CHAPTER 6

LIVE LOAD

CONTENTS

6.1 INTRODUCTION

The moving load generator provides the STRUDL user the ability to easily apply live loads to his structure during an analysis. The intention is to simulate a truck moving over a bridge. STRUDL will generate an independent static load for each position of the vehicle on the structure. The user may specify standard AASHO live loads or any combination of axle loads and spacings. Combinations of moving point loads and uniformly distributed loads can also be specified if required.

The moving load generator was given to the Bridge Department by the Ministry of Works in New Zealand.

NOTE: This feature can easily create large amounts of useless information if a simple mistake is made. Each engineer should carefully check his problem and then have it reviewed by a member of the Computer Committee or Bridge Computer Service.

6.2 THE SUPERSTRUCTURE COMMAND

General form:

SUPERSTRUCTURE spec list spec list ....

Elements:

$$\text{spec} = {}^{*}\left\{ \begin{array}{ll} \underline{\text{ANGLE}} & v \\ \underline{\text{N}}\text{UMBER} & i \\ \underline{\text{REV}}\text{ERSE} & \end{array} \right\}$$

v = Tolerance angle between consecutive members in the list. The angle is specified in the current user units. If the angle is omitted, 5° will be assumed.

i = Number of segments into which each member in the list is divided. If the number of segments is omitted, 10 will be assumed.

$$\text{list} = \left\{ \begin{array}{c} 'a_1' \\ i_1 \end{array} \right\} \quad \left\{ \begin{array}{c} 'a_2' \\ i_2 \end{array} \right\} \quad \ldots\ldots$$

$'a_1'$ = Alphanumeric member identifier

i_1 = Integer member identifier

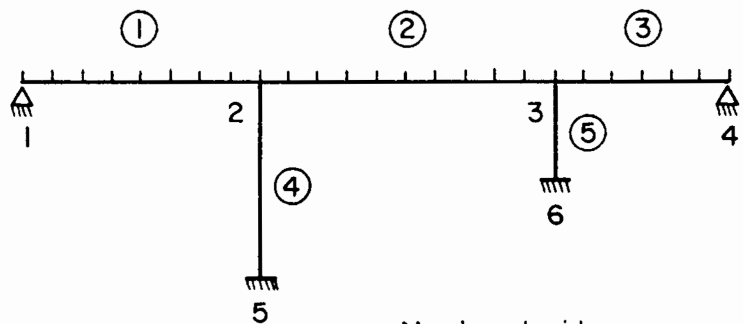
Explanation:

The SUPERSTRUCTURE command initiallizes the moving load generator. It must precede the description of the moving loads. Each member in the list must have been previously defined by a MEMBER INCIDENCE command.

The SUPERSTRUCTURE command is used to identify the path vehicles will take over the structure. The incidences of the members in the list determine the physical order of members over which the vehicles will move. Each moving vehicle will be stopped at each section of the superstructure, and a load case generated. Note, that the sections are defined at the end of each superstructure segment, and are independent of the SECTION command in STRUDL.

The superstructure list is checked for a contiguous vehicle path. A contiguous path requires the end joint of one member to be the starting joint of the following member. If this is not the case, a WARNING message will be printed. No remedial action will be taken. The user can reverse the direction of individual members in the superstructure list by using the REVERSE prefix.

The superstructure list is also checked for a sudden change in direction of the vehicle path. The angle of intersection of adjacent members is checked against the tolerance angle. If the tolerance angle is exceeded, a WARNING message will be printed. Again no remedial action will be taken. This provides an indication to the user, for instance, if a pier has inadvertantly been specified in the superstructure list.



Member	Incidences	
1	1	2
2	2	3
3	3	4
4	2	5
5	3	6

EXAMPLE STRUCTURE

Fig. 1

Examples:

The superstructure for the structure shown in Fig. 1 may be described with the following commands:

1. SUPERSTRUCTURE N 8 1 N 10 2 N 6 3

   This will define the vehicle path to pass over members 1, 2, and 3. The vehicle will be stopped at the 1/8th points on member 1, the 1/10th points on member 2, and the 1/6th points on member 3.

2. SUPERSTRUCTURE 1 2 3

   This will define the superstructure as members 1, 2, and 3, with the default of 10 segments on each member.

Possible errors:

1. SUPERSTRUCTURE 3 2 1

   This will define the vehicle to pass over members 3, 2, and 1. However, it will pass over each member from left to right, in the order 3-4, 2-3, 1-2. A WARNING message will be printed, as the specified vehicle path is not contiguous.

   The correct order for right to left can be obtained by using the form.

SUPERSTRUCTURE REVERSE 3 REVERSE 2 REVERSE 1

2. SUPERSTRUCTURE 1 3

   Again a warning message will be printed that the superstructure is not contiguous.

3. SUPERSTRUCTURE 1 2 5

   In this case the vehicle path will be defined to pass over members 1 and 2 and down the pier 5. A warning message will be printed.

   In all of the above error cases, warning messages only will be printed. No rememdial action will be taken. Subsequent load generation will proceed with the superstructure as specified. The superstructure should be checked in accordance with the user's intention.

6.3 THE MOVING LOAD COMMAND

General Form:

MOVE (LOAD) (direction) vehicle (direction) vehicle ....

Elements:

direction = { {FORWARDS, FWD}, {BACKWARDS, BWD}, BOTH }

$$
\text{vehicle} = \left\{ \begin{array}{l} \underline{\text{TRUCK}} \quad (\underline{\text{NP}}\ i_1) \quad p_1 \quad d_1 \quad p_2 \quad \cdots \\ \left\{ \begin{array}{l} \underline{\text{H20-S16-44}} \\ \underline{\text{HS20}} \end{array} \right\} v \\ \left\{ \begin{array}{l} \underline{\text{H20-S16-T16}} \\ \underline{\text{HST}} \end{array} \right\} \\ \underline{\text{STANDARD}} \quad i_2 \end{array} \right\}
$$

Elements:

i_1 = is the pivot axle number, counted from the front of the truck. The pivot axle is stopped at each superstructure section as the vehicle moves over the superstructure. If NP is omitted, the centre axle is taken when there are an odd number of axles and the axle one forward from the centre for an even number of axles (Figure 3).

$p_1 \ldots p_n$ = The axle loads

$d_1 \ldots d_{n-1}$ = The axle spacings

i_2 = The standard vehicle number. Two model standard vehicles are included (Figure 6 and Figure 7). A facility to incorporate additional 'standard' vehicles is described in Section 6.9.

v = The variable spacing of the rear two axles on the H20-S16-44 truck (Figure 4), the spacing should be specified between 14 feet and 30 feet inclusive. The spacing to be used is that which will produce maximum stresses. By default, 14 feet will be used.

Explanation:

The MOVE LOAD command is used to specify the vehicle (or vehicles) which will move in either (or both) directions across the superstructure. Each vehicle will move in the direction indicated. By default BOTH directions will be assumed initially (since the truck may be unsymmetric, critical stresses may not occur if the vehicle is run one way only). The vehicle will move onto, across, and off the superstructure. The vehicle will be stopped with its pivot point at each superstructure section. For the purpose of moving on and off the superstructure, dummy segments equal in length to the segments of the end members will provide stopping points such that the leading or trailing axle will be just on the superstructure at each end (Figure 2).

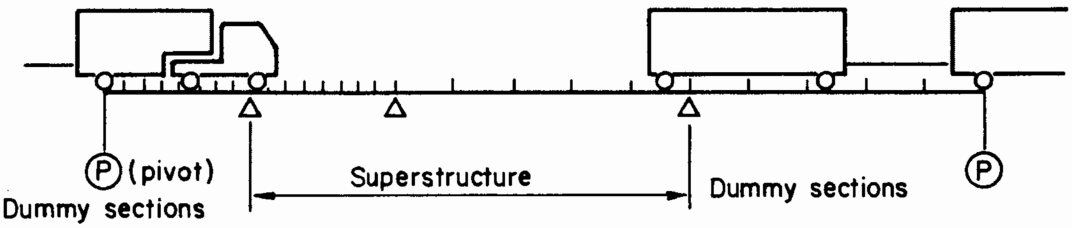
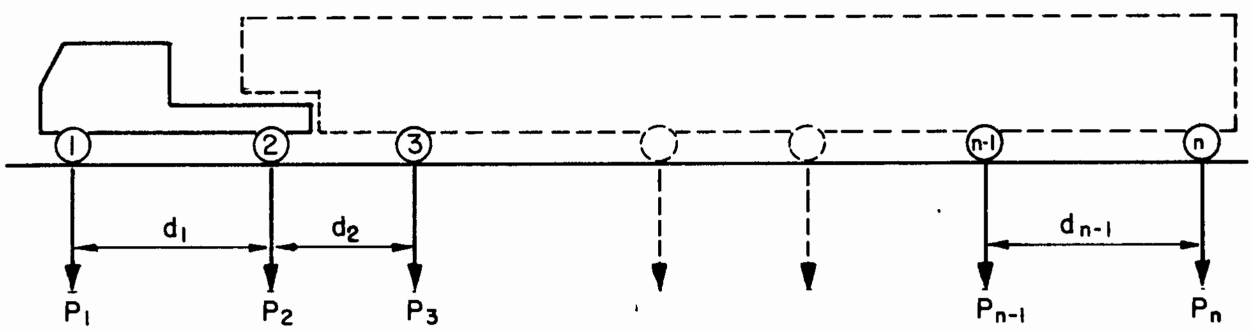


Fig. 2

The MOVE LOAD command does NOT generate any loads, but defines the vehicle movement over the superstructure. A selection of vehicle types are available:



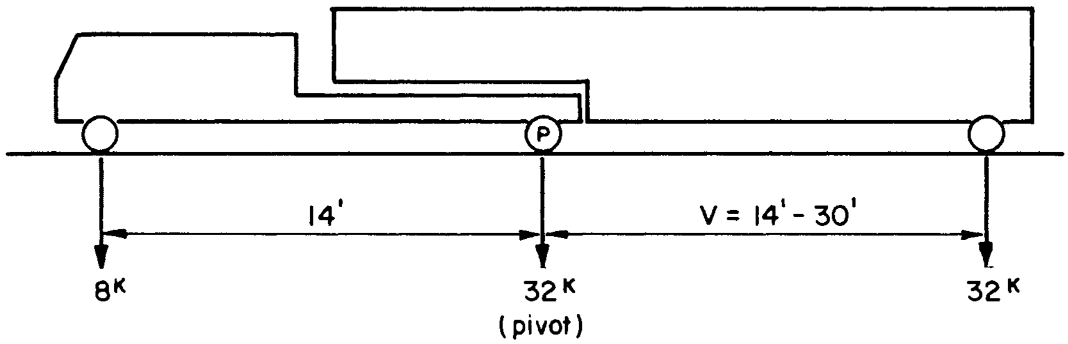
GENERAL TRUCK

Fig. 3

1. TRUCK

A general truck can be defined by the user. This truck is illustrated in Figure 3. The truck is specified from the front axle, the spacing between the first and second axles, the second axle, and so on until the rear axle. By default the center axle (or the axle immediately forward of center) is taken as the pivot axle. The general train of loads in Figure 3 could be specified by a command of the type (in the current user units):

1. MOVE LOAD FORWARD NP n/2 p_1 d_1 p_2 d_2 p_3 ... p_{n-1} d_{n-1} p_n



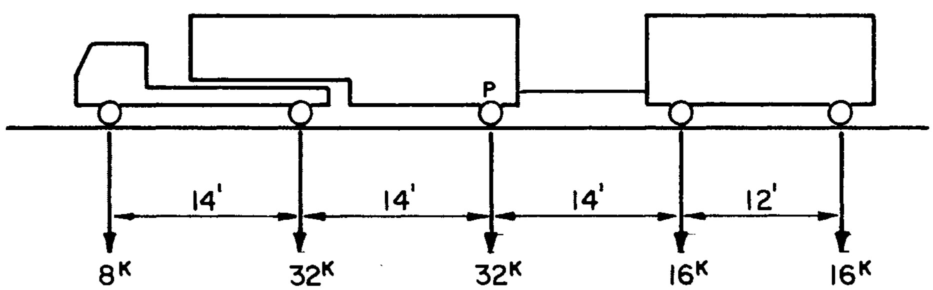
H 20-S16-44 TRUCK

Fig. 4

2. H20-S16-44

The axle spacing and weight distribution of the standard H20-S16-44 truck is illustrated in Figure 4. A default value for the spacing between the rear axles is taken as 14 feet. The following commands are equivalent (units pound inches):

1. MOVE LOAD FORWARD H20-S16-44 BACKWARD H20-S16-44
2. MOVE LOAD BOTH HS20
3. MOVE LOAD BOTH TRUCK NP 2 8000 168 32000 168 32000
4. MOVE LOAD BOTH H20-S16-44 168



H 20-S16-T16 TRUCK

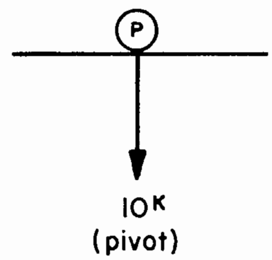
Fig. 5

3. H20-S16-T16

The axle spacing and weight distribution of the standard H20-S16-T16 truck is illustrated in Figure 5.

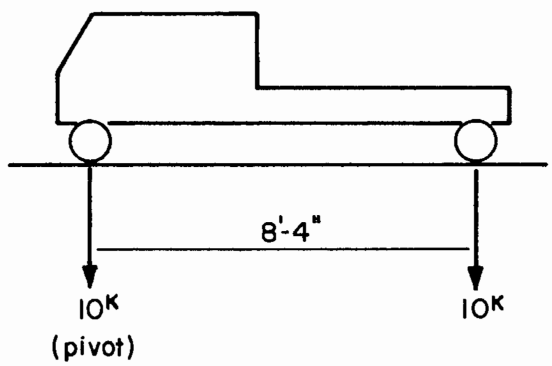
The following commands are equivalent (units kip feet).

1. MOVE LOAD FORWARD H20-S16-T16
2. MOVE LOAD FORWARD HST
3. MOVE LOAD FORWARD TRUCK NP 3 8 14 32 14 32 14 16 12 16



'STANDARD 1'

Fig. 6



'STANDARD 2'

Fig. 7

4. <u>STANDARD</u>

Two 'standard' trucks are included (for modification or addition to the standard set of trucks see Section 6.9. These are illustrated in Figures 6 and 7. The following commands are equivalent (units pound inches).

1. MOVE LOAD FORWARD STANDARD 1 BACKWARD STANDARD 2
2. MOVE LOAD FORWARD TRUCK 10000 BACKWARD TRUCK 10000, 100 - 10000

Notice that these commands define two vehicles to move over the superstructure (but not simultaneously).

POSSIBLE ERRORS

1. MOVE LOAD TRUCK 18 14 18 16

   Here the distance 16 (feet) is not followed by an axle load, and will be ignored.

2. MOVE LOAD 18 14 18 14 16

   Here no vehicle type has been specified.

6.4 THE LANE LOADING COMMAND

General Form:

LANE (LOAD) loads members loads members ....

Elements:

loads = * { P v_1 / W v_2 }

v_1 = The value of a single concentrated point load (in current user units) which will move across members of the superstructure.

v_2 = The uniform distributed load intensity in current user units.

members = { ALL / ALL BUT list / list }

list = * { alphalist / integerlist / n_1 { TO / THROUGH } n_2 }

alphalist = 'a_1' ('a_2') .... = alphanumeric member identifier

integerlist = i_1 (i_2) .... = integer member identifier

Explanation:

The LANE LOAD command is used to specify the design lane loading. For the purposes of using this command, the lane load is defined as a uniform load W applied to one or more members together with a single concentrated load P which will move over selected members of the superstructure. The members to which each load will be applied are specified in the member list following that load. ALL and ALL BUT options refer to the superstructure list only. The concentrated load P can only be applied to superstructure members, and will be stopped at each section of each member. The uniform load W is not restricted to superstructure members.

The cases where W and P are specified in the LANE LOAD command together (as with the * in the loads element), are illustrated:

1. LANE LOAD W w P p list

   In this case, W and P will be applied to each member in the list, i.e. W will only be applied to the member P is moving over.

2. LANE LOAD P p W w list

   This is the same as case 1.

3. LANE LOAD P p list W w

   This is the same as case 1.

4. LANE LOAD W w list P p

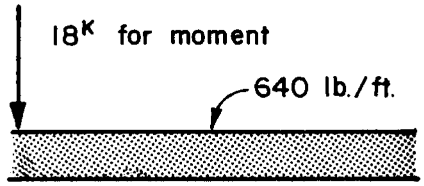
   In this case, W will be applied to all members in the list, as P moves over each member in the list.

5. LANE LOAD W w $list_w$ P p $list_p$

   In this case, W will be applied to all members in $list_w$, as P moves over each member in $list_p$.

6. LANE LOAD P p $list_p$ W w $list_w$

   In this case, firstly the concentrated load P will move over each member of $list_p$ and no uniform load will be applied, and secondly W and P will be applied to each member of $list_w$ as in case 1.

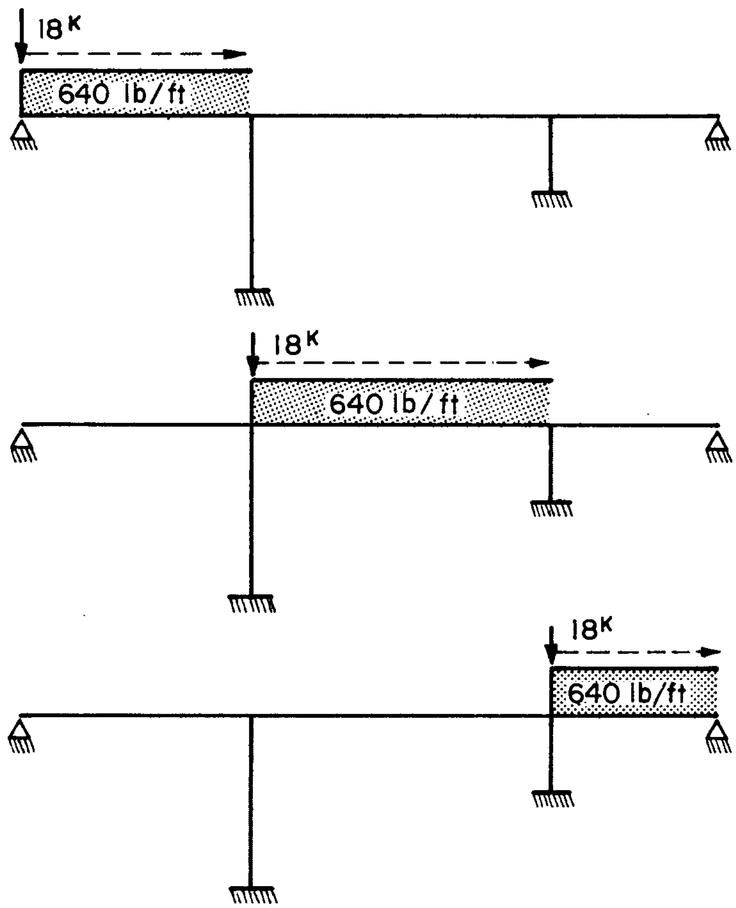


H20-S16-44 LANE LOADING

Fig. 8

Examples:

A standard lane loading for H20-S16-44 is illustrated in Figure 8. Practical applications of this loading to the structure shown in Figure 1 are:



LANE LOADS

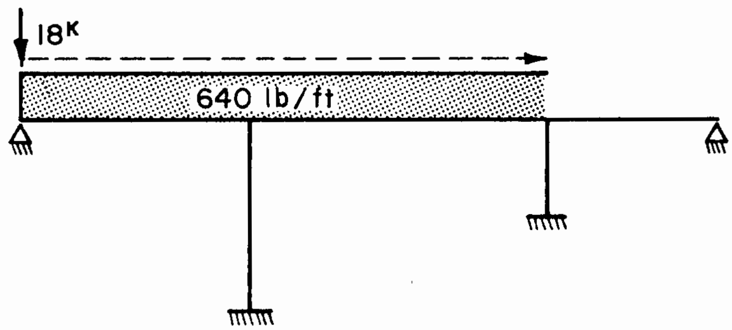
Fig. 9

1. Commands which may be used to specify a lane loading for Figure 9 are (kip Ft units):

   LANE LOAD P 18 W 0.64 1 2 3

   or

   LANE LOAD W 0.64 P 18 ALL



LANE LOADS

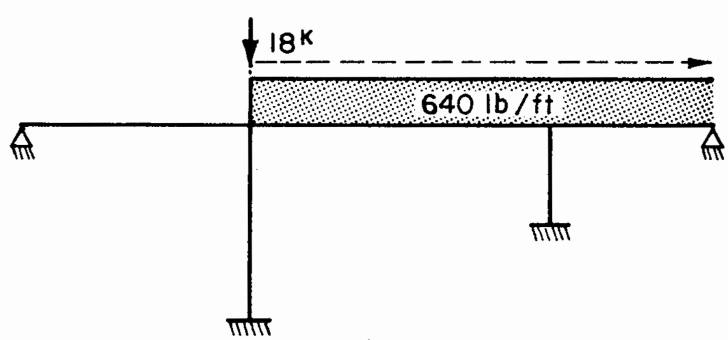
Fig. 10

2. Commands to specify the lane loading in Figure 10 include:

   LANE LOAD W 0.64 1 2 P 18 1 2

   or

   LANE LOAD W 0.64 1 2 P 18



LANE LOADS

Fig. 11

3. Figure 11 loading can be specified as:

   LANE LOAD W 0.64 2 3 P 18 2 3

or

LANE LOAD W 0.64 2 3 P 18

Possible Errors:

1. LANE LOAD P 18 W 0.64 1 2 4

   Member 4 will be ignored for the concentrated 18k load if member 4 has not been defined in the superstructure. However, the uniform 0.64k load will still be applied to member 4.

6.5 THE GENERATE LOADINGS COMMAND

GENERATE (LOADS) { X / -Y / Z } [SCALE] v [INITIAL] i ({ PUNCH / PRINT })

Elements:

v = A scale factor by which all generated loads will be multiplied. The assumed value is -1.0 i.e. the loads will be assumed to be applied in the GLOBAL Y direction with a negative magnitude.

i = An initial integer load identifier. Each generated load case is given an unique load identifier, starting from this initial value and incremented by unity. If this initial value is not specified, 1 is assumed. Previously defined integer load identifiers will be bypassed (i.e. they will not be redefined).

Explanation:

The GENERATE LOADS command will generate all the loads as previously specified in the MOVE LOAD and LANE LOAD commands. The user has the option of generating the loads directly into the STRUDL data structure and stored for his job, or he can punch cards which can be fed into a STRUDL job at a later date. These cards are in the standard STRUDL loading command format and can be easily modified by the user, e.g. to add additional concentrated loads to lane loadings to allow for adjacent or alternate spans loaded.

The PRINT option can be used to list the actual LOAD commands necessary to give the generated loadings. These cards will be punched with the PUNCH option but with this latter option the loads will not be retained internally for the current job. If neither option is used, only the load identifiers and title of the generated loads will be listed.

The loads can be applied in any of the GLOBAL coordinate axis directions. The Y axis is assumed if not specified.

All generated loads are multiplied by a constant scale factor, which may be varied from the assumed value of -1.0, to allow for multiple lanes, eccentricity, impact factor, etc.

The user has the option of controlling the starting value of the loading identifier. However, unique identifiers will automatically be generated, and this option would mainly be of use when the LOAD commands were to be punched.

Each load generated is also given a load title which indicates the origin of the load (TRUCK, LANE, FORWARD, MEMBER, etc.).

When all the moving loads have been generated, the superstructure and vehicle definitions are no longer defined.

Examples:

1. GENERATE

   This will generate the loads on the previously defined superstructure. The loads will be in the -Y direction.

2. GENERATE LOADS PUNCH

   This will cause LOAD commands, to be punched onto cards. These cards can then be fed into a normal STRUDL problem.

6.6 USE OF THE MOVING LOADS GENERATOR

The moving loads generator provides an additional method of specifying loading conditions on a structure defined in STRUDL. Although it has been designed specifically to easily move vehicles over bridge structures, it is not restricted to these applications. For example, the LANE LOAD command can provide a simple method of specifying uniform loads on a large number of members, using P = 0.

The moving loads commands should always be used as a block of commands. However, the block of commands can be used more than once provided that members and joints have previously been defined. The sequence of commands should be:

```
USE LOAD GENERATOR

SUPERSTRUCTURE

MOVE LOAD or
LANE LOAD

   .
   .
   .
GENERATE LOADS

END LOAD GENERATOR
```

USE LOAD GENERATOR Command

USE LOAD (GENERATOR)

Explanation: This command initializes the moving loads generator and must be the first command in the moving loads block of commands.

END LOAD GENERATOR Command

END LOAD (GENERATOR)

Explanation: This terminates the moving load generator and enables a return to other STRUDL commands.

For additional information refer to MCAUTO STRUDL Manual Appendix E.

This block of commands should not include other STRUDL commands between the SUPERSTRUCTURE command and the GENERATE command.

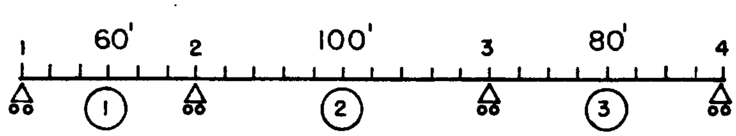
The moving loads generator provides a very powerful method of specifying loads. Care should be taken that excessive loads are not generated. This can easily occur by letting a vehicle move in both directions over a symmetrical structure. Normally only small differences will be noticed (1-2%) by moving vehicles in both directions on most unsymmetrical structures.

Large numbers of loads will also be generated where the superstructure is defined with fine subdivision, and consideration should be taken of the stage in the design when the analysis is made in deciding on the vehicle stopping points.

Bridge-type structures often contain relatively few joints and hence do not normally require the solution of large numbers of equations. However, when large numbers of loads have been generated, solution times can often be reduced by breaking the LOAD LIST up and analysing the structure for each group of loads, rather than all of the loads at once.

Although results for any or all of the loads can be printed, it is generally only the envelope of loads which is of interest. Hence, internal member envelope commands would normally be used for output, whether printed or plotted. However, obtaining internal member results can be very time-consuming. A quick analysis with few members and few joints will often require a relatively large amount of time to provide internal member results. On the other hand, introducing artificial joints along the members increases the analysis times, but if internal results are requested only at the ends of the members, a reduction in the time required to process the results may be evident. Also, member displacements can be directly obtained.

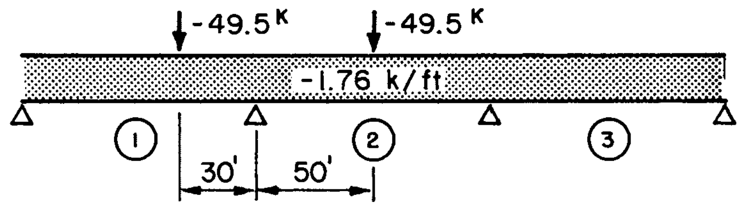
The bridge represented in Figure 12 has been analysed for loads obtained with the moving load generator. The commented listing of this job follows.



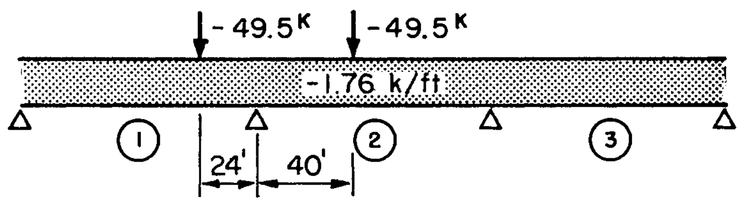
SUPERSTRUCTURE

Fig. 12

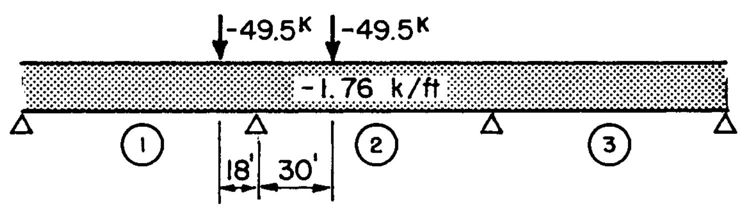
LOAD 1 - DEADLOAD



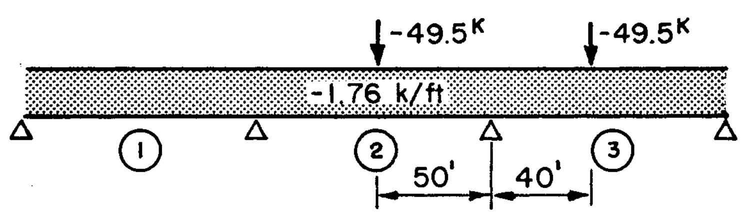
LOAD 2- ADDITIONAL LANE LOAD SPAN 1-2



LOAD 3- ADDITIONAL LANE LOAD SPAN 1-2

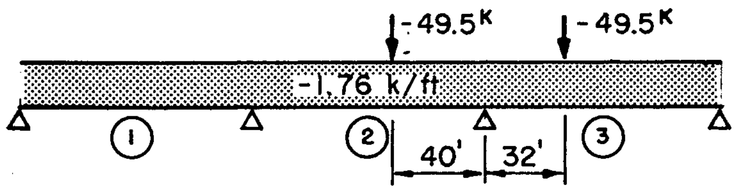


LOAD 4- ADDITIONAL LANE LOAD SPAN 1-2

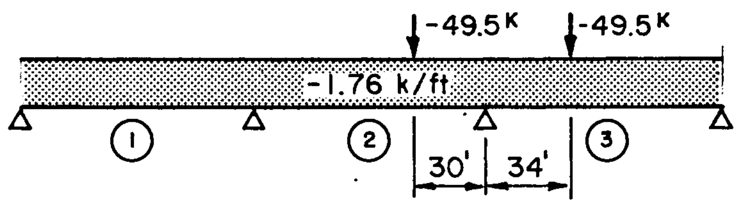


LOAD 5- ADDITIONAL LANE LOAD SPAN 2-3

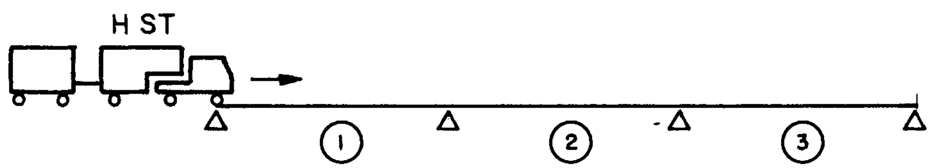
Fig. 12



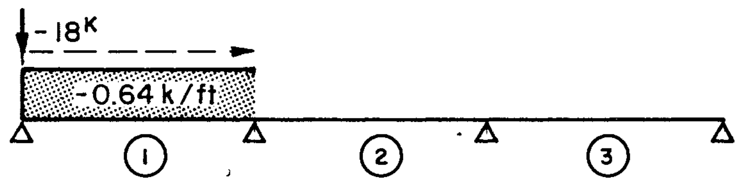
LOAD 6 - ADDITIONAL LANE LOAD SPAN 2-3



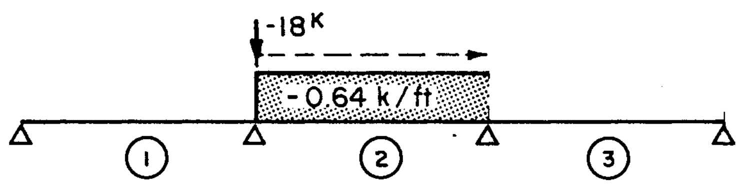
LOAD 7 - ADDITIONAL LANE LOAD SPAN 2-3



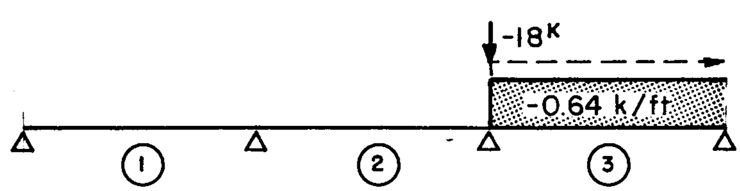
H 20-S16-T16 LOAD



LANE LOAD SPAN 1



LANE LOAD SPAN 2



LANE LOAD SPAN 3

Fig. 12

```
STRUDL 'MOVLOAD'  'EXAMPLE SHOWING USE OF MOVING LOAD'

          ***********************************************
          *                                             *
          *               ICES STRUDL-II                *
          *      THE STRUCTURAL DESIGN LANGUAGE         *
          *   MASSACHUSETTS INSTITUTE OF TECHNOLOGY     *
          *            STATE OF CALIFORNIA              *
          *    BRIDGE DEPARTMENT DIVISION OF HWYS.      *
          *   SPECIAL STUDIES SECTION   PH. 445-6519    *
          *   V2 MO OCT. 1970   INSTALLED JAN. 1970     *
          *        20:01:37        10/15/71             *
          *   UPDATE NO. 1 MAY 1971          BY RAI     *
          *       DATA POOL SIZE SET AT 24,500          *
          *                                             *
          ***********************************************

TYPE PLANE FRAME

UNITS KIP FEET

SET ELEMENTS INTEGER

JOINT COORDINATES

1 0 0 S

2 60 0 S

3 160 0 S

4 240 0 S

MEMBER INCIDENCES

1 1 2

2 2 3

3 3 4

JOINTS 1 2 3 4 RELEASE MOMENT Z

JOINTS 1 2 3 RELEASE FORCE X

MEMBER 1 2 3 PROPS PRISMATIC AX 20 IZ 200

CONSTANTS

E 720000 ALL

$

$ NO OF LANES = 2

$ IMPACT FACTOR = 1.25

$ ECCENTRICITY FACTOR = 1.1

$ TOTAL FACTOR = 2.75 - TRUCK AND LANE LOADS WILL ALL BE MULTIPLIED BY THIS

$

LOADING 1 'DEADLOAD'

MEM 1 2 3 LOAD FORCE Y UNI -3.5

$

$ SIX ADDITIONAL LOADING CASES WILL NOW BE ADDED TO ENSURE THAT THE

$ MAXIMUM NEGATIVE MOMENTS OVER THE SUPPORTS ARE INCLUDED. THESE ARE PROBABLY

$ GOVERNED BY LANE LOAD, WITH ADJACENT SPANS LOADED WITH UNIFORM AND POINT

$ LOADS.

$
```

```
LOADING 2 'ADDITIONAL LANE LOAD SPAN 1-2, W=0.64, P=18 AT 0.5L1 & 0.5L2'
MEM 1 2 LOAD FORCE Y UNI -1.76
MEM 1 LOAD FORCE Y CON FR -49.5 0.5
MEM 2 LOAD FORCE Y CON FR -49.5 0.5
LOADING 3 'ADDITIONAL LANE LOAD SPAN 1-2, W=0.64, P=18 AT 0.6L1 & 0.4L2'
MEM 1 2 LOAD FORCE Y UNI -1.76
MEM 1 LOAD FOR Y CON FR -49.5 0.6
MEM 2 LOAD FOR Y CON FR -49.5 0.4
LOADING 4 'ADDITIONAL LANE LOAD SPAN 1-2, W=0.64, P=18 AT 0.7L1 & 0.3L2'
MEM 1 2 LOAD FORCE Y UNI -1.76
MEM 1 LOAD FOR Y CON FR -49.5 0.7
MEM 2 LOAD FOR Y CON FR -49.5 0.3
LOADING 5 'ADDITIONAL LANE LOAD SPAN 2-3, W=0.64, P=18 AT 0.5L2 & 0.5L3'
MEM 2 3 LOAD FOR Y UNI -1.76
MEM 2 3 LOAD FOR Y CON -49.5 0.5
LOADING 6 'ADDITIONAL LANE LOAD SPAN 2-3, W=0.64, P=18 AT 0.6L2 & 0.4L3'
MEM 2 3 LOAD FOR Y UNI -1.76
MEM 2 LOAD FOR Y CON FR -49.5 0.6
MEM 3 LOAD FOR Y CON FR -49.5 0.4
LOADING 7 'ADDITIONAL LANE LOAD SPAN 2-3, W=0.64, P=18 AT 0.7L2 & 0.3L3'
MEM 2 3 LOAD FOR Y UNI -1.76
MEM 2 LOAD FOR Y CON FR -49.5 0.7
MEM 3 LOAD FOR Y CON FR -49.5 0.3
$
$ DETAILS OF TRUCK LOADING WHICH WILL BE GENERATED FOLLOW
$
SUPERSTRUCTURE  N 6  1  N 10  2  N 8  3
MOVE LOAD FORWARD H20-S16-T16
LANE LOAD P 18 D 0.64 1 2 3
$
$ TRUCK AND LANE LOADS WILL NOW BE GENERATED
$ THE EQUIVALENT LOAD COMMANDS WILL ALSO BE PRINTED
$
GENERATE LOADS SCALE -2.75 PRINT
LOADING - 8              H20-S16-T16       FORWARD, PIVOT ON SECTION -2    MEMBER 1
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -22.0000000 L     8.0000000
LOADING - 9              H20-S16-T16       FORWARD, PIVOT ON SECTION -1    MEMBER 1
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    18.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L     4.0000000
LOADING - 10             H20-S16-T16       FORWARD, PIVOT ON SECTION  0    MEMBER 1
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    28.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    14.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L     0.0
LOADING - 11             H20-S16-T16       FORWARD, PIVOT ON SECTION  1    MEMBER 1
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    38.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    24.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    10.0000000
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LOADING - 12          H20-S16-T16      FORWARD, PIVOT ON SECTION  2    MEMBER 1
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    48.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    34.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    20.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L     6.0000000
LOADING - 13          H20-S16-T16      FORWARD, PIVOT ON SECTION  3    MEMBER 1
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    58.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    44.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    30.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    16.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L     4.0000000
LOADING - 14          H20-S16-T16      FORWARD, PIVOT ON SECTION  4    MEMBER 1
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L     8.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    54.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    40.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    26.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    14.0000000
LOADING - 15          H20-S16-T16      FORWARD, PIVOT ON SECTION  5    MEMBER 1
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    18.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L     4.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    50.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    36.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    24.0000000
LOADING - 16          H20-S16-T16      FORWARD, PIVOT ON SECTION  0    MEMBER 2
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    28.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    14.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L     0.0
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    46.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    34.0000000
LOADING - 17          H20-S16-T16      FORWARD, PIVOT ON SECTION  1    MEMBER 2
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    38.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    24.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    10.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    56.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    44.0000000
LOADING - 18          H20-S16-T16      FORWARD, PIVOT ON SECTION  2    MEMBER 2
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    48.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    34.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    20.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L     6.0000000
MEMBER 1        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    54.0000000
LOADING - 19          H20-S16-T16      FORWARD, PIVOT ON SECTION  3    MEMBER 2
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    58.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    44.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    30.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    16.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L     4.0000000
LOADING - 20          H20-S16-T16      FORWARD, PIVOT ON SECTION  4    MEMBER 2
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    68.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    54.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    40.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    26.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    14.0000000
LOADING - 21          H20-S16-T16      FORWARD, PIVOT ON SECTION  5    MEMBER 2
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    78.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    64.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    50.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    36.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    24.0000000
LOADING - 22          H20-S16-T16      FORWARD, PIVOT ON SECTION  6    MEMBER 2
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    88.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    74.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    60.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    46.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    34.0000000
LOADING - 23          H20-S16-T16      FORWARD, PIVOT ON SECTION  7    MEMBER 2
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -22.0000000 L    98.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    84.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    70.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    56.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    44.0000000
LOADING - 24          H20-S16-T16      FORWARD, PIVOT ON SECTION  8    MEMBER 2
MEMBER 3        LOAD FORCE Y CONCENTRATED P   -22.0000000 L     8.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    94.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -88.0000000 L    80.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    66.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P   -44.0000000 L    54.0000000
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LOADING - 25          H20-S16-T16       FORWARD, PIVOT ON SECTION  9    MEMBER 2
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -22.0000000 L     18.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L      4.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     90.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     76.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     64.0000000
LOADING - 26          H20-S16-T16       FORWARD, PIVOT ON SECTION  0    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -22.0000000 L     28.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     14.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L      0.0
MEMBER 2        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     86.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     74.0000000
LOADING - 27          H20-S16-T16       FORWARD, PIVOT ON SECTION  1    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -22.0000000 L     38.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     24.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     10.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     96.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     84.0000000
LOADING - 28          H20-S16-T16       FORWARD, PIVOT ON SECTION  2    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -22.0000000 L     48.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     34.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     20.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L      6.0000000
MEMBER 2        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     94.0000000
LOADING - 29          H20-S16-T16       FORWARD, PIVOT ON SECTION  3    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -22.0000000 L     58.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     44.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     30.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     16.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L      4.0000000
LOADING - 30          H20-S16-T16       FORWARD, PIVOT ON SECTION  4    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -22.0000000 L     68.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     54.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     40.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     26.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     14.0000000
LOADING - 31          H20-S16-T16       FORWARD, PIVOT ON SECTION  5    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -22.0000000 L     78.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     64.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     50.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     36.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     24.0000000
LOADING - 32          H20-S16-T16       FORWARD, PIVOT ON SECTION  6    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     74.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     60.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     46.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     34.0000000
LOADING - 33          H20-S16-T16       FORWARD, PIVOT ON SECTION  7    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -88.0000000 L     70.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     56.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     44.0000000
LOADING - 34          H20-S16-T16       FORWARD, PIVOT ON SECTION  8    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     66.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     54.0000000
LOADING - 35          H20-S16-T16       FORWARD, PIVOT ON SECTION  9    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     76.0000000
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     64.0000000
LOADING - 36          H20-S16-T16       FORWARD, PIVOT ON SECTION 10    MEMBER 3
MEMBER 3        LOAD FORCE Y CONCENTRATED P    -44.0000000 L     74.0000000
LOADING - 37           LANE LOAD        FORWARD, PIVOT ON SECTION  0    MEMBER 1
MEMBER 1        LOAD FORCE Y GLOBAL UNIFORM FRACTION W    -1.7599983
MEMBER 1        LOAD FORCE Y CONCENTRATED P    -49.5000000 L      0.0
LOADING - 38           LANE LOAD        FORWARD, PIVOT ON SECTION  1    MEMBER 1
MEMBER 1        LOAD FORCE Y GLOBAL UNIFORM FRACTION W    -1.7599983
MEMBER 1        LOAD FORCE Y CONCENTRATED P    -49.5000000 L     10.0000000
LOADING - 39           LANE LOAD        FORWARD, PIVOT ON SECTION  2    MEMBER 1
MEMBER 1        LOAD FORCE Y GLOBAL UNIFORM FRACTION W    -1.7599983
MEMBER 1        LOAD FORCE Y CONCENTRATED P    -49.5000000 L     20.0000000
LOADING - 40           LANE LOAD        FORWARD, PIVOT ON SECTION  3    MEMBER 1
MEMBER 1        LOAD FORCE Y GLOBAL UNIFORM FRACTION W    -1.7599983
MEMBER 1        LOAD FORCE Y CONCENTRATED P    -49.5000000 L     30.0000000
LOADING - 41           LANE LOAD        FORWARD, PIVOT ON SECTION  4    MEMBER 1
MEMBER 1        LOAD FORCE Y GLOBAL UNIFORM FRACTION W    -1.7599983
MEMBER 1        LOAD FORCE Y CONCENTRATED P    -49.5000000 L     40.0000000
LOADING - 42           LANE LOAD        FORWARD, PIVOT ON SECTION  5    MEMBER 1
MEMBER 1        LOAD FORCE Y GLOBAL UNIFORM FRACTION W    -1.7599983
MEMBER 1        LOAD FORCE Y CONCENTRATED P    -49.5000000 L     50.0000000
LOADING - 43           LANE LOAD        FORWARD, PIVOT ON SECTION  6    MEMBER 1
MEMBER 1        LOAD FORCE Y GLOBAL UNIFORM FRACTION W    -1.7599983
MEMBER 1        LOAD FORCE Y CONCENTRATED P    -49.5000000 L     60.0000000
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LOADING - 44           LANE LOAD         FORWARD, PIVOT ON SECTION  0     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L      0.0
LOADING - 45           LANE LOAD         FORWARD, PIVOT ON SECTION  1     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     10.0000000
LOADING - 46           LANE LOAD         FORWARD, PIVOT ON SECTION  2     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     20.0000000
LOADING - 47           LANE LOAD         FORWARD, PIVOT ON SECTION  3     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     30.0000000
LOADING - 48           LANE LOAD         FORWARD, PIVOT ON SECTION  4     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     40.0000000
LOADING - 49           LANE LOAD         FORWARD, PIVOT ON SECTION  5     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     50.0000000
LOADING - 50           LANE LOAD         FORWARD, PIVOT ON SECTION  6     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     60.0000000
LOADING - 51           LANE LOAD         FORWARD, PIVOT ON SECTION, 7     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     70.0000000
LOADING - 52           LANE LOAD         FORWARD, PIVOT ON SECTION  8     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     80.0000000
LOADING - 53           LANE LOAD         FORWARD, PIVOT ON SECTION  9     MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     90.0000000
LOADING - 54           LANE LOAD         FORWARD, PIVOT ON SECTION  10    MEMBER 2
MEMBER 2         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 2         LOAD FORCE Y CONCENTRATED P    -49.5000000 L    100.0000000
LOADING - 55           LANE LOAD         FORWARD, PIVOT ON SECTION  0     MEMBER 3
MEMBER 3         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 3         LOAD FORCE Y CONCENTRATED P    -49.5000000 L      0.0
LOADING - 56           LANE LOAD         FORWARD, PIVOT ON SECTION  1     MEMBER 3
MEMBER 3         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 3         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     10.0000000
LOADING - 57           LANE LOAD         FORWARD, PIVOT ON SECTION  2     MEMBER 3
MEMBER 3         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 3         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     20.0000000
LOADING - 58           LANE LOAD         FORWARD, PIVOT ON SECTION  3     MEMBER 3
MEMBER 3         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 3         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     30.0000000
LOADING - 59           LANE LOAD         FORWARD, PIVOT ON SECTION  4     MEMBER 3
MEMBER 3         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 3         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     40.0000000
LOADING - 60           LANE LOAD         FORWARD, PIVOT ON SECTION  5     MEMBER 3
MEMBER 3         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 3         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     50.0000000
LOADING - 61           LANE LOAD         FORWARD, PIVOT ON SECTION  6     MEMBER 3
MEMBER 3         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 3         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     60.0000000
LOADING - 62           LANE LOAD         FORWARD, PIVOT ON SECTION  7     MEMBER 3
MEMBER 3         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 3         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     70.0000000
LOADING - 63           LANE LOAD         FORWARD, PIVOT ON SECTION  8     MEMBER 3
MEMBER 3         LOAD FORCE Y GLOBAL UNIFORM FRACTION W     -1.7599983
MEMBER 3         LOAD FORCE Y CONCENTRATED P    -49.5000000 L     80.0000000

$

LOAD LIST ALL

DUMP TIME

STIFFNESS ANALYSIS
TIME FOR CONSISTENCY CHECKS FOR     3 MEMBERS        2.54 SECONDS
TIME TO GENERATE      3 ELEMENT STIF. MATRICES       3.95 SECONDS
TIME TO PROCESS   201 MEMBER LOADS                 101.02 SECONDS
TIME TO ASSEMBLE THE STIFFNESS MATRIX                0.12 SECONDS
TIME TO PROCESS     4 JOINTS                         0.62 SECONDS REV. OCT 71 RAI
TIME TO SOLVE WITH     1 PARTITIONS                  0.50 SECONDS
TIME TO PROCESS      4 JOINT DISPLACEMENTS           0.75 SECONDS
TIME TO PROCESS     3 ELEMENT DISTORTIONS            3.45 SECONDS
TIME FOR STATICS CHECK                               1.27 SECONDS

LOAD LIST ALL BUT 1

OUTPUT DECIMAL 2

LIST FORCE ENVELOPE MEM 1 2 3 SEC FR DS 0 0.1
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*RESULTS OF LATEST ANALYSES*
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PROBLEM - MOVLOAD   TITLE - EXAMPLE SHOWING USE OF MOVING LOAD

ACTIVE UNITS FEET KIP RAD DEGF SEC

ACTIVE STRUCTURE TYPE PLANE   FRAME

ACTIVE COORDINATE AXES X Y

INTERNAL MEMBER RESULTS

MEMBER FORCE ENVELOPE

MEMBER 1

DISTANCE FROM START	/------ FORCE ------ AXIAL	Y SHEAR	Z SHEAR	TORSION	------MOMENT------ Y BENDING	Z BENDING
0.0 FR	0.0	41.16	0.0	0.0	0.0	0.00
		20				37
	0.0	-161.56	0.0	0.0	0.0	-0.00
		10				12
0.100	0.0	41.16	0.0	0.0	0.0	757.80
		20				12
	0.0	-126.30	0.0	0.0	0.0	-246.97
		12				20
0.200	0.0	41.16	0.0	0.0	0.0	1305.85
		20				11
	0.0	-82.30	0.0	0.0	0.0	-493.94
		12				20
0.300	0.0	41.16	0.0	0.0	0.0	1745.40
		20				12
	0.0	-82.30	0.0	0.0	0.0	-740.91
		12				20
0.400	0.0	41.16	0.0	0.0	0.0	1887.20
		20				12
	0.0	-41.58	0.0	0.0	0.0	-587.88
		15				20
0.500	0.0	52.51	0.0	0.0	0.0	2005.28
		11				13
	0.0	-37.51	0.0	0.0	0.0	-1234.86
		13				20
0.600	0.0	93.70	0.0	0.0	0.0	1702.34
		12				13
	0.0	-9.08	0.0	0.0	0.0	-1481.83
		30				20
0.700	0.0	95.65	0.0	0.0	0.0	1399.40
		14				13
	0.0	-9.08	0.0	0.0	0.0	-1728.80
		30				20
0.800	0.0	138.49	0.0	0.0	0.0	744.47
		13				13
	0.0	-9.08	0.0	0.0	0.0	-1975.77
		30				20
0.900	0.0	138.49	0.0	0.0	0.0	490.40
		13				30
	0.0	-9.08	0.0	0.0	0.0	-2222.74
		30				20
1.000	0.0	183.65	0.0	0.0	0.0	544.89
		14				30
	0.0	-9.08	0.0	0.0	0.0	-2469.71
		30				20

MEMBER 2

DISTANCE FROM START		/ AXIAL	FORCE Y SHEAR	Z SHEAR	// TORSION	MOMENT Y BENDING	Z BENDING
0.0	FR	0.0	22.89	0.0	0.0	0.0	544.89
			30				30
		0.0	-208.50	0.0	0.0	0.0	-2469.72
			19				20
0.100		0.0	22.89	0.0	0.0	0.0	316.04
			30				30
		0.0	-177.84	0.0	0.0	0.0	-966.07
			20				2
0.200		0.0	22.89	0.0	0.0	0.0	1206.89
			30				18
		0.0	-148.03	0.0	0.0	0.0	-715.73
			18				13
0.300		0.0	22.89	0.0	0.0	0.0	2203.96
			30				19
		0.0	-120.50	0.0	0.0	0.0	-592.88
			19				13
0.400		0.0	27.97	0.0	0.0	0.0	2883.83
			18				20
		0.0	-89.84	0.0	0.0	0.0	-470.03
			20				13
0.500		0.0	55.50	0.0	0.0	0.0	3149.21
			19				21
		0.0	-57.46	0.0	0.0	0.0	-599.38
			21				30
0.600		0.0	86.16	0.0	0.0	0.0	2959.97
			20				22
		0.0	-27.28	0.0	0.0	0.0	-828.23
			25				30
0.700		0.0	118.54	0.0	0.0	0.0	2332.79
			21				23
		0.0	-12.28	0.0	0.0	0.0	-1057.09
			13				30
0.800		0.0	151.21	0.0	0.0	0.0	1385.61
			22				23
		0.0	-12.28	0.0	0.0	0.0	-1285.94
			13				30
0.900		0.0	182.72	0.0	0.0	0.0	144.21
			23				13
		0.0	-12.28	0.0	0.0	0.0	-1514.79
			13				30
1.000		0.0	211.66	0.0	0.0	0.0	267.06
			24				13
		0.0	-12.28	0.0	0.0	0.0	-2395.53
			13				6

MEMBER 3

DISTANCE FROM START		/ AXIAL	FORCE Y SHEAR	Z SHEAR	// TORSION	MOMENT Y BENDING	Z BENDING
0.0	FR	0.0	3.34	0.0	0.0	0.0	267.06
			13				13
		0.0	-198.93	0.0	0.0	0.0	-2395.55
			29				6
0.100		0.0	3.34	0.0	0.0	0.0	240.36
			13				13
		0.0	-168.60	0.0	0.0	0.0	-1908.30
			27				22
0.200		0.0	3.34	0.0	0.0	0.0	952.64
			13				29
		0.0	-154.93	0.0	0.0	0.0	-1696.27
			29				22
0.300		0.0	3.34	0.0	0.0	0.0	1840.06
			13				29
		0.0	-125.23	0.0	0.0	0.0	-1484.24
			31				22
0.400		0.0	8.09	0.0	0.0	0.0	2551.48
			26				29
		0.0	-87.07	0.0	0.0	0.0	-1272.20
			32				22

0.500	0.0	33.88	0.0	0.0	0.0	3044.17
		28				30
	0.0	-75.70	0.0	0.0	0.0	-1060.17
		30				22
0.600	0.0	65.07	0.0	0.0	0.0	2945.74
		29				30
	0.0	-37.23	0.0	0.0	0.0	-848.14
		31				22
0.700	0.0	100.30	0.0	0.0	0.0	2671.31
		30				30
	0.0	-26.50	0.0	0.0	0.0	-636.10
		22				22
0.800	0.0	100.30	0.0	0.0	0.0	2264.38
		30				31
	0.0	-26.50	0.0	0.0	0.0	-424.07
		22				22
0.900	0.0	138.77	0.0	0.0	0.0	1239.49
		31				32
	0.0	-26.50	0.0	0.0	0.0	-212.04
		22				22
1.000	0.0	176.93	0.0	0.0	0.0	0.03
		32				32
	0.0	-26.50	0.0	0.0	0.0	-0.00
		22				22

LOAD LIST 1.

OUTPUT DECIMAL 2

LIST SEC FORCES MEM 1 2 3 SEC FR DS 0 0.1

```
******************************
*RESULTS OF LATEST ANALYSES*
******************************
```

PROBLEM - MOVLOAD   TITLE - EXAMPLE SHOWING USE OF MOVING LOAD

ACTIVE UNITS FEET KIP RAD DEGF SEC

ACTIVE STRUCTURE TYPE PLANE FRAME

ACTIVE COORDINATE AXES X Y

INTERNAL MEMBER RESULTS

MEMBER SECTION FORCES

MEMBER 1

LOADING 1   DEADLOAD

DISTANCE FROM START	/---------- FORCE ---------- AXIAL	Y SHEAR	Z SHEAR	//---------- MOMENT ---------- TORSION	Y BENDING	Z BENDING
0.0 FR	0.0	-65.28	0.0	0.0	0.0	0.00
0.100	0.0	-44.28	0.0	0.0	0.0	328.66
0.200	0.0	-23.28	0.0	0.0	0.0	531.31
0.300	0.0	-2.28	0.0	0.0	0.0	607.96
0.400	0.0	18.72	0.0	0.0	0.0	558.62
0.500	0.0	[illegible]	0.0	0.0	0.0	363.28
0.600	0.0	60.72	0.0	0.0	0.0	91.93
0.700	0.0	81.72	0.0	0.0	0.0	-345.41
0.800	0.0	102.72	0.0	0.0	0.0	-898.75
0.900	0.0	123.72	0.0	0.0	0.0	-1578.09
1.000	0.0	144.72	0.0	0.0	0.0	-2383.43

MEMBER 2

LOADING 1 DEADLOAD

DISTANCE FROM START	AXIAL	FORCE Y SHEAR	Z SHEAR	TORSION	Y BENDING	MOMENT Z BENDING
0.0 FR	0.0	-168.70	0.0	0.0	0.0	-2383.45
0.100	0.0	-133.71	0.0	0.0	0.0	-871.40
0.200	0.0	-98.71	0.0	0.0	0.0	290.65
0.300	0.0	-63.71	0.0	0.0	0.0	1102.70
0.400	0.0	-28.71	0.0	0.0	0.0	1564.75
0.500	0.0	6.29	0.0	0.0	0.0	1676.81
0.600	0.0	41.29	0.0	0.0	0.0	1438.86
0.700	0.0	76.29	0.0	0.0	0.0	850.91
0.800	0.0	111.29	0.0	0.0	0.0	-87.03
0.900	0.0	146.29	0.0	0.0	0.0	-1374.97
1.000	0.0	181.29	0.0	0.0	0.0	-3012.91

MEMBER 3

LOADING 1 DEADLOAD

DISTANCE FROM START	AXIAL	FORCE Y SHEAR	Z SHEAR	TORSION	Y BENDING	MOMENT Z BENDING
0.0 FR	0.0	-177.66	0.0	0.0	0.0	-3012.94
0.100	0.0	-149.66	0.0	0.0	0.0	-1703.65
0.200	0.0	-121.66	0.0	0.0	0.0	-618.36
0.300	0.0	-93.66	0.0	0.0	0.0	242.94
0.400	0.0	-65.66	0.0	0.0	0.0	880.23
0.500	0.0	-37.66	0.0	0.0	0.0	1293.52
0.600	0.0	-9.66	0.0	0.0	0.0	1482.82
0.700	0.0	18.34	0.0	0.0	0.0	1448.12
0.800	0.0	46.34	0.0	0.0	0.0	1189.41
0.900	0.0	74.34	0.0	0.0	0.0	706.72
1.000	0.0	102.34	0.0	0.0	0.0	0.02

FINISH

GOOD-BYE

6.7 Diagnostic Messages

1. *** STRUDL WARNING B.01 - MEMBER________USED IN SUPERSTRUCTURE

   HAS NOT BEEN DEFINED

   MEMBER IGNORED.

   Condition: User is attempting to define a superstructure using a member for which no member incidences have been previously specified. This member will not be included in the superstructure.

   Recommended Action: Define the member with a MEMBER INCIDENCES command and redefine the superstructure.

2. *** STRUDL ERROR B.02 - NO DECK MEMBERS SPECIFIED IN SUPER-

   STRUCTURE

   Condition: User is attempting to define a superstructure but has no previously defined members included in the superstructure list.

   Recommended Action: Define the members with a MEMBER INCIDENCES command and redefine the superstructure.

3. *** STRUDL WARNING B.03 - MEMBER________USED FOR LANE LOADING

   HAS NOT BEEN DEFINED

   MEMBER IGNORED.

   Condition: A member is included in the lane load uniform load list for which no member incidences have been previously specified. No uniform load will be placed on the member.

   Recommended Action: Check that a uniform load is required on the member.

4. *** STRUDL WARNING B.04 - MEMBER_________USED FOR LANE LOAD-

   ING HAS NOT BEEN INCLUDED IN THE

   SUPERSTRUCTURE

   MEMBER IGNORED

   Condition: A member is included in the lane load point load list which is not a superstructure member. The point load will not move over this member.

Recommended Action: Check that the point load is required to move over this member.

5. ***STRUDL WARNING B.05 - MEMBER________IS NOT CONTIGUOUS WITH

PREVIOUS MEMBER IN SUPERSTRUCTURE

JOINTS IN QUESTION - RIGHT END OF

MEMBER___BEING JOINT___AND LEFT

END OF MEMBER_____BEING JOINT_____

MEMBER IS INCLUDED IN DECKING AS

STATED

Condition: A superstructure is defined with members l-j,k-j instead of i-j,j-k. The vehicles will be assumed to move over the members i-j,k-j.

Recommended Action: Redefine the superstructure, prefixing the invalid member with the reverse modifier. ie i-j REV k-j Alternatively, redefine the MEMBER INCIDENCES and respecify the superstructure.

6. ***STRUDL WARNING B.06 - MEMBERS______ AND ________INTERSECT

AT ANGLE ________ USER UNITS

Condition: A superstructure is defined with the angle between two adjacent members being greater than the tolerance angle.

Recommended Action: Check that the superstructure does not accidently go down a pier, transversely across the deck, etc.

7. ***STRUDL ERROR B.07 - AN ATTEMPT HAS BEEN MADE TO DEFINE A

MOVING LOADING WITHOUT SPECIFYING A SUPERSTRUCTURE

Condition: Strudl Error B.02 has been ignored, or other STRUDL commands have been used.

Recommended Action: Define a valid superstructure.

8. ***STRUDL ERROR B.09 - NO SUPERSTRUCTURE HAS BEEN DEFINED

Condition: An attempt has been made to use the command MOVE, LANE or GENERATE without defining a SUPERSTRUCTURE. Note that after a GENERATE command, no superstructure remains defined. Also other STRUDL commands should not be used between the SUPERSTRUCTURE command and the GENERATE command.

Recommended Action: Specify a superstructure.

6.8 Abstract of Commands.

1. SUPERSTRUCTURE command

```
SUPERSTRUCTURE spec list spec list

          { ANGLE     v }
spec  =   { NUMBER    i }
          { REVERSE     }

          { 'a1' }      ( { 'a2' } )
list  =   {  i1  }      ( {  i2  } )     ....
```

2. MOVING LOAD command

```
MOVE (LOAD)  (direction) vehicle (direction) vehicle  ....

              { { FORWARD  } }
              { { FWD      } }
direction =   { { BACKWARD } }
              { { BWD      } }
              {   BOTH       }

              { TRUCK  (NP i1)  p1  d1  p2  .... }
              { { H20-S16-44 }                   }
vehicle =     { { HS20       }                   }
              { { H20-S16-T16 }                  }
              { { HST         }                  }
              { STANDARD i2                      }
```

3. LANE LOAD command

```
LANE (LOAD)  loads members loads members  ....

        * { P    v1 }
          { W    v2 }
```

```
              { ALL          }
members  =    { ALL BUT list }
              { list         }
```

```
          * { alphalist                   }
list  =     { integerlist                 }
            { n1  (TO      )   n2         }
            {     (THROUGH)               }
```

4. GENERATE LOADS command

```
                              {  X  }
GENERATE (LOADS)              { →Y  } [SCALE] v [INITIAL] i (  { PRINT } )
                              {  Z  }                          { PUNCH }
```

6.9 The addition of STANDARD Vehicles

The subroutine SBSTAN can be replaced in module QQFNMV to provide additional standard vehicles. This has been included to obviate the need to change the STRUDL dictionary and avoid the associated problems with SAVED files.

This subroutine uses STRUDL scratch common. The common variables are:

NAME	REL.ADD	DISPLACEMENT.	
		Hex.	Dec
11	81	140	320
TSTRT	95	178	376
NX	96	17C	380
125	105	1AO	416
TRX(P)	231	398	920
DFACTR	316	4EC	1260
WFACTR	317	4FO	1264

Il- Integer STANDARD truck number, as defined in the MOVE LOAD command. A computed GO TO selects the vehicle definition.

TSTRT- Integer pivot axle number. For most vehicles this will probably be either the centre axle (odd) or the axle immediately forward of the centre (even).

NX- Integer number of LOAD - SPACING entries in the truck array TRX.

I 25 - Integer vehicle number. The first standard vehicle will be number 6, etc.

TRX - One level, full word, dynamic array of alternate axle load, axle spacing values. These should be converted from the internal STRUDL units (pound, inch) to the current user units, i.e.

TRX (1)	= Load /WFACTR	(1st axle)
TRX (2)	= spacing /DFACTR	
TRX (3)	= Load /WFACTR	(2nd axle)
TRX(NX-1)	= spacingi-1/DFACTR	
TRX(NX)	= Loadi/WFACTR	(last axle)

DFACTR - Full word containing distance units conversion factor from active units to STRUDL standard units.

WFACTR - Full word containing force units conversion factor from active units to STRUDL standard units.

Subroutine SBSTAN finally TRANSFERS to module SBFNTR.