

**COMPUTERS & STRUCTURES, INC.**

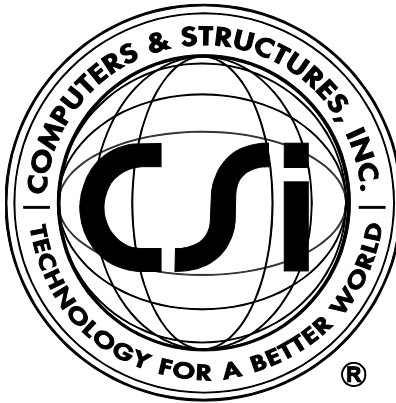
**STRUCTURAL AND EARTHQUAKE ENGINEERING SOFTWARE**

**SAP 2000**® version  
19  
Integrated Solution for  
Structural Analysis and Design

**SACS Import Manual**







# **SACS Import Manual**

for

**SAP2000**®

# COPYRIGHT

Copyright © Computers and Structures, Inc., 1978-2016  
All rights reserved.

The CSI Logo® and SAP2000® are registered trademarks of Computers and Structures, Inc. Adobe® and Acrobat® are registered trademarks of Adobe Systems Incorporated. SACS™ is a trademark of Bentley Systems, Inc.

The computer program SAP2000® and all associated documentation are proprietary and copyrighted products. Worldwide rights of ownership rest with Computers and Structures, Inc. Unlicensed use of this program or reproduction of documentation in any form, without prior written authorization from Computers and Structures, Inc., is explicitly prohibited.

No part of this publication may be reproduced or distributed in any form or by any means, or stored in a database or retrieval system, without the prior explicit written permission of the publisher.

Further information and copies of this documentation may be obtained from:

Computers and Structures, Inc.

[www.csiamerica.com](http://www.csiamerica.com)

[info@csiamerica.com](mailto:info@csiamerica.com) (for general information)

[support@csiamerica.com](mailto:support@csiamerica.com) (for technical support)

# **DISCLAIMER**

CONSIDERABLE TIME, EFFORT AND EXPENSE HAVE GONE INTO THE DEVELOPMENT AND TESTING OF THIS SOFTWARE. HOWEVER, THE USER ACCEPTS AND UNDERSTANDS THAT NO WARRANTY IS EXPRESSED OR IMPLIED BY THE DEVELOPERS OR THE DISTRIBUTORS ON THE ACCURACY OR THE RELIABILITY OF THIS PRODUCT.

THIS PRODUCT IS A PRACTICAL AND POWERFUL TOOL FOR STRUCTURAL DESIGN. HOWEVER, THE USER MUST EXPLICITLY UNDERSTAND THE BASIC ASSUMPTIONS OF THE SOFTWARE MODELING, ANALYSIS, AND DESIGN ALGORITHMS AND COMPENSATE FOR THE ASPECTS THAT ARE NOT ADDRESSED.

THE INFORMATION PRODUCED BY THE SOFTWARE MUST BE CHECKED BY A QUALIFIED AND EXPERIENCED ENGINEER. THE ENGINEER MUST INDEPENDENTLY VERIFY THE RESULTS AND TAKE PROFESSIONAL RESPONSIBILITY FOR THE INFORMATION THAT IS USED.

---

# Contents

---

<b>1 Introduction</b>	
1.1 Import a SACS File	1
1.2 Review Import Log	2
<b>2 Read the SACS Input File</b>	
2.1 Input File Format	1
2.2 "Lines" Read	1
<b>3 Translate the Model to SAP2000</b>	
3.1 SACS IV	1
3.1.1 OPTIONS "Line"	1
3.1.2 SECT "Line"	2
3.1.3 GRUP "Line"	3
3.1.4 MEMBER "Line"	4
3.1.5 MEMBER OFFSETS "Line"	5
3.1.6 PGRUP "Line"	6
3.1.7 PLATE "Line"	7
3.1.8 JOINT "Line"	8
3.1.9 JOINT PERSET "Line"	9
3.1.10 JOINT ELASTI "Line"	9
3.1.11 LOADCN "Line"	10
3.1.12 LOAD UNIF "Line"	10
3.1.13 LOAD DMOM "Line"	11
3.1.14 LOAD CONC "Line"	11
3.1.15 LOAD MOMT "Line"	12
3.1.16 LOAD JOIN "Line"	13
3.1.17 LCOMB "Line"	13

---

# 1 Introduction

---

This manual describes the capabilities for importing SACS models into SAP2000®. SACS Version 5.6 files are currently handled. Models from other versions should also import, although this has not been thoroughly tested.

It is important to read this entire manual before importing a SACS model in order to become familiar with any limitations of the import or assumptions that have been made.

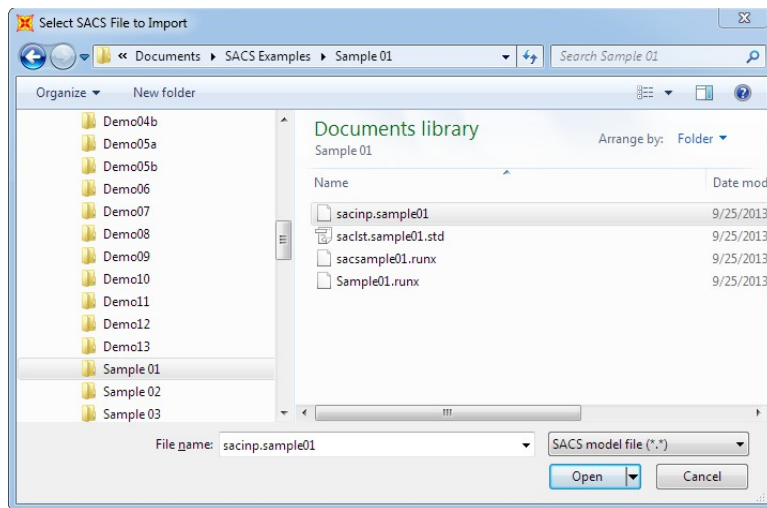
The process of importing a SACS model is broken into two main steps, namely

- reading the contents of the SACS input file
- translating the SACS model contents into a SAP2000 model

Chapter 2 of this manual describes the first step of reading the SACS input file, while Chapter 3 describes in detail the translation of the SACS model into a SAP2000 model.

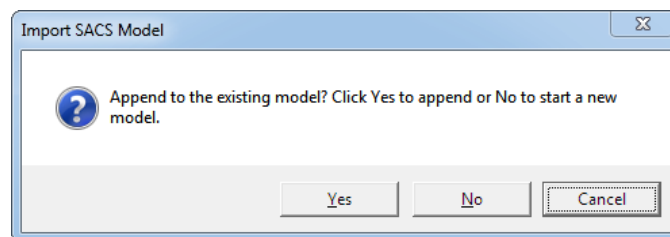
## 1.1 Import a SACS File

A SACS model is imported using the **File menu > Import > SACS File...** command. The file to be imported is located using the file dialog box shown in Figure 1-1. Select the desired file to import and click the **Open** button to begin the import process. After selecting the file, if a model is currently open a prompt appears, as shown in Figure 1-2, asking whether to append to the existing model or start a new model.



**Figure 1.1: File open dialog**

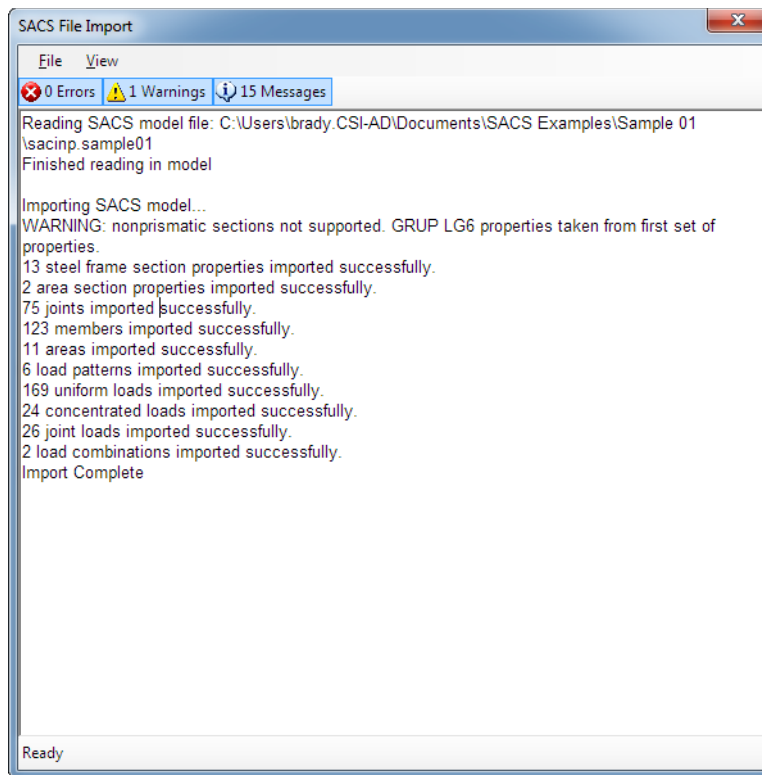
The first step of the import process reads the SACS file to determine the contents of the model. If the file is successfully read, the import process automatically begins. An import log, similar to the one shown in Figure 1-3, is displayed, providing information on the status of the import process. Upon completion of the import process, the import log remains on the screen and should be reviewed before proceeding.



**Figure 1.2: Prompt to append model**

## 1.2 Review Import Log

The import log is visible during the entire import process and presents information on the status of the read and translation steps. The log can be saved to a Rich Text File (RTF) using the **File menu > Save Log As...** command on the form. Messages are categorized into the following three types and can be hidden/displayed in the log form by clicking on the buttons at the top of the form or using the commands on the **View menu** of the form.



*Figure 1.3: Import log*

- **Messages** – these messages are for information purposes only and do not affect the imported model. Typical messages tell the number of objects read or imported.
- **Warnings** – these messages highlight items which should be reviewed after importing the model. Typically these messages are related to assumptions made during the translation process where there is not a direct one-to-one translation.
- **Errors** – these messages highlight items which resulted in an error during the import process and should be resolved before using the imported model. Typically these messages are related to incorrect values in the SACS file or an issue during the translation process.

The import log should be reviewed after the import process is complete and any issues should be resolved before proceeding to use the imported model. It is also recommended that the imported model be checked for accuracy.



---

## 2 Read the SACS Input File

---

This chapter describes the process of reading the SACS input file which is the first step in the import process.

### 2.1 Input File Format

The SACS input file is composed of “lines”. Each input line is read individually and the content parsed into appropriate fields. The following sections define which “lines” are read during the import.

### 2.2 “Lines” Read

The following list of “lines” are read in during the import process. Details of the translation of the “line” data are provided in the following chapters. It is recommended that the following chapters describing the translation be reviewed as some items on the “lines” may not be translated. For further information about any of the “lines”, please refer to the SACS User's Manual.

#### SACS IV

OPTIONS	Input, analysis, and output options
SECT	Member cross section properties
GRUP	Material and other properties
MEMBER	Member connectivities
MEMB2	Additional member data
MEMBER OFFSETS	Member offsets

## SACS Import

---

PGRUP	Plate material and other properties
PLATE	Plate connectivities
PLATE OFFSETS	Plate offsets
JOINT	Joint coordinates
JOINT PERSET	Joint permanent settlements
JOINT ELASTI	Joint elastic supports
LOADCN	Load condition specification
LOAD UNIF	Member distributed loads
LOAD DMOM	Member distributed moments
LOAD CONC	Member concentrated loads
LOAD MOMT	Member concentrated moments
LOAD JOIN	Joint concentrated loads
LCOMB	Load combinations

---

## 3 Translate the Model to SAP2000

---

This chapter describes the translation of the SACS model to SAP2000. Only the “lines” defined in Chapter 3 as being read in are discussed in this chapter. Note that not all features on each “line” are imported, so it is important to review the following sections to determine what parts of the model are imported.

For further information about a particular feature or capability of SAP2000, refer to the SAP2000 manuals available from the **Help menu > Documentation...** command or to the interactive help, available from the **Help menu > Contents and Index...** command.

### 3.1 SACS IV

This section describes the imported “lines” from the SACS IV input file.

#### 3.1.1 OPTIONS “Line”

The OPTIONS “line” provides input, analysis, and output options. Only the units and code check options are currently read and used to define the database units and steel frame design code during translation.

## SACS Import

Options	
SAP2000 Usage	SACS Field
Database units	Units
Steel frame preferences design code	Code Check Options

**Table 3.1: OPTIONS "line" translation**

### 3.1.2 SECT "Line"

The SECT "line" defines dimensions and properties for frame section properties. These lines are read in but not directly imported. The data is used while importing the various group lines for frame sections. Table 3.2 shows the mapping of the various section types.

Section Types	
SAP2000 Field	SACS Field
not translated	Section Label
I/Wide flange	WF – wide flange, WFC – wide flange compact
Pipe	TUB – tube section
Tube	BOX – box section, RTB – rectangular tube
Channel	CHL – channel section
Angle	ANG – single angle section
Double Angle	DAL – double angle section
General	PRI – prismatic element
Tee	TEE – tee section
Nonprismatic	CON – conical transition section
not translated	PLG – plate girder
not translated	BLB – bulb plate cross section
not translated	LNR – launch runner
not translated	JUL – jack-up leg
not translated	PGD – double web plate girder
not translated	PGB – boxed plate girder
not translated	PGU – unsymmetrical plate girder

**Table 3.2: SECT "line" shape translation**

### 3.1.3 GRUP “Line”

The GRUP “line” defines section and material properties for similar steel frames. The GRUP lines are converted to material properties and frame section properties in SAP2000. If material properties are specified, they overwrite the values specified on the SECT “lines” or in global definitions. Table 3.3 shows the mapping to the material properties.

Material Properties	
SAP2000 Field	SACS Field
Material Name	N/A – taken as “SACS#” where # is a unique number
Material Type	N/A – taken as Steel
Weight per Unit Volume	Steel Density
Mass per Unit Volume	N/A – automatically calculated by SAP2000
Modulus of Elasticity	E
Poisson's Ratio	N/A – calculated from the elastic and shear moduli
Coefficient of Thermal Expansion	N/A – SAP2000 defaults used
Shear Modulus	G
Minimum Yield Stress	SY
Minimum Tensile Stress	N/A – taken as $1.3 \cdot F_y$
Effective Yield Stress	N/A – taken as $1.1 \cdot F_y$
Effective Tensile Stress	N/A – taken as $1.1 \cdot F_u$

**Table 3.3: GRUP “line” material properties translation**

The section properties are used to define new frame section properties in SAP2000. Table 3.4 shows the mapping to the frame section properties.

Section Properties	
SAP2000 Field	SACS Field
Section Name	Group Label
Material	N/A – based on the name assigned to the material properties on the GRUP or SECT “line”
<b>not translated</b>	Redesign Code
Outside Diameter (Pipe Section)	Tubular Outside Diameter
Wall Thickness (Pipe Section)	Tubular Wall Thickness
Nonprismatic Segment Length	Segment Length

**Table 3.4: GRUP “line” section properties translation**



Additional fields in the GRUP “line” are translated according to the mapping in Table 3.5.

Other GRUP Fields	
SAP2000 Field	SACS Field
not translated	Gap Element Type
Member Design Overwrite $C_b$	$C_b$ Option
Member Design Overwrite $C_m$	Member Class
not translated	Average Joint Thickness
Member Design Overwrite Effective Length Factor	$K_y$
Member Design Overwrite Effective Length Factor	$K_z$
not translated	Tubular Ring Spacing
not translated	Tubular Shear Area
not translated	Flooding

**Table 3.5: GRUP “line” other parameters translation**

### 3.1.4 MEMBER “Line”

The MEMBER “line” defines frame connectivity and properties. The MEMBER lines are translated to line objects in SAP2000. If properties are specified that also exist on the GRUP/GRUPL “lines”, they overwrite the values specified on the GRUP/GRUPL “lines” or in global definitions. Table 3.6 shows the mapping to the line objects.

Members with a length shorter than two times the SAP2000 merge tolerance are imported as linear link elements. The link property uses the GRUP label and is therefore easily identifiable for further editing as required.

Multiple members connected between the same two joints are not imported, only the first member is imported.

Line Object and Assignments	
SAP2000 Field	SACS Field
Start Joint (I)	A
End Joint (J)	B
Section Property	Group Label
not translated	Stress Output
Tension/compression limit assignment. If tension only, compression limit set to 0; if compression only, tension limit set to 0.	Gap Element Type
Releases	End Fixity Values
Local Axes Angle assignment	Chord Angle
Used to define local axes direction using advanced local axes assignment with two joints and a plane	Joint Z-axis Reference Joint
not translated	Flood Condition
Specifies whether overwrites are assigned for effective length factors or unbraced lengths	K or L Option
not translated	Avg Joint Thickness
Member Design Overwrite Effective Length Factor or Unbraced Length Ratio	KY or LY
Member Design Overwrite Effective Length Factor or Unbraced Length Ratio	KZ or LZ
not translated	Unbraced Length or Shear Mod
Property modifiers on the weight and mass density are assigned to the line.	Steel Density
not translated	Stress and UC Segments
not translated	Effective Diameter for Added Mass

**Table 3.6: MEMBER "line" object and assignments translation**

### 3.1.5 MEMBER OFFSETS "Line"

The MEMBER OFFSETS "line" defines offsets assigned to a member. Table 3.7 shows the mapping to the line objects.

MEMBER OFFSETS Fields	
SAP2000 Field	SACS Field
Frame Joint Offsets to Cardinal Point	Joint A – X, Y, Z
Frame Joint Offsets to Cardinal Point	Joint B – X, Y, Z

**Table 3.7: MEMBER OFFSETS "line" parameters translation**

### 3.1.6 PGRUP "Line"

The PGRUP "line" defines material and section properties for area objects. The material property values are used to define new steel material properties in SAP2000. The material properties from all of the PGRUP "lines" are checked for duplicates before creating the required SAP2000 material properties. Table 3.8 shows the mapping to the material properties.

Material Properties	
SAP2000 Field	SACS Field
Material Name	N/A – taken as "SACS#" where # is a unique number
Material Type	N/A – taken as Steel
Weight per Unit Volume	Weight Density
Mass per Unit Volume	N/A – automatically calculated by SAP2000
Modulus of Elasticity	E
Poisson's Ratio	Poisson's Ratio
Coefficient of Thermal Expansion	N/A – SAP2000 defaults used
Shear Modulus	N/A – automatically calculated by SAP2000
Minimum Yield Stress	Yield Stress SY
Minimum Tensile Stress	N/A – taken as $1.3 * F_y$
Effective Yield Stress	N/A – taken as $1.1 * F_y$
Effective Tensile Stress	N/A – taken as $1.1 * F_u$

**Table 3.8: PGRUP "line" material properties translation**

The section properties are used to define new area section properties in SAP2000. Table 3.9 shows the mapping to the section properties.

Section Properties	
SAP2000 Field	SACS Field
Section Name	Plate Group Label
not translated	Panel Designation
not translated	Auto Neutral Axis Offset
Thickness – Membrane/Bending	Plate Thickness
Type – taken as Shell	Plate Type
Material Name	N/A – based on the name assigned to the material properties on the PGRUP “line”
Material Angle	N/A – taken as 0
not translated	Plate Local Z Offset
not translated	Stiffener Data
Stiffness Modifiers	N/A – not set, defaults assumed

**Table 3.9: PGRUP “line” section properties translation**

### 3.1.7 PLATE “Line”

The PLATE “line” defines three or four-sided plate elements. The joints are used to define new area objects in SAP2000. The Plate Group Id specifies the area section property. If no Plate Group Id is specified a material property and area section property are defined according to the mapping for the PGRUP line. Table 3.10 shows the mapping to the area object.

Area Object	
SAP2000 Field	SACS Field
Label	Plate Name
Point 1	Joint A
Point 2	Joint B
Point 3	Joint C
Point 4	Joint D
Section Name	Plate Group Label
not translated	'RP' 'SK'
Thickness – Membrane/Bending	Plate Thickness
not translated	Offset Option

**Table 3.10: PLATE “line” object translation**

## SACS Import

---

If material properties are specified, they overwrite the values specified on the PGRUP “lines” or in global definitions. Table 3.11 shows the mapping to the material properties.

Material Properties	
SAP2000 Field	SACS Field
Material Name	N/A – taken as “SACS#” where # is a unique number
Material Type	N/A – taken as Concrete
Weight per Unit Volume	Weight Density
Mass per Unit Volume	N/A – automatically calculated by SAP2000
Modulus of Elasticity	Elastic Modulus E
Poisson's Ratio	Poisson's Ratio U
Coefficient of Thermal Expansion	N/A – SAP2000 defaults used
Shear Modulus	N/A – automatically calculated by SAP2000
Minimum Yield Stress	Yield Stress SY
Minimum Tensile Stress	N/A – taken as $1.3 \cdot F_y$
Effective Yield Stress	N/A – taken as $1.1 \cdot F_y$
Effective Tensile Stress	N/A – taken as $1.1 \cdot F_u$

**Table 3.11: PLATE “line” material properties translation**

### 3.1.8 JOINT “Line”

The JOINT “line” defines coordinates and restraints for point objects. Table 3.12 shows the mapping to the joint data.

Joint Properties	
SAP2000 Field	SACS Field
X	X-coordinate larger + X-coordinate smaller value
Y	Y-coordinate larger + Y-coordinate smaller value
Z	Z-coordinate larger + Z-coordinate smaller value
Restraint	Joint Fixity Values

**Table 3.12: JOINT “line” translation**



### 3.1.9 JOINT PERSET “Line”

The JOINT PERSET “line” defines permanent settlement conditions for joints. The permanent settlements are applied as ground displacements in SAP2000. The Basic Load Case Id specifies the load pattern to assign the displacement loads to. If no Basic Load Case Id is specified, the displacements are applied to all load cases. Table 3.13 shows the mapping to the ground displacement load.

Ground Displacement Assignment	
SAP2000 Field	SACS Field
Label	Joint Name
Translation Global X, Y, Z	Specified Joint Displacements
Rotation About Global X, Y, Z	Specified Joint Rotations
Load Pattern Name	Load Condition Name

**Table 3.13: JOINT PERSET “line” translation**

### 3.1.10 JOINT ELASTI “Line”

The JOINT ELASTI “line” defines spring supports for joints. Table 3.14 shows the mapping to the joint spring assignment.

Joint Spring Assignment	
SAP2000 Field	SACS Field
N/A – joint to which the spring is assigned	Joint Name
Translation 1, 2, 3	Translational Spring Rates
Rotation About 1, 2, 3	Rotational Spring Rates
Coordinate System	N/A – taken as Local
Options	N/A – taken as Add to Existing Loads
not translated	Joint 2
not translated	Joint 3

**Table 3.14: ELASTI “line” translation**

### 3.1.11 LOADCN “Line”

The LOADCN “line” defines a load case id. A SAP2000 load pattern and load case are created for each load case id. Table 3.15 shows the mapping to the load patterns.

Load Pattern Properties	
SAP2000 Field	SACS Field
Load Pattern Name	Load Condition Name
Type	N/A – taken as Other
Self Weight Multiplier	N/A – taken as 0
Auto Lateral Load Pattern	N/A

**Table 3.15: LOADCN “line” translation**

### 3.1.12 LOAD UNIF “Line”

The LOAD UNIF “line” defines distributed forces for line objects. Table 3.16 shows the mapping to the uniform line forces.

Distributed Line Forces Assignment	
SAP2000 Field	SACS Field
Load Pattern Name	Taken as last specified LOADCN in input file
Load Type	N/A – taken as Forces
Direction	Load Direction X, Y, or Z
Line Object Start Joint I	Joint A
Line Object End Joint J	Joint B
Distance 1	Distance from End A to Beginning of Distributed Load
Load 1	Beginning Distributed Load Value
Distance 2 – taken as Distance 1 plus Load Length	Distance Over Which Load Acts
Load 2	Final Distributed Load Value
Coord Sys	Coordinate System for Load
not translated	Comments

**Table 3.16: LOAD UNIF “line” load translation**

### 3.1.13 LOAD DMOM “Line”

The LOAD DMOM “line” defines distributed moments for line objects. Table 3.17 shows the mapping to the distributed line moments.

<b>Distributed Line Moments Assignment</b>	
<b>SAP2000 Field</b>	<b>SACS Field</b>
Load Pattern Name	Taken as last specified LOADCN in input file
Load Type	N/A – taken as Moments
Direction	Moment Direction X, Y, or Z
Line Object Start Joint I	Joint A
Line Object End Joint J	Joint B
Distance 1	Distance from End A to Beginning of Distributed Moment
Load 1	Beginning Distributed Moment Value
Distance 2 – taken as Distance 1 plus Load Length	Distance Over Which Moment Acts
Load 2	Final Distributed Moment Value
Coord Sys	Coordinate System for Moment
not translated	Comments

**Table 3.17: LOAD DMOM “line” load translation**

### 3.1.14 LOAD CONC “Line”

The LOAD CONC “line” defines concentrated loads for line objects. Table 3.18 shows the mapping to the concentrated line loads.

## SACS Import

---

Concentrated Line Load Assignment	
SAP2000 Field	SACS Field
Load Pattern Name	Taken as last specified LOADCN in input file
Load Type	N/A – taken as Forces
Direction	Load Direction X, Y, or Z
Line Object Start Joint I	Joint A
Line Object End Joint J	Joint B
Distance 1	Distance from Joint A to Concentrated Force
Load 1	Concentrated Force Value
Coord Sys	Coordinate System
not translated	Comment

**Table 3.18: LOAD CONC "line" load translation**

### 3.1.15 LOAD MOMT “Line”

The LOAD MOMT “line” defines concentrated moments for line objects. Table 3.19 shows the mapping to the concentrated line moments.

Concentrated Line Moment Assignment	
SAP2000 Field	SACS Field
Load Pattern Name	Taken as last specified LOADCN in input file
Load Type	N/A – taken as Moments
Direction	Load Direction X, Y, or Z
Line Object Start Joint I	Joint A
Line Object End Joint J	Joint B
Distance 1	Distance from Joint A to Concentrated Moment
Load 1	Concentrated Moment Value
Coord Sys	Coordinate System
not translated	Comment

**Table 3.19: LOAD MOMT "line" load translation**

### 3.1.16 LOAD JOIN “Line”

The LOAD JOIN “line” defines joint forces or moments for point objects. Table 3.20 shows the mapping to the point loads and moments.

Point Load and Moment Assignment	
SAP2000 Field	SACS Field
Load Pattern Name	Taken as last specified LOADCN in input file
Point Label	Joint Name
Force Global X or Force 1	Force FX
Force Global Y or Force 2	Force FY
Force Global Z or Force 3	Force FZ
Moment About Global X or Moment About 1	Moment MX
Moment About Global Y or Moment About 2	Moment MY
Moment About Global Z or Moment About 3	Moment MZ
Coordinate System	N/A – taken as Global
not translated	Remarks

**Table 3.20: LOAD JOIN “line” load translation**

### 3.1.17 LCOMB “Line”

The LCOMB “line” defines load combinations. Table 3.21 shows the mapping to the load combinations.

Load Combination Definitions	
SAP2000 Field	SACS Field
Load Combination Name	Combination Name
Load Case Name	Load Case Name
Scale Factor	Load Factor

**Table 3.21: LCOMB “line” combination translation**