive input data, Kinetics Noise Control engineers will conservatively estimate the center of gravity location. While estimating a dimension or magnitude for this isn't unreasonable, the direction of the imbalance is almost always

**UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT**



Toll Free (USA only): 800-959-1229  
 International: 614-889-0480  
 Fax: 614-889-0540  
 World Wide Web: www.kineticsnoise.com  
 Email: sales@kineticsnoise.com

DOCUMENT:  
**D1-6**  
 VISCMA MEMBER

unknown. Because of this, unless the direction of the imbalance is clearly stated (relative to features on the equipment that are spelled out) the worst-case computed corner restraint condition should be assumed for all corner locations.

### Seismic Certification Document (B)

When appropriate and as indicated above, the seismic certifications will include the (B)-type document. It can be identified by the (B) in the top right corner and the word *Seismic* included in the Title.

While it is formatted in the same manner and includes much the same information as the (A) document, it contains detailed information relating to the capacity of the required oversize base plate and additional anchors.

### Input Data

The only difference between the (A)- and (B)-documents within the input data section is that the schematic equipment layout sketch is changed to show the size and layout of the required oversize base plate.

Tag 1

KNC PO: XXXXX **KINETICS SEISMIC CERTIFICATION (B)**

Input Data			
Project: <b>Sample Project</b>	Representative: <b>Representative Name</b>	P.O. Number: <b>XX-XXX-XX</b>	
Date: <b>11-12-2003</b>	Code Used: <b>2000IBC</b>	Min Horiz G: <b>.30</b>	
Equip Type: <b>Equip 1</b>	Tag: <b>Tag 1</b>	Min Vert G: <b>.00</b>	
Installation Type: <b>Base Mounted, Common Support/Restraint Loc</b>	Code G (ASD): <b>.79/.08 (H/V)</b>		
Soil Type: <b>Sd (1.1)</b>	Fault Type: <b>n/a</b>	Fault Proximity: <b>n/a</b>	Conc Ancs(ASD): <b>1.70/.08 (H/V)</b>

**BasePlate Dimensions**

.50 Dia Anchors

Data used is derived from Customer input, others are responsible for the accuracy of this data.

Wgt(lb): **3000** Elev-Roof/Equip: **42/30 ft**

Geometry (in):

Ap: <b>2.50</b>	Ss: <b>.78</b>
l: <b>1.00</b>	Rp s/c: <b>2.50/1.00</b>
A: <b>120.00</b>	B: <b>56.00</b>
ex: <b>10.50</b>	ey: <b>3.00</b>

Hgt (CG to Restraint): **25.00**

Restraint Data

Total # of Restraints:	<b>4</b>
Restraints/Side on Lg Axis:	<b>2</b>
Restraints/Side on Sht Axis:	<b>2</b>
Restraint Type:	<b>FHS(Isolated) &gt; 8 Dias.</b>
Loc 1:	<b>1-35/805</b>
Loc 2:	<b>1-35/805</b>
Loc 3:	<b>1-35/805</b>
Loc 4:	<b>1-35/805</b>

Information on the on the bolt pattern, anchor size, overall dimensions, and weld locations are all presented in a readable format.

### Output Data

The first portion of the output data (which indicates the loads at the restraint points) remains unchanged from the (A)-Document. Information on the modified anchorage arrangement is, however, new.

## UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT



Toll Free (USA only): 800-959-1229  
 International: 614-889-0480  
 Fax: 614-889-0540  
 World Wide Web: www.kineticsnoise.com  
 Email: sales@kineticsnoise.com

DOCUMENT:

**D1-6**



<b>Output Data</b>				
Seismically Generated Loads (lb)	Loc 1	Loc 2	Loc 3	Loc 4
Static Load	-552	-685	-787	-976
Max Uplift Load at Loc:	231	111	20	-150
Max Horizontal	439	544	625	775
Calculated Restraint Factors of Safety (Must be greater than or equal to 1)				
	Loc 1	Loc 2	Loc 3	Loc 4
Anchor Size Required / Qty	0.5 / 4	0.5 / 4	0.5 / 4	0.5 / 4
Min Anchor Embedment Req'd	4"	4"	4"	4"
Anchor Safety Factor in Concrete	5.30	4.28	3.73	2.98
For Restraint Locations (Loc 1, etc), see Sheet A				

Listed will be the quantity and size of the anchors, the required anchor embedment depth, and the resulting anchorage safety factor for each location.

**Notes**

Additional notes are provided that relate directly to the oversized base plate and the anchors that go with them.

**Wind Certification Document (A)**

When requested, Kinetics Noise Control will perform an additional wind certification. It is very similar to the seismic certification and can be identified by the (A) in the top right corner and the words *Wind Load* included in the title.

**Input Data**

Tag 1

KNC PO: XXXXX      **KINETICS WIND LOAD CERTIFICATION (A)**

Input Data			
Project: <b>Sample Project</b>	Representative: <b>Representative Name</b>	P.O. Number: <b>XX-XXX-XX</b>	
Date: <b>11-12-2003</b>	Code Used: <b>2000IBC</b>	Wind Pressure: <b>35.0 PSF</b>	
Equip Type: <b>Equip 1</b>	Tag: <b>Tag 1</b>		
Installation Type: <b>Base Mounted, Common Support/Restraint Loc</b>			
		Data used is derived from Customer input, others are responsible for the accuracy of this data. Wgt(lb): <b>3000</b> Elev-Roof/Equip: <b>42/30 ft</b> Geometry (in):	
		Length: <b>150.00</b> Width: <b>50.00</b> Height: <b>50.00</b> ex: <b>10.50</b> ey: <b>3.00</b> Center Hgt of Area: <b>25.00</b>	
Restraint Data Total # of Restraints: <b>4</b> Restraints/Side on Lg Axis: <b>2</b> Restraints/Side on Sht Axis: <b>2</b> Restraint Type: <b>FHS\Isolated\ &gt; 8 Dias.</b> Loc 1: <b>1-35/805</b> Loc 2: <b>1-35/805</b> Loc 3: <b>1-35/805</b> Loc 4: <b>1-35/805</b>			

The areas where there are differences between the wind load input data and the seismic load input data are indicated above.

**UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT**



Toll Free (USA only): 800-959-1229  
 International: 614-889-0480  
 Fax: 614-889-0540  
 World Wide Web: www.kineticsnoise.com  
 Email: sales@kineticsnoise.com



The seismic G-forces listed in the seismic certification are replaced by a design wind pressure. In addition, the length, width, and height of the restrained equipment are indicated.

All of the remaining input information remains the same.

### **Output Data**

The output data format is exactly the same as the output data in the seismic certification. The only difference is that the values listed are the result of the wind load and not of the seismic load.

As with the seismic certification, the possibility exists in a wind application that concrete anchorage may be inadequate. If this is the case, a (B)-document similar to the (B)-seismic document is generated.

### **Wind Certification Document (B)**

Without going into great detail, the difference between the (B)-wind certification document and the (A)-wind certification document is identical to the differences between the (B)-seismic document and the (A)-seismic document. Refer back to the earlier comments for further clarification.

## UNDERSTANDING KNC'S STANDARD CERTIFICATION OUTPUT

PAGE 10 OF 10

RELEASE DATE: 5/17/04



Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:

D1-6



## UNDERSTANDING NON-STANDARD CERTIFICATION OUTPUT

There are periodically equipment applications that do not fit well into the automated seismic computation programs developed by Kinetics Noise Control. This holds true for others that perform this service as well. This section of the manual indicates the minimum material that should be expected to be included in the output document, from Kinetics Noise Control or from any other reputable organization.

This data comprises those items that must be verified by the end user to ensure that the appropriate information was provided, was understood and was used. Because of the number of links in the chain, miscommunication in this area is common and failure to do validate this data can make the certification invalid.

It also provides input that should be used by the equipment manufacturer and the building structural engineer to ensure that the durability of the equipment and locally, of the structure, is adequate to withstand the seismic inputs.

### Echoed Input Data

First there should be a list of assumed inputs. Overall, there should be a listing of the project, any reference order numbers to which the certification applies and the date the calculation was performed. In addition, global parameters like the Code used, the ground acceleration coefficient, the soil type, any appropriate fault factors and Importance factors should be listed. If there are over-riding design accelerations included in the spec, these should be defined as well.

This data is necessary to communicate to all concerned which code was applied and what factors were either provided to the individual doing the calculation or were assumed by them. The date should be included as changes are sometimes required in the field and calculations need to be re-run. If there are multiple calculations that end up in a job file, the date offers a historical link as to which calculation is valid.

Moving on to the application specific information, there should be a listing of the Equipment Importance factor (if different from the structure), assumed or dictated equipment elevation data, equipment type (by definition), mounting parameters and overall geometric and weight data. The parameters used here can significantly impact the performance of the system and frequently are not fully disclosed to the individual performing the analysis. Items such as CG locations, elevations in the structure, life-safety assumptions, and even weights are often not clear. Even when provided, this information often comes in piecemeal via phone, fax or separate email correspondence. Because the individual has no direct control over the accuracy of the input information, it is critical that it be echoed back to ensure that the data applied makes sense to the user.

## UNDERSTANDING NON-STANDARD CERTIFICATION OUTPUT



Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:  
**D1.7**  


## Computed Output Information

The minimum output material that must be offered to the end user as a result of the computation is the following:

- 1) The computed Seismic load (in G's) appropriate for the particular piece of equipment in question.
- 2) A selection of a restraint device (or devices) including model, size, quantity, general arrangement and specific locations.
- 3) The maximum expected horizontal and vertical forces at those devices resulting from the application of a "worst case" seismic load.
- 4) Confirmation that the restraint device is adequate in size to withstand the loads.
- 5) If anchored to concrete and an oversized baseplate is required, the size of that baseplate.
- 6) Minimum size and embedment depth of anchors for concrete applications.
- 7) If required, identification of anchor type (Wedge or Undercut).
- 8) If bolted to steel, the minimum acceptable size of attachment bolts.
- 9) If welded to steel, the minimum size of welds required to make the connection.
- 10) An installation sketch or schematic orienting the equipment.

### A Seismic Calculation Assumptions and Disclaimer Document

This critical document spells out in detail, what is and what is not addressed by the certification. In addition, it indicates what assumptions may have been made in putting the analysis together. Lastly, it indicates to whom this information should be forwarded to ensure that all facets relating to the acceptability of the installation are addressed.

### Stamped or Sealed Coversheet

A dated coversheet listing the certification document by Tag and indicating the name of the individual who performed the certification along with their Professional Engineering seal must also be included. If there is only one calculation, in lieu of a coversheet, the certification document itself can include this information.

## UNDERSTANDING NON-STANDARD CERTIFICATION OUTPUT

PAGE 2 OF 2

RELEASE DATE: 9/17/04



Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:

**D1.7**



## Seismic and Wind Certification General Assumptions and Disclaimer

All Seismic and Wind Certifications performed by Kinetics Noise Control, Inc., and/or its associates, unless clearly stated otherwise in the body of that certification document, will be performed in accordance with the assumptions and disclaimers identified herein.

### Loads Considered

The loads considered in this certification are limited to those forces described in the seismic portion of the specified code for the project. If Kinetics Noise Control is not otherwise informed, the most recent version of the appropriate code will be used. Wind will not be considered during the analysis unless it is specified to be included in the seismic certification request. In the absence of wind velocity and the appropriate factors, Kinetics Noise Control will use 35 PSF as a wind load requirement. If this is not adequate, it is the responsibility of the Design Professional of Record to notify Kinetics Noise Control.

### Extent of the Certification

The certification addresses those items that directly restrain a component or piece of equipment and are provided by Kinetics Noise Control. It includes the attachment weld, anchor or bolt that is required to affix the restraint to the building structure, or third-party support structure, and extends through the weld or bolt that attaches the restraint to the restrained component or piece of equipment. An example of a third-party support structure is a sheet metal roof curb or equipment rail or base not provided by Kinetics Noise Control. The certification does not cover the capabilities of the building structure or third-party support structure to withstand the seismic loading, nor does it cover the ability of the equipment, component or component frame to structurally withstand these same forces. Provided in the certification are the design horizontal and vertical loads at the attachment locations that can be used by others to evaluate the ability of the building or third-party support structure or piece of equipment to withstand these loads. Determination of the applicability of the certification design loads to a specific project remains the responsibility of the Design Professional of Record.

### Equipment Data

The equipment weight, geometry, and CG data used to perform the certification have been provided to Kinetics Noise Control by others, no attempt has been made by Kinetics Noise Control to verify its accuracy and it is up those providing the information to do so. Where CG data is not provided, associates of Kinetics Noise Control will attempt to make reasonable yet conservative estimates as to the magnitude of any imbalance, although it must be recognized that the direction of the imbalance is often unknown. Unless the equipment orientation is obvious from the diagram in the certification document, it should be assumed that the orientation is not known. Under these conditions, the worst-case restraint, attachment and/or anchorage selection indicated for any particular location must be used for all locations.

KINETICS™ Seismic Design Manual

## GENERAL ASSUMPTIONS AND DISCLAIMER

PAGE 1 OF 2

RELEASE DATE: 10/29/03



Toll Free (USA only): 800-959-1229  
International: 614-889-0480  
Fax: 614-889-0540  
World Wide Web: [www.kineticsnoise.com](http://www.kineticsnoise.com)  
Email: [sales@kineticsnoise.com](mailto:sales@kineticsnoise.com)

DOCUMENT:

**D1.8**



### **Equipment Durability**

Kinetics Noise Control and its associates make no representations as to equipment durability and its ability to survive a seismic event and remain functional.

### **Installation**

Where detailed installation procedures are not addressed in KNC-provided documentation, all seismic hardware and components must be installed in conformance with FEMA 412, 413, and 415. Free copies are available from FEMA (1-800-480-2520) or through Kinetics Noise Control.

### **Equipment, Restraint, and Component Attachment Holes**

For seismic restraint, it is necessary that any attachment bolts positioned in the path between the equipment to be restrained and the building structure be a tight fit with their mating holes (the hole is to be not more than 1/16" in diameter larger than the attachment bolt). In the case of Kinetics Noise Control-supplied restraint components, attachment safety factors are based on hardware sized per the above. In the case of directly attached equipment, the hardware and components provided by Kinetics Noise Control are the minimum required to withstand the seismic loading. If attachment holes in the equipment exceed the recommendation above, the attachment hole is to be sleeved or grouted to bring its effective diameter down to not more than 1/16" larger than the attachment hardware used.

### **Anchor Capacity and Edge Distances**

All anchor load allowables are based on ICBO test data and assume full anchor embedment in 3000 psi concrete and a minimum spacing between the anchor centerline and the edge of the slab into which it is sunk in accordance with the included anchorage data. The anchor data used is appropriate for the anchors provided by Kinetics Noise Control, unless otherwise noted. Under some conditions as noted in the calculations, undercut anchors may be required

### **Stamps**

Stamped documents are intended to support the Engineer of Record on the project. If the project is located in an area for which Kinetics does not have a valid PE license, the documents will be stamped with a valid out-of-state seal. This practice is intended solely to indicate that a competent individual has reviewed the document. It is not intended to imply that the licensee is legally empowered to practice in the jurisdiction of the project.

### **General**

Kinetics Noise Control, Inc., and its associates guarantees that we will use that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession to determine restraint and/or attachment safety factors based on customer-supplied input data. No other warranty, expressed or implied, is made or intended.

## **GENERAL ASSUMPTIONS AND DISCLAIMER**

