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# The Influence of Weights and Dimensions on the Stability and Control of Heavy Duty Trucks in Canada

Final Report

Volume II - Appendices A-B

Robert D. Ervin  
Yoram Guy

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| 16. Abstract<br><p>The stability and control characteristics of heavy-duty truck combinations used in Canada were determined as an aid for the development of new regulations on the weights and dimensions of vehicles in interprovincial trucking. Truck combinations which are currently in use in Canada were first identified through a survey activity. Parameters describing these vehicles were evaluated and an extensive computerized analysis of dynamic performance characteristics was conducted. Full-scale tests were run as a supplement to the computerized study for three of the selected vehicles.</p> <p>The results serve to classify the contrasting dynamic performance qualities of some 22 vehicle configurations, distinguished by number and placement of axles, number of trailers, and type of hitching mechanisms. Also, the sensitivity of the dynamic behavior of each configuration to variations in weights and dimensions, as well as certain component properties, is determined. Novel measures of performance were developed for characterizing (1) the dynamic stability of roll-coupled trailer combinations and the offtracking overshoot in a rapid path-change maneuver, and (2) the potential for low-speed jackknife while towing a trailer with multiple-wide-spread axles around a tight turn. Generalized performance evaluation techniques are outlined for future use in examining prospective new vehicle combinations.</p> |  |  |  |   |           |
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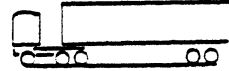
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APPENDIX A

DATA DESCRIBING TRUCK COMBINATIONS IN CANADA—COVERING  
EACH OF NINE BASIC TYPES OF CONFIGURATIONS

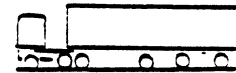
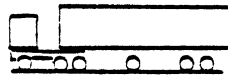
### Configuration 1.1. 3 AXLE TRACTOR + 2 AXLE SEMITRAILER



|                         | ONTARIO                                | QUEBEC   | N.E.                         | ALBERTA        | MANITOBA                      | B.C.                                    |
|-------------------------|--|--|------------------------------|----------------|-------------------------------|---|
| <u>Typical GCW :</u>    | 88...96K                               | 87...92K                                       | 80...87K                     | 80...82K       | 80K                           | 82...87K                                |
| <u>Overall Length :</u> | 23.0 m                                 | 21.0 m   | 20.0 m                       | 20.0 m         | 20.0 m                        | 20.0 m                                  |
| <u>Tandem Axles :</u>   |  |  | 35.3 @ 48"                   |                |                               |   |
| Load @ Spread           | 37.9 @ 51..55"                         | 38.6 @ 59">                                    | 36.4 @ 54"                   | 35.3 @ --      | 35.3 @ --                     | 36.4 @ 59">                             |
| [K*]                    | 39.5 @ 60..63"                         | 39.7 @ 60"<                                    | 37.5 @ 60"                   |                |                               | 37.5 @ 59..73"                          |
|                         | 42.1 @ 71"<                            |  | 39.7 @ 72"                   |                |                               |   |
| <u>Typical Tractor</u>  |  |  |                              |                |                               |   |
| Front Axle Load         | 12K                                    | 10...12K                                       | 9...10K                      | 10...12K       | 10K                           | 10...12K                                |
| Wheelbase (a)           | 144...200"                             | 144...190"                                     | 155...220"                   | 190...220"     | 140...200"                    | 180...220"                              |
| 5th Wheel Offset (c)    | 7...14"                                | 3" (?)   | 0...16"                      | 0...6"         | 6...16"                       | 0...12"                                 |
| <u>Rear Suspension</u>  |  |  |                              |                |                               |   |
| - Tandem Spread         | 52, 54, 60, 72"                        | 54, 60"  | 48, 54, 60"                  | 54, 60"        | 49, 52, 55"                   | 54, 60"                                 |
| - Makes/Types:          | RTE.340..380<br>Hndrksn/Rubber<br>Air  | RTE.360..440<br>Nwry / Air 40K                 | RTE.380..440<br>Mack "Camel" | <u>RTE.380</u> | RTE.340..380<br>Hndrksn/Visc. | Hndrksn/Rubber<br>Air<br>Reyco/4 Spring |
| - Typical Load :        | 38...42K                               | 38.5...40K                                     | 35...37.5K                   | 35K            | 35K                           | 36...37.5K                              |
| - Load Ratings :        | 38, 40, 44K                            | 38...44K                                       | 38, 44K                      | 38, 40K        | 38K                           | 38...44K                                |
| <u>Typical Trailer</u>  |  |  |                              |                |                               |   |
| Overall Length:         | 45...48 FT                             | 45...48 FT                                     | 40...48 FT                   | 45...48 FT     | 45...48 FT                    | 45...48 FT                              |
| King Pin Setting        | 36"                                    | 36"  | 32...36"                     | (30"), 36"     | 36"                           | 30...36"                                |
| Rr Overhang (d)         | 30...100"                              | 30...100"                                      | 30...90"                     | 36...60"       | 30...45"                      | 30"                                     |
| <u>Suspension</u>       |  |  |                              |                |                               |   |
| - Tandem Spread         | 72"                                    | 72"  | 48, 60, 72"                  | 54, 60"        | 45 (?), 60"                   | 54, 60"                                 |
| - Makes/Types:          | 4 Spring (misc)<br>Air<br>Chalmers/Rbr | Reyco-21-B<br>Chalmers/Rbr<br>Nwry / Air ,Frhf | Reyco/4 Sprg<br>Freuhauf     | Reyco/4 Sprg   | Reyco/4 Sprg<br>Freuhauf/1 Lf | Reyco-21-B                              |
| - Typical Load :        | 38...42K                               | 40K  | 35...40K                     | 35K            | 35K                           | 36...37.5K                              |
| - Load Ratings :        | 38...44K                               | 44K  | 38, 44K                      | 40...44K       | 38K                           | 38...44K                                |



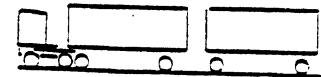
**Configuration 1.2. 3 AXLE TRACTOR + 2 AXLE SEMITRAILER  
+ BELLY AXLE**



|                         | ONTARIO                               | QUEBEC                        | N.B.                         | ALBERTA | MANITOBA | B.C.                                    |
|-------------------------|---------------------------------------|-------------------------------|------------------------------|---------|----------|---|
| <u>Typical GCW :</u>    | 116...118K                            | 114...118K                    | 105...108K                   |         |          | 103...107K                              |
| <u>Overall Length :</u> | 23.0 m                                | 21.0 m                        | 20. m, 21. (*)               |         |          | 20. m, 23. (*)                          |
| <u>Tandem Axles :</u>   |                                       |                               | 35.3 @ 48"                   |         |          |   |
| Load @ Spread           | 37.9 @ 51..55"                        | 38.6 @ 59">                   | 36.4 @ 54"                   |         |          | 36.4 @ 59">                             |
| [K*]                    | 39.5 @ 60..63"                        | 39.7 @ 60"<                   | 37.5 @ 60"                   |         |          | 37.5 @ 59..73"                          |
|                         | 42.1 @ 71"<                           |                               | 39.7 @ 72"                   |         |          |   |
| <u>Typical Tractor</u>  |                                       |                               |                              |         |          |   |
| Front Axle Load         | 12K                                   | 9..11.5, <14K                 | 9...10K                      |         |          | 11...12K                                |
| Wheelbase (a)           | 152,186,214"                          | 144...190"                    | 155...220"                   |         |          | 180...220"                              |
| 5thWl Offset (c)        | 7...14"                               | 3" (?)                        | 0...16"                      |         |          | 0...12"                                 |
| <u>Rear Suspension</u>  |                                       |                               |                              |         |          |   |
| -Tandem Spread          | 72"                                   | 54, 60"                       | 60"                          |         |          | 60"                                     |
| - Makes/Types:          | RTE.340..380<br>Hndrksn/Rubber<br>Air | RTE.360..440<br>Nwy / Air 40K | RTE.380..440<br>Mack "Camel" |         |          | Hndrksn/Rubber<br>Air<br>Reyco/4 Spring |
| - Typical Load :        | 38...42K                              | 38.5...40K                    | 35..37.5K                    |         |          | 36...37.5K                              |
| - Load Ratings :        | 44K                                   | 38...44K                      | 38, 44K                      |         |          | 38...44K                                |
| <u>Typical Trailer</u>  |                                       |                               |                              |         |          |   |
| Overall Length:         | 45...48 FT                            | 45...48 FT                    | 45 FT                        |         |          | 45 FT                                   |
| King Pin Setting        | 36"                                   | 36"                           | 32...36"                     |         |          | 18...36"                                |
| Rr Overhang (d)         | 30"                                   | 40...72"                      | 30"                          |         |          | 30"                                     |
| <u>Rear Suspension</u>  |                                       |                               |                              |         |          |   |
| -Tandem Spread          | 72"                                   | 72, 96"(**)                   | 72"                          |         |          | 54, 60"                                 |
| - Makes/Types:          | 4 Spring (misc)<br>Neway / Air        | Reyco-21-B                    | Reyco/4 Sprg<br>Freuhauf     |         |          | Reyco-21-B                              |
| - Typical Load :        | 42K                                   | 40, 44K(**)                   | 40K                          |         |          | 36...37.5K                              |
| - Load Ratings :        | 44K                                   | 44K                           | 38, 44K                      |         |          | 38...44K                                |
| <u>Belly Axle</u>       |                                       |                               |                              | NONE    | NONE     |   |
| Location (e) :          | 16 FT                                 | 16 FT                         | 16 FT                        |         |          | "midway"                                |
| <u>Suspension :</u>     |                                       |                               |                              |         |          |   |
| - Makes/Types:          | Neway / Air                           | Air                           | Neway / Air                  |         |          | CESCHI / Air                            |
| - Typical Load :        | 20...22K                              | 22K                           | 18...20K                     |         |          | 20K                                     |
| - Load Ratings :        | 22.5K                                 | 23K                           | 20...23K                     |         |          | 23K                                     |
| - Self Steered :        | -- ? --                               | Allowed(***)                  | -- ? --                      |         |          | Required                                |

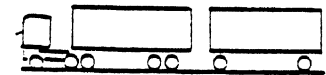
- (\*) High value if distance from foremost kingpin to rear end does not exceed 16.75m (55 FT).  
 (\*\*) Any adjacent axles separated 96" or more are considered as singles (= allowed 22K each).  
 (\*\*\*) Either belly axle (#4) or last axle (#6) may self-steer.

Configuration 2.1. 5 & 6 AXLE A & C-TRAIN DOUBLES  
(2 OR 3 AXLE TRACTOR)



|                         | ONTARIO        | QUEBEC | N.B.  | ALBERTA    | MANITOBA     | B.C.              |
|-------------------------|----------------|--------|-------|------------|--------------|-------------------|
| <u>Train Type</u> :     | A, C           | (N/A)  | (N/A) | A, C       | A, C         | A                 |
| <u>Num. of Axles</u> :  | 5              |        |       | 6          | 6            | 6                 |
| <u>Typical GCW</u> :    | 100K           |        |       | 102...104K | 103K         | 95...109K         |
| <u>Overall Length</u> : | 23.0 m         |        |       | 23.0 m     | 23.0 m       | 23.0 m            |
| <u>Tandem Axles</u> :   |                |        |       |            |              |                   |
| Load @ Spread           | 37.9 @ 51..55" |        |       | 35.3 @ --  | 35.3 @ --    | 36.4 @ 59">       |
| [K*]                    | 39.5 @ 60..63" |        |       |            |              | 37.5 @ 59..73"    |
|                         | 42.1 @ 71"<    |        |       |            |              |                   |
| <u>Typical Tractor</u>  |                |        |       |            |              |                   |
| Front Axle Load         | 12K            |        |       | 10...12K   | 12K          | 10...12K          |
| Wheelbase (a)           | 121...142"     |        |       | 190"       | 140"...(?)   | 180...220"        |
| 5thW1 Offset (c)        | -- ? --        |        |       | 6...8"     | -- ? --      | 0...12" (?)       |
| Rear Suspension         |                |        |       |            |              |                   |
| -Tandem Spread          | 0.             |        |       | 54, 60"    | 49, 52, 55"  | 60"               |
| -Makes/Types:           | misc.          |        |       | RTE.380    | RTE.340..380 | Hndrksn/Rubber    |
|                         |                |        |       |            |              | Hndrksn/Visc. Air |
|                         |                |        |       |            |              | Reyco/4 Spring    |
| - Typical Load :        | 22K            |        |       | 35K        | 35K          | 25...37K          |
| - Load Ratings :        | 23K            |        |       | 38, 40K    | 38K          | 38...44K          |
| <u>Front Trailer</u>    |                |        |       |            |              |                   |
| Bed Length (b) :        | 27...28 FT     |        |       | 26...28 FT | 27 FT        | 27...28 FT        |
| King Pin Setting        | 36"            |        |       | 36"        | 36"          | 24...36"          |
| Rr Overhang (d)         | 30"            |        |       | 30"        | 30"          | 30"               |
| Suspension :            |                |        |       |            |              |                   |
| - Typical Load :        | 22K            |        |       | 18K        | 18K          | 20K               |
| - Load Ratings :        | 22K            |        |       | 22K        | 20, 22, 23K  | 22K               |
| <u>Rear Trailer</u>     |                |        |       |            |              |                   |
| Bed Length (f) :        | 27...28 FT     |        |       | 26...26 FT | 27 FT        | 27...28 FT        |
| King Pin Setting        | 36"            |        |       | 36"        | 36"          | 30...36"          |
| Drawbar Length          | 72"            |        |       | 76"        | 72"          | 72"               |
| Rr Overhang (g)         | 30"            |        |       | 30"        | 30"          | 30"               |
| Dolly Axle :            |                |        |       |            |              |                   |
| - Typical Load :        | 22K            |        |       | 19K        | 18K          | 20K               |
| - Load Ratings :        | 22K            |        |       | 22K        | 20, 22, 23K  | 22K               |
| Rear Axle :             |                |        |       |            |              |                   |
| - Typical Load :        | 22K            |        |       | 20K        | 20K          | 20K               |
| - Load Ratings :        | 22K            |        |       | 22K        | 20, 22, 23K  | 22K               |

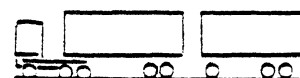
**Configuration 2.2. 7 AXLE A & C-TRAIN DOUBLES  
(2 AXLE SEMI & 2 AXLE PUP)**



|                         | <u>ONTARIO</u> | <u>QUEBEC</u> | <u>N.B.</u> | <u>ALBERTA</u> | <u>MANITOBA</u>               | <u>B.C.</u> |
|-------------------------|----------------|---------------|-------------|----------------|-------------------------------|-------------|
| <u>Train Type</u> :     |                |               |             | A, C           | A, C                          |             |
| <u>Typical GCW</u> :    |                |               |             | 118K>          | 120K                          |             |
| <u>Overall Length</u> : |                |               |             | 23.0 m         | 23.0 m                        |             |
| <u>Tandem Axles</u> :   |                |               |             |                |                               |             |
| Load @ Spread<br>[K*]   |                |               |             | 35.3 @ --      | 35.3 @ --                     |             |
| <u>Typical Tractor</u>  |                |               |             |                |                               |             |
| Front Axle Load         |                |               |             | 10K            | 10K                           |             |
| Wheelbase (a)           |                |               |             | 190"(?)        | 140"...(?)                    |             |
| 5th/11 Offset (c)       |                |               |             | 0...6" (?)     | 17" (?)                       |             |
| Rear Suspension         |                |               |             |                |                               |             |
| -Tandem Spread          |                |               |             | 54, 60"        | 50"                           |             |
| -Makes/Types :          |                |               |             | <u>RTE.380</u> | RTE.340..380<br>Hndrksn/Visc. |             |
| -Typical Load :         |                |               |             | 35K            | 35K                           |             |
| -Load Ratings :         |                |               |             | 38, 40K        | 38K                           |             |
| <u>Front Trailer</u>    |                |               |             |                |                               |             |
| Bed Length (*) :        |                |               |             | 32...36 FT     | 38..40,[27] FT                |             |
| King Pin Setting        |                |               |             | -- ? --        | -- ? --                       |             |
| Rr Overhang (d)         |                |               |             | 30"            | 30"                           |             |
| Suspension :            |                |               |             |                |                               |             |
| -Tandem Spread          |                |               |             | 54, 60"        | 49", (60" ?)                  |             |
| -Typical Load :         |                |               |             | 35K            | 35K                           |             |
| -Load Ratings :         |                |               |             | 38K            | 38K                           |             |
| <u>Rear Trailer</u>     |                |               |             |                |                               |             |
| Bed Length (*) :        |                |               |             | 16...20 FT(*)  | 18, [27] FT                   |             |
| King Pin Setting        |                |               |             | 24" (*,**)     | -- ? --                       |             |
| Drawbar Length          |                |               |             | 72, 108" (*)   | 72, 102"                      |             |
| Rr Overhang(g)          |                |               |             | 30"            | 30, 36"                       |             |
| Dolly Axle :            |                |               |             |                |                               |             |
| -Typical Load :         |                |               |             | 18K (*)        | 20K                           |             |
| -Load Ratings :         |                |               |             | 22K            | 20, 22, <u>23K</u>            |             |
| Rear axle :             |                |               |             |                |                               |             |
| -Typical Load :         |                |               |             | 20K (*)        | 20K                           |             |
| -Load Ratings :         |                |               |             | 22K            | 20, 22, <u>23K</u>            |             |

(\*) Lengths apply mainly for tankers, except those in [brackets] which refer to general freight trailers.  
 (\*) Adjacent axles separated 3.5m (138") or more are treated as singles (allowed 20K each).  
 (\*\*) For a 16 FT bed.

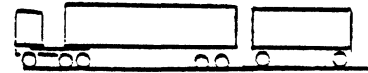
**Configuration 2.4. 8 AXLE A & C-TRAIN DOUBLES  
(SINGLE AXLE DOLLY)**



|                         | ONTARIO                               | QUEBEC                       | N.B. | ALBERTA      | MANITOBA                      | B.C.                                    |
|-------------------------|---------------------------------------|------------------------------|------|--------------|-------------------------------|---|
| <u>Train Type</u> :     | A, C                                  | A, C                         |      | A, C         | A, C                          | A.                                      |
| <u>Typical GCW</u> :    | 140K>                                 | 127K>                        |      | 118K>        | 125K>                         | 126K                                    |
| <u>Overall Length</u> : | 23.0 m                                | 21.0m                        |      | 23.0 m       | 23.0 m                        | 23.0 m                                  |
| <u>Tandem Axles</u> :   |                                       |                              |      |              |                               |   |
| Load @ Spread           | 37.9 @ 51..55"                        | 38.6 @ 59">                  |      | 35.3 @ --    | 35.3 @ --                     | 36.4 @ 59">                             |
| [K*]                    | 39.5 @ 60..63"<br>42.1 @ 71"<         | 39.7 @ 60"<                  |      |              |                               | 37.5 @ 59..73"                          |
| <u>Typical Tractor</u>  |                                       |                              |      |              |                               |   |
| Front Axle Load         | 9...12K                               | 10...12K                     |      | 9...10K      | 10K                           | 10...12K                                |
| Wheelbase (a)           | 152">=                                | 144"...(?)                   |      | 190"(?)      | 140"...(?)                    | 180"...(?)                              |
| 5thWl Offset (c)        | 7...14" (?)                           | 3" (?)                       |      | 0...6"       | 17"                           | 0...12" (?)                             |
| Rear Suspension         |                                       |                              |      |              |                               |   |
| -Tandem Spread          | 52,54,60,72"                          | 54, 60"                      |      | 54, 60"      | 50"                           | 54, 60"                                 |
| - Makes/Types:          | RTE.340..380<br>Hndrksn/Rubber<br>Air | RTE.360..440<br>Nwry/Air 40K |      | RTE.380      | RTE.340..380<br>Hndrksn/Visc. | Hndrksn/Rubber<br>Air<br>Reyco/4 Spring |
| - Typical Load :        | 36K                                   | 35...38K                     |      | 32...33K     | 32K                           | 36K                                     |
| - Load Ratings :        | 38, 40, 44K                           | 38...44K                     |      | 38, 40K      | 38K                           | 38...44K                                |
| <u>Front Trailer</u>    |                                       |                              |      |              |                               |   |
| Bed Length (b) :        | 27 FT                                 | 27 FT                        |      | 27 FT        | 38.5 FT                       | 27 FT                                   |
| King Pin Setting        | 36"                                   | 36"                          |      | 36"          | 36"                           | 36"                                     |
| Rr Overhang (d)         | 30"                                   | 30, 48" (*)                  |      | 30"          | 35" (*)                       | 30"                                     |
| Suspension              |                                       |                              |      |              |                               |   |
| -Tandem Spread          | 72"                                   | 48"                          |      | 54, 60"      | 65.5"                         | 60"                                     |
| - Typical Load :        | 36K (?)                               | 35...38K                     |      | 22...28K     | 32K                           | 32K (**)                                |
| - Load Ratings :        | 38...44K                              | 44K                          |      | 38...44K     | 38K                           | 38...44K                                |
| <u>Rear Trailer</u>     |                                       |                              |      |              |                               |   |
| Bed Length (f) :        | 27 FT                                 | 27 FT                        |      | 27 FT        | 22 FT (*)                     | 27...28 FT                              |
| King Pin Setting        | 24"                                   | 24"                          |      | 24"          | 18"                           | 30"                                     |
| Drawbar Length          | 72" (?)                               | 72"                          |      | 76"          | 104" (*)                      | 132" (**)                               |
| Rr Overhang(g):         | 30" (?)                               | 30" (?) (***)                |      | 30"          | 55"                           | 30"                                     |
| Dolly Axle :            |                                       |                              |      | (Reyco-21-B) |                               |   |
| - Typical Load :        | 18K                                   | 22K                          |      | 15K          | 19K                           | 16K (**)                                |
| - Load Ratings :        | 22, 23K                               | 22, 23K                      |      | 22, 23K      | 22, 23K                       | 22, 23K                                 |
| Rear Suspension         |                                       |                              |      |              |                               |   |
| -Tandem Spread          | 72"                                   | 48"                          |      | 54, 60"      | 49"                           | 60"                                     |
| - Typical Load :        | 36K                                   | 35...38K                     |      | 32...33K     | 32K                           | 30K                                     |
| - Load Ratings :        | 38...44K                              | 44K                          |      | 38...44K     | 38K                           | 38...44K                                |

NOTE : All typical axle loads are estimated, based on regulated GCW and/or axle-group load limits.  
 (\*) Minimum wheelbase over axles #4 thru #6 is 168" for a 60K load on that group.  
 (\*\*) Minimum wheelbase over axles #4 thru #6 is 162" for a 48.5K load on that group.  
 (\*\*\*) Minimum wheelbase over axles #2 thru #8 is 15.5m (50'10").  
 (\*) Minimum inner wheelbase from a tandem to a single axle is 3.5m (139"), or load limits go down.

Configuration 2.3. ROCKY MOUNTAIN DOUBLES  
(2 AXLE SEMI & 2 AXLE PUP)



|                         | ONTARIO | QUEBEC | N.B. | ALBERTA        | MANITOBA           | B.C. |
|-------------------------|---------|--------|------|----------------|--------------------|------|
| <u>Train Type</u> :     |         |        |      | A              | A                  |      |
| <u>Typical GCW</u> :    |         |        |      | 94K (*)        | 120K               |      |
| <u>Overall Length</u> : |         |        |      | 31.0 m (~)     | 31.0 m (~)         |      |
| <u>Tandem Axles</u> :   |         |        |      |                |                    |      |
| Load @ Spread [K*]      |         |        |      | 35.3 @ --      | 35.3 @ --          |      |
| <u>Typical Tractor</u>  |         |        |      |                |                    |      |
| Front Axle Load         |         |        |      | 10K            | 10K                |      |
| Wheelbase (a)           |         |        |      | 190" (?)       | 140" ... (?)       |      |
| 5th Wl Offset (c)       |         |        |      | 0...6" (?)     | 17" (?)            |      |
| Rear Suspension         |         |        |      |                |                    |      |
| -Tandem Spread          |         |        |      | 54, 60"        | 50"                |      |
| -Makes/Types:           |         |        |      | <u>RTE.380</u> | RTE.340..380       |      |
| Hndrksn/Visc.           |         |        |      |                |                    |      |
| -Typical Load :         |         |        |      | 28K (*)        | 35K                |      |
| -Load Ratings :         |         |        |      | 38, 40K        | 38K                |      |
| <u>Front Trailer</u>    |         |        |      |                |                    |      |
| Bed Length (b):         |         |        |      | 45 FT          | 45 FT              |      |
| King Pin Setting        |         |        |      | 36"            | 36"                |      |
| Rr Overhang (d)         |         |        |      | 30"            | 30"                |      |
| Suspension :            |         |        |      |                |                    |      |
| -Tandem Spread          |         |        |      | 54, 60"        | 49", 60" (?)       |      |
| -Typical Load :         |         |        |      | 28K (*)        | 35K                |      |
| -Load Ratings :         |         |        |      | 38K            | 38K                |      |
| <u>Rear Trailer</u>     |         |        |      |                |                    |      |
| Bed Length (f):         |         |        |      | 27, 30 FT      | 27 FT              |      |
| King Pin Setting        |         |        |      | 36"            | 36"                |      |
| Drawbar Length          |         |        |      | 72"            | 72"                |      |
| Rr Overhang(g):         |         |        |      | 30"            | 30"                |      |
| Dolly Axle :            |         |        |      |                |                    |      |
| -Typical Load :         |         |        |      | 14K (*)        | 20K                |      |
| -Load Ratings :         |         |        |      | 22, 23K        | 20, 22, <u>23K</u> |      |
| Rear axle :             |         |        |      |                |                    |      |
| -Typical Load :         |         |        |      | 14K (*)        | 20K                |      |
| -Load Ratings :         |         |        |      | 22, 23K        | 20, 22, <u>23K</u> |      |

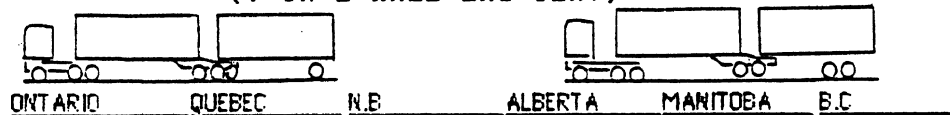
(\*) Typical GCW and axle loads are estimated, assuming uniform cargo densities, to account for a combined load limit of 42K on axles #4 thru #6.

**Configuration 3.1. A & C-TRAIN TRIPLES  
(1 AXLE DOLLIES, SINGLE OR TANDEM REARS)**



|                            | ALBERTA        | MANITOBA                      | B.C. |
|----------------------------|----------------|-------------------------------|------|
| <u>Train Type</u> :        | A, C           | A                             |      |
| <u>Num. of Axles</u> :     | 11, [8]        | 8                             |      |
| <u>Typical GCW</u> :       | 118K>          | 125K>                         |      |
| <u>Overall Length</u> :    | 31.0 m (~)     | 31.0 m (~)                    |      |
| <u>Tandem Axles</u> :      |                |                               |      |
| Load @ Spread [K#]         | 35.3 @ --      | 35.3 @ --                     |      |
| <u>Typical Tractor</u>     |                |                               |      |
| Front Axle Load            | 10K            | 10K                           |      |
| Wheelbase (a)              | 190" (?)       | 140" ... (?)                  |      |
| 5thW1 Offset (c)           | 0...6" (?)     | 17" (?)                       |      |
| Rear Suspension            |                |                               |      |
| - Tandem Spread            | 54, 60"        | 50"                           |      |
| - Makes/Types              | <u>RTE.380</u> | RTE.340..380<br>Hndrksn/Visc. |      |
| - Typical Load :           | 18K            | 20K                           |      |
| - Load Ratings :           | 38, 40K        | 38K                           |      |
| <u>Semitrailer #1</u>      |                |                               |      |
| Bed Length (b):            | 26...28 FT     | 27 FT                         |      |
| King Pin Setting           | -- ? --        | -- ? --                       |      |
| Rr Overhang (d)            | 30"            | 30"                           |      |
| Suspension :               |                |                               |      |
| - Tandem Spread            | 54, 60", [0.]  | 0.                            |      |
| - Typical Load :           | 18K            | 19K                           |      |
| - Load Ratings :           | 38..44K, [22K] | 20, 22, <u>23K</u>            |      |
| <u>Trailers #2 &amp; 3</u> |                |                               |      |
| Bed Length (f):            | 26...28 FT     | 27 FT                         |      |
| King Pin Setting           | 24"            | -- ? --                       |      |
| Drawbar Length             | 72"            | 72, 102"                      |      |
| Rr Overhang(g):            | 30"            | 30, 36"                       |      |
| Dolly Axle :               |                |                               |      |
| - Typical Load :           | 18K            | 19K                           |      |
| - Load Ratings :           | 22K            | 20, 22, <u>23K</u>            |      |
| Rear Suspension            |                |                               |      |
| - Tandem Spread            | 54, 60", [0.]  | 0.                            |      |
| - Typical Load :           | 18K            | 19K                           |      |
| - Load Ratings :           | 38..44K, [22K] | 20, 22, <u>23K</u>            |      |

**Configuration 4.1. 6 & 7 AXLE B-TRAIN DOUBLES  
(1 OR 2 AXLE 2nd SEMI)**



|                         | ONTARIO                               | QUEBEC                         | N.B. | ALBERTA       | MANITOBA                          | B.C.                                    |
|-------------------------|---------------------------------------|--------------------------------|------|---------------|-----------------------------------|---|
| <u>Num. of Axles :</u>  | 6                                     | 7                              |      | 7             | 7                                 | 7                                       |
| <u>Typical GCW :</u>    | 114K                                  | 124..126K                      |      | 115..117K     | 115..117K                         | 125.5K                                  |
| <u>Overall Length :</u> | 23.0 m                                | 21.0 m                         |      | 23.0 m        | 23.0 m                            | 23.0 m                                  |
| <u>Tandem Axles :</u>   |                                       |                                |      |               |                                   |   |
| Load @ Spread           | 37.9 @ 51..55"                        | 38.6 @ 59">                    |      | 35.3 @ --     | 35.3 @ --                         | 36.4 @ 59">                             |
| [K*]                    | 39.5 @ 60..63"                        | 39.7 @ 60"<                    |      |               |                                   | 37.5 @ 59..73"                          |
|                         | 42.1 @ 71"<                           |                                |      |               |                                   |   |
| <u>Typical Tractor</u>  |                                       |                                |      |               |                                   |   |
| Front Axle Load         | 12K                                   | 10...12K                       |      | 10...12K      | 10...12K                          | 13K                                     |
| Wheelbase (a)           | 162" (?)                              | 144...190"                     |      | 190...220"    | 140...200"                        | 180...220"                              |
| 5th Wl Offset (c)       | 7...14"                               | 3" (?)                         |      | 0...24"       | 6"                                | 0...12" (?)                             |
| Rear Suspension         |                                       |                                |      |               |                                   |   |
| -Tandem Spread          | 52"                                   | 54, 60"                        |      | 54, 60"       | 49, 52, 55"                       | 54, 60"                                 |
| -Makes/Types:           | RTE.340..380<br>Hndrksn/Rubber<br>Air | RTE.360..440<br>Nwry / Air 40K |      | RTE.380       | RTE.340..380<br>Hndrksn/Visc. Air | Hndrksn/Rubber<br>Air<br>Reyco/4 Spring |
| -Typical Load :         | 38K                                   | 38K                            |      | 35K (*)       | 35K                               | 37.5K                                   |
| -Load Ratings :         | 38, 40, 44K                           | 38...44K                       |      | 38, 40K       | 38K                               | 38...44K                                |
| <u>Front Trailer</u>    |                                       |                                |      |               |                                   |   |
| Bed Length (b) :        | 27...32 FT                            | 26 FT                          |      | 26, 28, 30 FT | 26 FT                             | 27...28 FT (**)                         |
| King Pin Setting        | 36" (?)                               | 24"                            |      | 48..60, <88"  | 36", (80")                        | 30"                                     |
| 5th Wl Set (***)        | 0"                                    | 0"                             |      | 0"            | 0"                                | 0"                                      |
| Suspension              |                                       |                                |      |               |                                   |   |
| -Tandem Spread          | 72"                                   | 48"                            |      | 72"           | 66"                               | 60...72"                                |
| -Makes/Types:           | Reyco/4 Sprg                          | Reyco/4 Sprg                   |      | Reyco/4 Sprg  | Reyco/4 Sprg<br>Neway / Air       | Reyco-21-B                              |
| -Typical Load :         | 42K                                   | 38K                            |      | 35K (*)       | 35K                               | 37.5K                                   |
| -Load Ratings :         | 44K                                   | 44K                            |      | 40...44K      | 38K                               | 38...44K                                |
| <u>Rear Trailer</u>     |                                       |                                |      |               |                                   |   |
| Bed Length (e) :        | 24...27 FT                            | 26 FT                          |      | 26, 28, 29 FT | 28 FT                             | 27...28 FT (**)                         |
| King Pin Setting        | 30"                                   | 24"                            |      | 24...30"      | 18"                               | 12...30"                                |
| Rr Overhang(f) :        | 30"                                   | 30"                            |      | 60...72"      | 30...50"                          | 26...30"                                |
| Suspension              |                                       |                                |      |               |                                   |   |
| -Tandem Spread          | 0.                                    | 48"                            |      | 54...72"      | 49" (?)                           | 60"                                     |
| -Makes/Types:           | Reyco/4 Sprg                          | Reyco/4 Sprg                   |      | Reyco/4 Sprg  | Reyco/4 sprg                      | Reyco/4 Sprg                            |
| -Typical Load :         | 22K                                   | 38K                            |      | 35K (*)       | 35K                               | 37.5K                                   |
| -Load Ratings :         | 22, 23K                               | 44K                            |      | 40...44K      | 38K                               | 38...44K                                |

NOTE : The typical GCW and axle loads shown may require non-uniform cargo densities, or be lower.  
 (\*) In order to allow 70,500 lb (total) on two adjacent tandems, inner wheelbase must be  $\geq$  16.4FT.  
 (\*\*) Inner wheelbase between two adjacent tandems must be  $\geq$  26.25FT.  
 (\*\*\*) 5th wheel setback on front trailer is relative to rearmost axle centerline (positive behind axle).

Configuration 4.2. 8 AXLE B-TRAIN DOUBLES (3-AXLE 1st SEMI,  
OR 2-AXLE SEMI'S + 1 BELLY AXLE)



|                         | ONTARIO   | QUEBEC                      | N.B. | ALBERTA | MANITOBA | B.C.                           |
|-------------------------|---|-----------------------------|------|---------|----------|--------------------------------|
| <u>Typical GCW :</u>    | 140K>   | 127K>                       |      |         |          | 140K>                          |
| <u>Overall Length :</u> | 23.0 m  | 21.0 m                      |      |         |          | 23.0 m                         |
| <u>Tandem Axles :</u>   |   |                             |      |         |          |                                |
| Load @ Spread [K*]      | 37.9 @ 51..55"<br>39.5 @ 60..63"<br>42.1 @ 71"< | 38.6 @ 59"<br>39.7 @ 60"<   |      |         |          | 36.4 @ 59"><br>37.5 @ 59..73"  |
| <u>Typical Tractor</u>  |   |                             |      |         |          |                                |
| Front Axle Load         | 12K   | 10K                         |      |         |          | 13K                            |
| axle Setback :          | 48"   | 26"                         |      |         |          | 26"                            |
| Wheelbase (a)           | 162" (?)  | 144...190"                  |      |         |          | 180...220"                     |
| 5thWl Offset (c)        | 7...14"   | 3" (?)                      |      |         |          | 0...12" (?)                    |
| <u>Rear Suspension</u>  |   |                             |      |         |          |                                |
| -Tandem Spread          | 72"   | 54, 60"                     |      |         |          | 54, 60"                        |
| - Makes/Types:          | RTE.340..380<br>Hndr/Rbr,Air                    | RTE.360..440<br>Nwy/Air 40K |      |         |          | Hndrksn/Rubber<br>"Reyco", Air |
| - Typical Load :        | 36K   | 36K                         |      |         |          | 37.5K                          |
| - Load Ratings :        | 44K   | 44K                         |      |         |          | 38...44K                       |
| <u>Front Trailer</u>    |   |                             |      |         |          |                                |
| Bed Length (b) :        | 32 FT   | 26 FT (*)                   |      |         |          | 32/27 FT (*)                   |
| King Pin Setting        | 55"   | 24" (?)                     |      |         |          | 60"                            |
| 5thWl Set (**)          | 0"  | 0"                          |      |         |          | 0"                             |
| <u>Suspension</u>       |   |                             |      |         |          |                                |
| -Axle Spread :          | 48 + 48"  | 48 + 48"                    |      |         |          | 60...72"                       |
| - Makes/Types:          | Reyco/6 Sprg                                    | Reyco/6 Sprg                |      |         |          | Reyco/4 Sprg                   |
| - Typical Load :        | 56K   | 44K                         |      |         |          | 37.5K                          |
| - Load Ratings :        | 66K   | 66K                         |      |         |          | 38...44K                       |
| <u>Rear Trailer</u>     |   |                             |      |         |          |                                |
| Bed Length (e) :        | 22 FT   | 26 FT (*)                   |      |         |          | 27/32 FT (*)                   |
| King Pin Setting        | 30"   | 24" (?)                     |      |         |          | 12...30" (?)                   |
| Rr Overhang(f) :        | 30"   | 30" (?)                     |      |         |          | 26...30" (?)                   |
| <u>Suspension</u>       |   |                             |      |         |          |                                |
| -Tandem Spread          | 72"   | 48"                         |      |         |          | 60"                            |
| - Makes/Types:          | Reyco/4 Sprg                                    | Reyco/4 Sprg                |      |         |          | Reyco/4 Sprg                   |
| - Typical Load :        | 36K   | 36K                         |      |         |          | 37.5K                          |
| - Load Ratings :        | 44K   | 44K                         |      |         |          | 38...44K                       |
| <u>Belly Axle</u>       |   |                             |      |         |          |                                |
| Location (***):         | NONE  | NONE                        |      |         |          | On 32' Semi<br>60"...midway"   |
| Makes/Types :           |   |                             |      |         |          | ASTL-BPW<br>Knight, CESCHI     |
| Typical Load :          |   |                             |      |         |          | 14.5K                          |
| Load Ratings :          |   |                             |      |         |          | 22K                            |
| Self Steered :          |   |                             |      |         |          | Required                       |

(\*) Minimum wheelbase over axles #2 thru #8 is 15.5m (50'10"), or GCW and axle loads go down.

(\*) 32'+27' Semi's alternate positions. Inner wheelbase between two adjacent tandems must be >= 26.25FT.

(\*\*) 5th wheel setback on front trailer is relative to rearmost axle centerline (positive behind axle).

(\*\*\*) Belly axle location on trailer is from 60" to 0.5(inner wheelbase) ahead of nearest axle centerline.



## APPENDIX B

### SIMULATION INPUT

#### Contents:

- B.1 Input-Data "Echoes" for all Reference Configurations
- B.2 Conventions for Determining Tractor, Semitrailer and Dolly Inertial Properties
- B.3 Print-outs of Vehicle Component Parameters (Suspension, Spring, Tire and Self-Steering Axle Data)
- B.4 UMTRI Simulation Interface System (Pre-Processor and Executive)

## APPENDIX B

### SIMULATION INPUT

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## APPENDIX B.1

### INPUT-DATA "ECHOES" FOR REFERENCE CONFIGURATIONS (Variations No. 1.00)

Listing Sequence:

| No. | Conf. | Train | Description   |
|-----|-------|-------|---|
| 1.  | 1.1   | B     | one tandem-axle 48' semitrailer                           |
| 2.  | 1.2   | B     | one tridem-axle 48' semitrailer                           |
| 3.  | 1.3   | B     | one 3-axle 48' semitrailer                                |
| 4.  | 1.4   | B     | one four-axle 48' semitrailer                             |
| 5.  | 1.5   | B     | one tandem-axle 48' semitrailer + belly-axle              |
| 6.  | 2.1   | C     | 8-axle C-double, 27' tandem-axle trailers                 |
| 7.  | 2.2   | C     | 6-axle C-double, 27' single-axle trailers                 |
| 8.  | 2.3   | C     | 7-axle C-double, 27' mixed trailers                       |
| 9.  | 2.4   | A     | Turnpike-double, 48' tandem-axle trailers                 |
| 10. | 2.5   | C     | Rocky Mountain double, 48' and 27' trailers               |
| 11. | 3.1   | B     | 8-axle B-double, 27' trailer beds                         |
| 12. | 3.2   | B     | 7-axle B-double, 27' trailer beds                         |
| 13. | 3.3   | B     | 6-axle B-double, 27' trailer beds                         |
| 14. | 3.4   | B     | 8-axle B-double, 26' and 32' trailer beds, one belly axle |
| 15. | 4.1   | C     | 8-axle C-triple, 27' single-axle trailers                 |
| 16. | 4.2   | C     | 11-axle C-triple, 27' tandem-axle trailers                |

Notes:

1. Echoes are from the Yaw/Roll program, except for the triples (Nos 15 and 16), which are from the Phase-4 program. The path-follower input table is dummy.
2. Each echo is followed by a tabulated summary of the vehicle's static properties (inertial and geometric) by articulating unit, generated by the Pre-Processor program. All "X" dimensions are referenced to the front articulation point of the given unit (front axle for tractors). All "Z" dimensions are positive above ground.
3. Unless expressly indicated otherwise, all dimensions are in inches, weight and load units are lbs, and moment-of-inertia units are inch-lbs-sec<sup>2</sup>.



\*\*\*\*\*  
 \* RTAC STUDY \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC tractor-semi (39.5t/87k GCW), configuration 1.1, variation 1.00

# OF SPRUNG MASSES = 2  
 TOTAL # OF AXLES = 5  
 GROSS VEHICLE WEIGHT = 87081.00 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

|                     | DISTANCE AHEAD<br>OF SPRUNG MASS<br>C.G. (INCHES) | HEIGHT BELOW<br>SPRUNG MASS<br>C.G. (INCHES) | ROLL STIFFNESS<br>(IN.LB/DEG) | TYPE OF<br>CONSTRAINT |
|---------------------|---|--|-------------------------------|-----------------------|
| ON UNIT # 1         | -119.72   | 0.0  | 999999.88                     | 1                     |
| ARTICULATION PT # 1 |   |  |                               |                       |
| ON UNIT # 2         | 253.57  | 33.68  |                               |                       |

TYPE OF CONSTRAINT : O1 CONVENTIONAL 5TH WHEEL  
 O2 INVERTED 5TH WHEEL  
 O3 PINTLE HOOK  
 O4 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC  
 STEERING GEAR RATIO = 30.00  
 STEERING STIFFNESS (IN.LB/DEG) = 11000.00  
 TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00  
 MECHANICAL TRAIL (IN) = 1.00  
 # OF POINTS IN PATH TABLE = 4  
 X (FEET) Y (FEET)  
 0.0 0.0

RTAC tractor-semi (39.5t/87k GCW), configuration 1.1, variation 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

|  | AXLE # 1<br>***** | AXLE # 2<br>***** | AXLE # 3<br>***** | AXLE #<br>***** | ***** | ***** | ***** | ***** | ***** |
|--|-------------------|-------------------|-------------------|-----------------|-------|-------|-------|-------|-------|
| LOAD ON EACH AXLE (LB.)                        | 12125.00          | 18739.00          | 18739.00          |                 |       |       |       |       |       |
| AXLE WEIGHT (LB.)                              | 1200.00           | 2500.00           | 2500.00           |                 |       |       |       |       |       |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 3700.00           | 5100.00           | 5100.00           |                 |       |       |       |       |       |
| X DIST FROM SP MASS CG (IN)                    | 55.00             | -105.00           | -165.00           |                 |       |       |       |       |       |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00             | 20.00             | 20.00             |                 |       |       |       |       |       |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 18.25             | 33.00             | 33.00             |                 |       |       |       |       |       |
| HALF SPRING SPACING (IN)                       | 16.00             | 19.00             | 19.00             |                 |       |       |       |       |       |
| HALF TRACK - INNER TIRES (IN)                  | 40.00             | 29.50             | 29.50             |                 |       |       |       |       |       |
| DUAL TIRE SPACING (IN)                         | 0.0               | 13.00             | 13.00             |                 |       |       |       |       |       |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00           | 4500.00           | 4500.00           |                 |       |       |       |       |       |
| ROLL STEER COEFFICIENT                         | 0.0               | 0.22              | 0.23              |                 |       |       |       |       |       |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 3824.00           | 30000.00          | 85000.00          |                 |       |       |       |       |       |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 475.00            | 1000.00           | 1000.00           |                 |       |       |       |       |       |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 22.26             | 0.0               | 0.0               |                 |       |       |       |       |       |
| SPRING TABLE #                                 | 1                 | 2                 | 2                 |                 |       |       |       |       |       |
| CORNERING FORCE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |       |
| ALIGNING TORQUE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |       |

RTAC tractor-semi (39.5t/87k GCW), configuration 1.1, variation 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 66081.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 235411.94 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 5055859.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 5148717.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 77.68 INCHES

AXLE # 4 AXLE # 5 AXLE #  
\*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

LOAD ON EACH AXLE (LB.) 18739.00 18739.00

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -208.43 -256.43

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |



SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
\*\*\*\*\* \*\*

LATERAL FORCE VS. SLIP ANGLL

| 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|---------|--------|---------|---------|---------|---------|
| 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
| 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
| 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC tractor-semi (39.5t/87k GCW), configuration 1.1, variation 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

- \* Number of units: 2
- \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 31603.0  
FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr5.5t17t ; Hitch: ST6T:Hi.5thWheel  
WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 174.7

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

AXLE 1 -- Load: 12125.0; AxleLoc[x]: 0.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.IHref.Frt ST6T:Sp.IHref.Frt  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.StrAxle ST6T:Br.StrAxle  
ALOCK :

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkBm44 ; SuspLoad: 37478.0; SuspKey: 2

AXLE 1 -- Load: 18739.0; AxleLoc[x]: 160.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

AXLE 2 -- Load: 18739.0; AxleLoc[x]: 220.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.0  
FILES: Tare: ST6T:Se.48FtTndm ; Load: ST6T:SL.Se17t ; Hitch:  
WEIGHT: Total: 69081.0; Sprung: 66081.0; Payload: 55281.0  
XINERT: Total: 268338 ; Sprung: 235412 ; Payload: 153921  
YINERT: Total: 5486588 ; Sprung: 5055859 ; Payload: 3988369  
ZINERT: Total: 5562920 ; Sprung: 5148717 ; Payload: 4082719  
CGXLOC: Total: 263.7; Sprung: 253.6; Payload: 244.9  
CGZLOC: Total: 75.2; Sprung: 77.7; Payload: 79.0  
LENGTH: EffWlbse: 486.0; Last Wlbse: 486.0; HitchLoc[x]: 540.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 37478.0; SuspKey: 1

AXLE 1 -- Load: 18739.0; AxleLoc[x]: 462.0

|        |    |                |                   |
|--------|----|----------------|-------------------|
| AXLE 2 | -- | Load: 18739.0: | AxleLoc[x]: 510.0 |
|        |    | AXLE FILES     |                   |
|        |    | -----          | -----             |
|        |    | Lhs            | Rhs               |
|        |    | -----          | -----             |
|        |    | SPRING :       | STGT:Sp.MTC.Reyco |
|        |    | TIRE :         | STGT:T1.XZA11R225 |
|        |    | WHLBRK :       | STGT:Br.DualsAxle |
|        |    | ALOCK :        |                   |
|        |    | -----          | -----             |
|        |    | Lhs            | Rhs               |
|        |    | -----          | -----             |
|        |    | SPRING :       | STGT:Sp.MTC.Reyco |
|        |    | TIRE :         | STGT:T1.XZA11R225 |
|        |    | WHLBRK :       | STGT:Br.DualsAxle |
|        |    | ALOCK :        |                   |

\*\*\*\*\*  
 \* RTAC STUDY \*  
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\*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC tractor-semi (45t/99k GCW), configuration 1.2, variation 1.00

# OF SPRUNG MASSES = 2  
 TOTAL # OF AXLES = 6  
 GROSS VEHICLE WEIGHT = 99205.88 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

|                                 | DISTANCE AHEAD<br>OF SPRUNG MASS<br>C.G. (INCHES) | HEIGHT BELOW<br>SPRUNG MASS<br>C.G. (INCHES) | ROLL STIFFNESS<br>(IN.LB/DEG) | TYPE OF<br>CONSTRAINT |
|---------------------------------|---|--|-------------------------------|-----------------------|
| ARTICULATION PT # 1 ON UNIT # 1 | -119.72   | 0.0  | 999999.88                     | 1                     |
| ON UNIT # 2                     | 271.66  | 37.71  |                               |                       |

TYPE OF CONSTRAINT : 01 CONVENTIONAL 5TH WHEEL  
 02 INVERTED 5TH WHEEL  
 03 PINTLE HOOK  
 04 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00

# OF POINTS IN PATH TABLE = 4

X (FEET) Y (FEET)  
 0.0 0.0

RTAC tractor-semi (45t/99k GCW), configuration 1.2, variation 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 1 AXLE # 2 AXLE # 3 AXLE #  
\*\*\*\*\*  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 12125.00 18739.00 18739.00

AXLE WEIGHT (LB.) 1200.00 2500.00 2500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 3700.00 5100.00 5100.00

X DIST FROM SP MASS CG (IN) 55.00 -105.00 -165.00

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 18.25 33.00 33.00

HALF SPRING SPACING (IN) 16.00 19.00 19.00

HALF TRACK - INNER TIRES (IN) 40.00 29.50 29.50

DUAL TIRE SPACING (IN) 0.0 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.22 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 3824.00 30000.00 85000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 475.00 1000.00 1000.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 22.26 0.0 0.0

SPRING TABLE # 1 2 2

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1



RTAC tractor-semi (45t/99k GCW), configuration 1.2, variation 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 76705.88 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 277826.75 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 6517432.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 6611035.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 81.71 INCHES

AXLE # 4 AXLE # 5 AXLE # 6 AXLE #  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 16534.00 16534.50 16534.50

AXLE WEIGHT (LB.) 1500.00 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -142.34 -190.34 -238.34

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0 0.0

SPRING TABLE # 3 3 3

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
\*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

| 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|---------|--------|---------|---------|---------|---------|
| 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
| 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
| 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC tractor-semi (45t/99k GCW), configuration 1.2, variation 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

- \* Number of units: 2
- \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 31603.0  
FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr5.5t17t ; Hitch: ST6T:Hi.5thWheel  
WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 174.7

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

| AXLE 1 | -- Load: 12125.0; | AxleLoc[x]: 0.0   |                   |
|--------|-------------------|-------------------|-------------------|
|        | Axle Files        | Lhs               | Rhs               |
|        | -----             | -----             | -----             |
|        | SPRING :          | ST6T:Sp.IHref.Frt | ST6T:Sp.IHref.Frt |
|        | TIRE :            | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        | WHLBRK :          | ST6T:Br.StrAxle   | ST6T:Br.StrAxle   |
|        | ALOCK :           |                   |                   |

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkBm44 ; SuspLoad: 37478.0; SuspKey: 2

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| AXLE 1 | -- Load: 18739.0; | AxleLoc[x]: 160.0 |                   |
|--------|-------------------|-------------------|-------------------|
|        | Axle Files        | Lhs               | Rhs               |
|        | -----             | -----             | -----             |
|        | SPRING :          | ST6T:Sp.HknRTE440 | ST6T:Sp.HknRTE440 |
|        | TIRE :            | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        | WHLBRK :          | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
|        | ALOCK :           |                   |                   |

| AXLE 2 | -- Load: 18739.0; | AxleLoc[x]: 220.0 |                   |
|--------|-------------------|-------------------|-------------------|
|        | Axle Files        | Lhs               | Rhs               |
|        | -----             | -----             | -----             |
|        | SPRING :          | ST6T:Sp.HknRTE440 | ST6T:Sp.HknRTE440 |
|        | TIRE :            | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        | WHLBRK :          | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
|        | ALOCK :           |                   |                   |

UNIT # 2 -- SEMI ; # of Rear Suspensions: 2; Rear HitchLoad: 0.0  
FILES: Tare: ST6T:Se.48FtTrdm ; Load: ST6T:SL.Se7.5t15t ; Hitch:  
WEIGHT: Total: 81206.0; Sprung: 76705.9; Payload: 65405.9  
XINERT: Total: 332049 ; Sprung: 277827 ; Payload: 196203  
YINERT: Total: 6976093 ; Sprung: 6517432 ; Payload: 4732944  
ZINERT: Total: 7040074 ; Sprung: 6611035 ; Payload: 4830482  
CGXLOC: Total: 282.2; Sprung: 271.7; Payload: 265.9  
CGZLOC: Total: 78.3; Sprung: 81.7; Payload: 83.6  
LENGTH: EffWlbse: 462.0; Last Wlbse: 486.0; HitchLoc[x]: 540.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21Bsngl ; SuspLoad: 16534.0; SuspKey: 0

| AXLE 1 | -- Load: 16534.0; | AxleLoc[x]: 414.0 |  |
|--------|-------------------|-------------------|--|
|--------|-------------------|-------------------|--|

|   |                                     |
|---|-------------------------------------|
| SUSPENSION # 2; SuspF11e: ST6T:Su.Rc21B481n ; SuspLoad: 33069.0; SuspKey: 1 |                                     |
| AXLE 1  | -- Load: 16534.5; AxleLoc[x]: 462.0 |
| Axle Files  | Axle Files                          |
| SPRING :  | ST6T:Sp.MTC.Reyco                   |
| TIRE :  | ST6T:T1.XZA11R225                   |
| WHLBRK :  | ST6T:Br.DualsAx1e                   |
| ALOCK :   |                                     |
|   |                                     |
| AXLE 2  | -- Load: 16534.5; AxleLoc[x]: 510.0 |
| Axle Files  | Axle Files                          |
| SPRING :  | ST6T:Sp.MTC.Reyco                   |
| TIRE :  | ST6T:T1.XZA11R225                   |
| WHLBRK :  | ST6T:Br.DualsAx1e                   |
| ALOCK :   |                                     |

-----  
 Lhs  
 -----  
 ST6T:Sp.MTC.Reyco  
 ST6T:T1.XZA11R225  
 ST6T:Br.DualsAx1e

-----  
 Rhs  
 -----  
 ST6T:Sp.MTC.Reyco  
 ST6T:T1.XZA11R225  
 ST6T:Br.DualsAx1e

-----  
 Lhs  
 -----  
 ST6T:Sp.MTC.Reyco  
 ST6T:T1.XZA11R225  
 ST6T:Br.DualsAx1e

-----  
 Rhs  
 -----  
 ST6T:Sp.MTC.Reyco  
 ST6T:T1.XZA11R225  
 ST6T:Br.DualsAx1e



\*\*\*\*\*  
 \* RTAC STUDY \*  
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\*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC tractor-semi (49.5t/109k GCW), configuration 1.3, variation 1.00

# OF SPRUNG MASSES = 2  
 TOTAL # OF AXLES = 6  
 GROSS VEHICLE WEIGHT = 109125.69 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

| ARTICULATION PT # | ON UNIT # | DISTANCE AHEAD OF SPRUNG MASS C.G. (INCHES) | HEIGHT BELOW SPRUNG MASS C.G. (INCHES) | ROLL STIFFNESS (IN.LB/DEG) | TYPE OF CONSTRAINT |
|-------------------|-----------|---|--|----------------------------|--------------------|
| 1                 | 1         | -119.72                                     | 0.0                                    | 999999.88                  | 1                  |
| 2                 | 2         | 262.96                                      | 41.82                                  |                            |                    |

TYPE OF CONSTRAINT : 01 CONVENTIONAL 5TH WHEEL  
 02 INVERTED 5TH WHEEL  
 03 PINTLE HOOK  
 04 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00

# OF POINTS IN PATH TABLE = 4

X (FEET) Y (FEET)  
 0.0 0.0

RTAC tractor-semi (49.5t/109k GCW), configuration 1.3, variation 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 1 AXLE # 2 AXLE # 3 AXLE #  
\*\*\*\*\*  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 12125.00 18739.00 18739.00

AXLE WEIGHT (LB.) 1200.00 2500.00 2500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 3700.00 5100.00 5100.00

X DIST FROM SP MASS CG (IN) 55.00 -105.00 -165.00

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 18.25 33.00 33.00

HALF SPRING SPACING (IN) 16.00 19.00 19.00

HALF TRACK - INNER TIRES (IN) 40.00 29.50 29.50

DUAL TIRE SPACING (IN) 0.0 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.22 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 3824.00 30000.00 85000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 475.00 1000.00 1000.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 22.26 0.0 0.0

SPRING TABLE # 1 2 2

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1

RTAC tractor-semi (49.5t/109k GCW), configuration 1.3, variation 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 86625.69 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 329578.94 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 7278559.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 7364961.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 85.82 INCHES

AXLE # 4 AXLE # 5 AXLE # 6 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 19841.00 19841.00 19841.00

AXLE WEIGHT (LB.) 1500.00 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -55.04 -151.04 -247.04

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00 27.00

W HALF SPRING SPACING (IN) 22.00 22.00 22.00

W HALF TRACK - INNER TIRES (IN) 32.50 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SFC/IN) 0.0 0.0 0.0

SPRING TABLE # 3 3 3

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|         | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00 |
|---------|---------|---------|---------|---------|---------|-------|
| 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |       |
| 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |       |
| 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |       |
| 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |       |
| 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |       |



RTAC tractor-semi (49.5t/109k GCW), configuration 1.3, variation 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 2  
\* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 31603.0  
FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr5.St17t ; Hitch: ST6T:HI.5thWheel  
WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 174.7

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

AXLE 1 -- Load: 12125.0; AxleLoc[x]: 0.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.IHref.Frt ST6T:Sp.IHref.Frt  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.StrAxle ST6T:Br.StrAxle  
ALOCK :

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkBm44 ; SuspLoad: 37478.0; SuspKey: 2

AXLE 1 -- Load: 18739.0; AxleLoc[x]: 160.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

AXLE 2 -- Load: 18739.0; AxleLoc[x]: 220.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

UNIT # 2 -- SEMI ; # of Rear Suspensions: 3; Rear HitchLoad: 0.0  
FILES: Tare: ST6T:Se.48Ft3ax1e ; Load: ST6T:SL.Se3x9t ; Hitch:  
WEIGHT: Total: 91126.0; Sprung: 86625.7; Payload: 75325.7  
XINERT: Total: 389880 ; Sprung: 329579 ; Payload: 244501  
YINERT: Total: 7650832 ; Sprung: 7278559 ; Payload: 5469307  
ZINERT: Total: 7701533 ; Sprung: 7364961 ; Payload: 5563099  
CGXLOC: Total: 270.4; Sprung: 263.0; Payload: 256.7  
CGZLOC: Total: 82.6; Sprung: 85.8; Payload: 88.0  
LENGTH: EffWlbse: 414.0; Last Wlbse: 510.0; HitchLoc[x]: 540.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21BSngl ; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 318.0

| Axle Files      |           | Lhs               | Rhs                           |
|-----------------|-----------|-------------------|-------------------------------|
| -----           |           |                   |                               |
| SPRING :        |           | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco             |
| TIRE :          |           | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225             |
| WHLBRK :        |           | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle             |
| ALOCK :         |           |                   |                               |
| -----           |           |                   |                               |
| SUSPENSION # 2: | SuspFile: | ST6T:Su.Rc21BSng1 | SuspLoad: 19841.0; SuspKey: 0 |
| AXLE 1 --       | Load:     | 19841.0;          |                               |
|                 |           | AxleLoc[x]: 414.0 |                               |
| -----           |           |                   |                               |
| Axle Files      |           | Lhs               | Rhs                           |
| -----           |           |                   |                               |
| SPRING :        |           | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco             |
| TIRE :          |           | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225             |
| WHLBRK :        |           | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle             |
| ALOCK :         |           |                   |                               |
| -----           |           |                   |                               |
| SUSPENSION # 3: | SuspFile: | ST6T:Su.Rc21BSng1 | SuspLoad: 19841.0; SuspKey: 0 |
| AXLE 1 --       | Load:     | 19841.0;          |                               |
|                 |           | AxleLoc[x]: 510.0 |                               |
| -----           |           |                   |                               |
| Axle Files      |           | Lhs               | Rhs                           |
| -----           |           |                   |                               |
| SPRING :        |           | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco             |
| TIRE :          |           | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225             |
| WHLBRK :        |           | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle             |
| ALOCK :         |           |                   |                               |

\*\*\*\*\*  
 \* RTAC STUDY \*  
 \*\*\*\*\*  
 \*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC tractor-semi (57.5t/127k GCW), configuration 1.4, variation 1.00

# OF SPRUNG MASSES = 2  
 TOTAL # OF AXLES = 7  
 GROSS VEHICLE WEIGHT = 128966.63 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

| ARTICULATION PT # | ON UNIT # | DISTANCE AHEAD OF SPRUNG MASS C.G. (INCHES) | HEIGHT BELOW SPRUNG MASS C.G. (INCHES) | ROLL STIFFNESS (IN.LB/DEG) | TYPE OF CONSTRAINT |
|-------------------|-----------|---|--|----------------------------|--------------------|
|                   | 1         | -119.72                                     | 0.0                                    | 999999.88                  | 1                  |
|                   | 2         | 236.94                                      | 49.28                                  |                            |                    |

TYPE OF CONSTRAINT : O1 CONVENTIONAL 5TH WHEEL  
 O2 INVERTED 5TH WHEEL  
 O3 PINTLE HOOK  
 O4 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00

# OF POINTS IN PATH TABLE = 4

X (FEET) Y (FEET)  
 0.0 0.0

RTAC tractor-semi (57.5t/127k GCW), configuration 1.4, variation 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

|  | AXLE # 1<br>***** | AXLE # 2<br>***** | AXLE # 3<br>***** | AXLE #<br>***** | ***** | ***** | ***** | ***** |
|--|-------------------|-------------------|-------------------|-----------------|-------|-------|-------|-------|
| LOAD ON EACH AXLE (LB.)                        | 12125.00          | 18739.00          | 18739.00          |                 |       |       |       |       |
| AXLE WEIGHT (LB.)                              | 1200.00           | 2500.00           | 2500.00           |                 |       |       |       |       |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 3700.00           | 5100.00           | 5100.00           |                 |       |       |       |       |
| X DIST FROM SP MASS CG (IN)                    | 55.00             | -105.00           | -165.00           |                 |       |       |       |       |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00             | 20.00             | 20.00             |                 |       |       |       |       |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 18.25             | 33.00             | 33.00             |                 |       |       |       |       |
| 46 HALF SPRING SPACING (IN)                    | 16.00             | 19.00             | 19.00             |                 |       |       |       |       |
| HALF TRACK - INNER TIRES (IN)                  | 40.00             | 29.50             | 29.50             |                 |       |       |       |       |
| DUAL TIRE SPACING (IN)                         | 0.0               | 13.00             | 13.00             |                 |       |       |       |       |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00           | 4500.00           | 4500.00           |                 |       |       |       |       |
| ROLL STEER COEFFICIENT                         | 0.0               | 0.22              | 0.23              |                 |       |       |       |       |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 3824.00           | 30000.00          | 85000.00          |                 |       |       |       |       |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 475.00            | 1000.00           | 1000.00           |                 |       |       |       |       |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 22.26             | 0.0               | 0.0               |                 |       |       |       |       |
| SPRING TABLE #                                 | 1                 | 2                 | 2                 |                 |       |       |       |       |
| CORNERING FORCE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |
| ALIGNING TORQUE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |

RTAC tractor-sem1 (57.5t/127k GCW), configuration 1.4, variation 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 4

WEIGHT OF SPRUNG MASS = 104966.63 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 450008.56 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 8810189.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 8859723.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 93.28 INCHES

AXLE # 4 AXLE # 5 AXLE # 6 AXLE # 7 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 19841.00 19841.00 19841.00 19841.00

AXLE WEIGHT (LB.) 1500.00 1500.00 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00 4100.00 4100.00

X DIST FROM SP MASS CG (IN) 68.94 -45.06 -159.06 -273.06

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0 0.0 0.0

SPRING TABLE # 3 3 3 3

CORNERING FORCE TABLE # 1 1 1 1

ALIGNING TORQUE TABLE # 1 1 1 1

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |



CORNERING FORCE TABLE # 1  
 \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC tractor-semi (57.5t/127k GCW), configuration 1.4, variation 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 2  
\* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 31603.0  
FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr5.5t17t ; Hitch: ST6T:H1.5thWheel  
WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 174.7

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

AXLE 1 -- Load: 12125.0; AxleLoc[x]: 0.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.IHref.Frt ST6T:Sp.IHref.Frt  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.StrAxle ST6T:Br.StrAxle  
ALOCK :

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkM44 ; SuspLoad: 37478.0; SuspKey: 2

AXLE 1 -- Load: 18739.0; AxleLoc[x]: 160.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

AXLE 2 -- Load: 18739.0; AxleLoc[x]: 220.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

UNIT # 2 -- SEMI ; # of Rear Suspensions: 4; Rear HitchLoad: 0.0  
FILES: Tare: ST6T:Se.48Ft4axle ; Load: ST6T:SL.Se4x9t ; Hitch:  
WEIGHT: Total: 110967.0; Sprung: 104966.6; Payload: 93166.6  
XINERT: Total: 545355 ; Sprung: 450009 ; Payload: 351790  
YINERT: Total: 9294653 ; Sprung: 8810189 ; Payload: 6814092  
ZINERT: Total: 9281640 ; Sprung: 8859723 ; Payload: 6880719  
CGXLOC: Total: 242.5; Sprung: 236.9; Payload: 228.3  
CGZLOC: Total: 89.3; Sprung: 93.3; Payload: 96.1  
LENGTH: EffWlbse: 339.0; Last Wlbse: 510.0; HitchLoc[x]: 540.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21BSngl ; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 168.0

SUSPENSION # 2: SuspF11e: ST6T:Su.Rc21BSng1 ; SuspLoad: 19841.0; SuspKey: 0  
AXLE 1 -- Load: 19841.0; Ax1eLoc[x]: 282.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAx1e | ST6T:Br.DualsAx1e |
| ALOCK :    |                   |                   |

SUSPENSION # 3: SuspF11e: ST6T:Su.Rc21BSng1 ; SuspLoad: 19841.0; SuspKey: 0  
AXLE 1 -- Load: 19841.0; Ax1eLoc[x]: 396.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAx1e | ST6T:Br.DualsAx1e |
| ALOCK :    |                   |                   |

SUSPENSION # 4: SuspF11e: ST6T:Su.Rc21BSng1 ; SuspLoad: 19841.0; SuspKey: 0  
AXLE 1 -- Load: 19841.0; Ax1eLoc[x]: 510.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAx1e | ST6T:Br.DualsAx1e |
| ALOCK :    |                   |                   |

\*\*\*\*\*  
 \* RTAC STUDY \*  
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\*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC tractor-semi (48.5t/107k GCW), configuration 1.5, variation 1.00

# OF SPRUNG MASSES = 2  
 TOTAL # OF AXLES = 6  
 GROSS VEHICLE WEIGHT = 106921.88 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

|                     |             | DISTANCE AHEAD<br>OF SPRUNG MASS<br>C.G. (INCHES) | HEIGHT BELOW<br>SPRUNG MASS<br>C.G. (INCHES) | ROLL STIFFNESS<br>(IN.LB/DEG) | TYPE OF<br>CONSTRAINT |
|---------------------|-------------|---|--|-------------------------------|-----------------------|
| ARTICULATION PT # 1 | ON UNIT # 1 | -119.72   | 0.0  | 999999.88                     | 1                     |
|                     | ON UNIT # 2 | 246.71  | 41.19  |                               |                       |

TYPE OF CONSTRAINT : O1 CONVENTIONAL 5TH WHEEL  
 O2 INVERTED 5TH WHEEL  
 O3 PINTLE HOOK  
 O4 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00

# OF POINTS IN PATH TABLE = 4

X (FEET) Y (FEET)

0.0 0.0

RTAC tractor-semi (48.5t/107k GCW), configuration 1.5, variation 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 1 AXLE # 2 AXLE # 3 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 12125.00 18739.00 18739.00

AXLE WEIGHT (LB.) 1200.00 2500.00 2500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 3700.00 5100.00 5100.00

X DIST FROM SP MASS CG (IN) 55.00 -105.00 -165.00

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 18.25 33.00 33.00

5) HALF SPRING SPACING (IN) 16.00 19.00 19.00

HALF TRACK - INNER TIRES (IN) 40.00 29.50 29.50

DUAL TIRE SPACING (IN) 0.0 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.22 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 3824.00 30000.00 85000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 475.00 1000.00 1000.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 22.26 0.0 0.0

SPRING TABLE # 1 2 2

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1

RTAC tractor-semi (48.5t/107k GCW), configuration 1.5, variation 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 84421.88 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 316384.25 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 7098422.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 7186929.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 85.19 INCHES

|  | AXLE # 4<br>***** | AXLE # 5<br>***** | AXLE # 6<br>***** | AXLE #<br>***** | ***** | ***** | ***** | ***** | ***** |
|--|-------------------|-------------------|-------------------|-----------------|-------|-------|-------|-------|-------|
| LOAD ON EACH AXLE (LB.)                        | 19841.00          | 18739.00          | 18739.00          |                 |       |       |       |       |       |
| AXLE WEIGHT (LB.)                              | 1500.00           | 1500.00           | 1500.00           |                 |       |       |       |       |       |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 4100.00           | 4100.00           | 4100.00           |                 |       |       |       |       |       |
| X DIST FROM SP MASS CG (IN)                    | 24.71             | -215.29           | -263.29           |                 |       |       |       |       |       |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00             | 20.00             | 20.00             |                 |       |       |       |       |       |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 29.00             | 27.00             | 27.00             |                 |       |       |       |       |       |
| HALF SPRING SPACING (IN)                       | 22.00             | 22.00             | 22.00             |                 |       |       |       |       |       |
| HALF TRACK - INNER TIRES (IN)                  | 32.50             | 32.50             | 32.50             |                 |       |       |       |       |       |
| DUAL TIRE SPACING (IN)                         | 13.00             | 13.00             | 13.00             |                 |       |       |       |       |       |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00           | 4500.00           | 4500.00           |                 |       |       |       |       |       |
| ROLL STEER COEFFICIENT                         | 0.0               | 0.23              | 0.23              |                 |       |       |       |       |       |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 60000.00          | 9000.00           | 9000.00           |                 |       |       |       |       |       |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 362.00            | 975.00            | 975.00            |                 |       |       |       |       |       |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 0.0               | 0.0               | 0.0               |                 |       |       |       |       |       |
| SPRING TABLE #                                 | 3                 | 4                 | 4                 |                 |       |       |       |       |       |
| CORNERING FORCE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |       |
| ALIGNING TORQUE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |       |

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SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |



SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -41675.00   | -2.00                |
| 9300.00     | -0.75                |
| 10600.00    | -0.25                |
| 11137.50    | 0.0                  |
| 11662.50    | 0.25                 |
| 12775.00    | 0.75                 |
| 13387.50    | 1.00                 |
| 43406.25    | 2.50                 |

SPRING TABLE # 4  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\* \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC tractor-semi (48.5t/107k GCW), configuration 1.5, variation 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 2  
 \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR: # of Rear Suspensions: 1; Rear HitchLoad: 31603.0  
 FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr5.5t17t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
 XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
 YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
 ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
 CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
 CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWibse: 190.0; Last Wibse: 190.0; HitchLoc[x]: 174.7

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

|        |    |                |                 |                   |                   |
|--------|----|----------------|-----------------|-------------------|-------------------|
| AXLE 1 | -- | Load: 12125.0; | AxleLoc[x]: 0.0 |                   |                   |
|        |    | Axle Files     |                 | Lhs               | Rhs               |
|        |    | SPRING :       |                 | ST6T:Sp.IHref.Frt | ST6T:Sp.IHref.Frt |
|        |    | TIRE :         |                 | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       |                 | ST6T:Br.StrAxle   | ST6T:Br.StrAxle   |
|        |    | ALOCK :        |                 |                   |                   |

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkM44 ; SuspLoad: 37478.0; SuspKey: 2

|        |    |                |                   |                   |                   |
|--------|----|----------------|-------------------|-------------------|-------------------|
| AXLE 1 | -- | Load: 18739.0; | AxleLoc[x]: 160.0 |                   |                   |
|        |    | Axle Files     |                   | Lhs               | Rhs               |
|        |    | SPRING :       |                   | ST6T:Sp.HknRTE440 | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         |                   | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       |                   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |                   |                   |

|        |    |                |                   |                   |                   |
|--------|----|----------------|-------------------|-------------------|-------------------|
| AXLE 2 | -- | Load: 18739.0; | AxleLoc[x]: 220.0 |                   |                   |
|        |    | Axle Files     |                   | Lhs               | Rhs               |
|        |    | SPRING :       |                   | ST6T:Sp.HknRTE440 | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         |                   | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       |                   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |                   |                   |

UNIT # 2 -- SEMI ; # of Rear Suspensions: 2; Rear HitchLoad: 0.0  
 FILES: Tare: ST6T:Se.48ftBelly ; Load: ST6T:SL.Se9t17t ; Hitch:  
 WEIGHT: Total: 88922.0; Sprung: 84421.9; Payload: 73621.9  
 XINERT: Total: 375709 ; Sprung: 316384 ; Payload: 235677  
 ZINERT: Total: 7583667 ; Sprung: 7098422 ; Payload: 5342302  
 CGXLOC: Total: 254.4; Sprung: 246.7; Payload: 239.2  
 CGZLOC: Total: 81.9; Sprung: 85.2; Payload: 87.3  
 LENGTH: EffWibse: 394.6; Last Wibse: 486.0; HitchLoc[x]: 540.0

SUSPENSION # 1; SuspFile: ST6T:Su.A9517.245 ; SuspLoad: 19841.0; SuspKey: 0

|        |    |                |                   |  |  |
|--------|----|----------------|-------------------|--|--|
| AXLE 1 | -- | Load: 19841.0; | AxleLoc[x]: 222.0 |  |  |
|--------|----|----------------|-------------------|--|--|

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.AR9517.24 | ST6T:Sp.AR9517.24 |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

SUSPENSION # 2; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 37478.0; SuspKey: 1

| AXLE 1     | Load: 18739.0;    | AxleLoc[x]: 462.0 |  |
|------------|-------------------|-------------------|--|
| Axle Files | Lhs               | Rhs               |  |
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |  |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |  |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |  |
| ALOCK :    |                   |                   |  |

| AXLE 2     | Load: 18739.0;    | AxleLoc[x]: 510.0 |  |
|------------|-------------------|-------------------|--|
| Axle Files | Lhs               | Rhs               |  |
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |  |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |  |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |  |
| ALOCK :    |                   |                   |  |

\*\*\*\*\*  
 \* RTAC STUDY \*  
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 \*DIRECTIONAL RESPONSE SIMULATION\*  
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RTAC 8 axle C-train Doubles (49t/108k GCW), conf. 2.1, var. 1.00

# OF SPRUNG MASSES = 4  
 TOTAL # OF AXLES = 8  
 GROSS VEHICLE WEIGHT = 108024.88 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

|                     |              | DISTANCE AHEAD<br>OF SPRUNG MASS<br>C.G. (INCHES) | HEIGHT BELOW<br>SPRUNG MASS<br>C.G. (INCHES) | ROLL STIFFNESS<br>(IN.LB/DEG) | TYPE OF<br>CONSTRAINT |
|---------------------|--------------|---|--|-------------------------------|-----------------------|
| ARTICULATION PT # 1 | ON UNIT # 1. | -131.30   | 0.0  | 999999.88                     | 1                     |
|                     | ON UNIT # 2  | 141.67  | 36.78  |                               |                       |
| ARTICULATION PT # 2 | ON UNIT # 2  | -158.33   | 46.28  | 29999.98                      | 1                     |
|                     | ON UNIT # 3  | 72.00   | 9.50   |                               |                       |
| ARTICULATION PT # 3 | ON UNIT # 3  | 0.0   | 0.0  | 999999.88                     | 1                     |
|                     | ON UNIT # 4  | 141.43  | 36.83  |                               |                       |

LINKED ARTICULATION: GAIN: 0.001 STIFFNESS: 10000000.000 (IN-LB/DEG GAMMA2)

TYPE OF CONSTRAINT : 01 CONVENTIONAL 5TH WHEEL  
 02 INVERTED 5TH WHEEL  
 03 PINTLE HOOK  
 04 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00



STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00  
# OF POINTS IN PATH TABLE = 4

| X (FEET) | Y (FEET) |
|----------|----------|
| 0.0      | 0.0      |
| 45.00    | 0.0      |
| 50.00    | 0.0      |
| 1500.00  | 0.0      |

RTAC 8 axle C-train Doubles (49t/108k GCW), conf. 2.1, var. 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 1 AXLE # 2 AXLE # 3 AXLE #  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 9921.00 12676.50 12676.50

AXLE WEIGHT (LB.) 1200.00 2500.00 2500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 3700.00 5100.00 5100.00

X DIST FROM SP MASS CG (IN) 55.00 -105.00 -165.00

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 18.25 33.00 33.00

HALF SPRING SPACING (IN) 16.00 19.00 19.00

HALF TRACK - INNER TIRES (IN) 40.00 29.50 29.50

DUAL TIRE SPACING (IN) 0.0 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.22 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 3824.00 30000.00 85000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 475.00 1000.00 1000.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 22.26 0.0 0.0

SPRING TABLE # 1 2 2

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1

RTAC 8 axle C-train Doubles (49t/108k GCW), conf. 2.1, var. 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 40728.90 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 144110.88 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 1102684.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1154602.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 80.78 INCHES

AXLE # 4 AXLE # 5 AXLE #  
\*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

LOAD ON EACH AXLE (LB.) 13227.50 13227.50

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -80.33 -128.33

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

RTAC 8 axle C-train Doubles (49t/108k GCW), conf. 2.1, var. 1.00

UNIT # 3  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 1

WEIGHT OF SPRUNG MASS = 1000.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 10000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 5000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 6000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 6 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 19841.00

AXLE WEIGHT (LB.) 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00

X DIST FROM SP MASS CG (IN) 0.0

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00

70 HALF SPRING SPACING (IN) 22.00

HALF TRACK - INNER TIRES (IN) 32.50

DUAL TIRE SPACING (IN) 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00

ROLL STEER COEFFICIENT 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0

SPRING TABLE # 3

CORNERING FORCE TABLE # 1

ALIGNING TORQUE TABLE # 1

AXLE 6 IS SELF STEERING

PRIMARY STIFFNESS, IN-LB/DEG: 400000.00

COULOMB FRICTION, IN-LB: 15000.00

MECHANICAL TRAIL, INCHES: 6.00

STEERING TORQUE AND DISPLACEMENT BOUNDRIES

| TORQUE, IN-LB | ANGLE, DEG |
|---------------|------------|
| -56700.00     | -30.000    |
| -13200.00     | -1.000     |
| -400.00       | -0.500     |
| 0.0           | 0.0        |
| 400.00        | 0.500      |
| 13200.00      | 1.000      |
| 56700.00      | 30.000     |

RTAC 8 axle C-train Doubles (49t/108k GCW), conf. 2.1, var. 1.00

UNIT # 4  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 40796.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 144423.06 LB.IN.SEC\*\*2.

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 1104543.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1156450.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 80.83 INCHES

AXLE # 7 AXLE # 8 AXLE #  
\*\*\*\*\*  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 13227.50 13227.50

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -80.57 -128.57

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |



SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

| 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|---------|---------|---------|---------|---------|---------|
| 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
| 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
| 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
| 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
| 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 4  
 \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR: # of Rear Suspensions: 1; Rear HitchLoad: 17274.0  
 FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr4.511.5 ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
 XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
 YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
 ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
 CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
 CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 186.3

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 9921.0 ; SuspKey: 0

|        |    |               |                   |                   |
|--------|----|---------------|-------------------|-------------------|
| AXLE 1 | -- | Load: 9921.0; | AxleLoc[x]: 0.0   | Rhs               |
|        |    | Axle Files    |                   |                   |
|        |    | Lhs           |                   |                   |
|        |    | SPRING :      | ST6T:Sp.IHref.Frt | ST6T:Sp.IHref.Frt |
|        |    | TIRE :        | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :      | ST6T:Br.StrAxle   | ST6T:Br.StrAxle   |
|        |    | ALOCK :       |                   |                   |

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkBm44 ; SuspLoad: 25353.0; SuspKey: 2

|        |    |                |                   |                   |
|--------|----|----------------|-------------------|-------------------|
| AXLE 1 | -- | Load: 12676.5; | AxleLoc[x]: 160.0 | Rhs               |
|        |    | Axle Files     |                   |                   |
|        |    | Lhs            |                   |                   |
|        |    | SPRING :       | ST6T:Sp.HknRte440 | ST6T:Sp.HknRte440 |
|        |    | TIRE :         | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |                   |

AXLE 2 -- Load: 12676.5; AxleLoc[x]: 220.0

|  |  |            |                   |                   |
|--|--|------------|-------------------|-------------------|
|  |  | Axle Files |                   | Rhs               |
|  |  | Lhs        |                   |                   |
|  |  | SPRING :   | ST6T:Sp.HknRte440 | ST6T:Sp.HknRte440 |
|  |  | TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|  |  | WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
|  |  | ALOCK :    |                   |                   |

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.1

FILES: Tare: ST6T:Se.27FtIndm ; Load: ST6T:SL.Se12t ; Hitch: ST6T:H1.BdollyRef  
 WEIGHT: Total: 43728.9; Sprung: 40728.9; Payload: 35228.9  
 XINERT: Total: 179043 ; Sprung: 144111 ; Payload: 104013  
 YINERT: Total: 1212671 ; Sprung: 1102684 ; Payload: 823099  
 ZINERT: Total: 1246056 ; Sprung: 1154602 ; Payload: 877301  
 CGXLOC: Total: 148.8; Sprung: 141.7; Payload: 138.0  
 CGZLOC: Total: 76.6; Sprung: 80.8; Payload: 82.6  
 LENGTH: EffWlbse: 246.0; Last Wlbse: 246.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48in ; SuspLoad: 26455.0; SuspKey: 1

AXLE 1 -- Load: 13227.5; AxleLoc[x]: 222.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:Tl.XZA11R225 | ST6T:Tl.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 13227.5; AxleLoc[x]: 270.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:Tl.XZA11R225 | ST6T:Tl.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

UNIT # 3 -- DOLLY; # of Rear Suspensions: 1; Rear HitchLoad: 17341.0  
 FILES: Tare: ST6T:Do.Convrt1Ax ; Load: ST6T:SL.Do9t ; Hitch: ST6T:Hl.5thWheel  
 WEIGHT: Total: 2500.1 ; Sprung: 1000.0 ; Payload: 0.0  
 XINERT: Total: 14995 ; Sprung: 10000 ; Payload: 0  
 YINERT: Total: 5895 ; Sprung: 5000 ; Payload: 0  
 ZINERT: Total: 10100 ; Sprung: 6000 ; Payload: 0  
 CGXLOC: Total: 72.0; Sprung: 72.0; Payload: 0.0  
 CGZLOC: Total: 29.6; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 72.0; Last Wlbse: 72.0; HitchLoc[x]: 72.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21Bsng1 ; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 72.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:Tl.XZA11R225 | ST6T:Tl.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

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UNIT # 4 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.0  
 FILES: Tare: ST6T:Se.27FtTndm ; Load: ST6T:SL.Se12t ; Hitch:  
 WEIGHT: Total: 43796.0; Sprung: 40796.0; Payload: 35296.0  
 XINERT: Total: 179403 ; Sprung: 144423 ; Payload: 104307  
 YINERT: Total: 1214937 ; Sprung: 1104543 ; Payload: 824762  
 ZINERT: Total: 1248264 ; Sprung: 1156450 ; Payload: 878972  
 CGXLOC: Total: 148.6; Sprung: 141.4; Payload: 137.8  
 CGZLOC: Total: 76.7; Sprung: 80.8; Payload: 82.7  
 LENGTH: EffWlbse: 246.0; Last Wlbse: 246.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 26455.0; SuspKey: 1

AXLE 1 -- Load: 13227.5; AxleLoc[x]: 222.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:Tl.XZA11R225 | ST6T:Tl.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 13227.5; AxleLoc[x]: 270.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:Tl.XZA11R225 | ST6T:Tl.XZA11R225 |

\*\*\*\*\*  
 \* RTAC STUDY \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC 6 axle C-train Doubles (43t/95k GCW), conf. 2.2, var. 1.00

# OF SPRUNG MASSES = 4  
 TOTAL # OF AXLES = 6  
 GROSS VEHICLE WEIGHT = 94796.69 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

| ARTICULATION PT #   | ON UNIT #   | DISTANCE AHEAD OF SPRUNG MASS C.G. (INCHES) | HEIGHT BELOW SPRUNG MASS C.G. (INCHES) | ROLL STIFFNESS (IN.LB/DEG) | TYPE OF CONSTRAINT |
|---------------------|-------------|---|--|----------------------------|--------------------|
| ARTICULATION PT # 1 | ON UNIT # 1 | -131.30                                     | 0.0                                    | 999999.88                  | 1                  |
|                     | ON UNIT # 2 | 139.04                                      | 34.18                                  |                            |                    |
| ARTICULATION PT # 2 | ON UNIT # 2 | -160.96                                     | 43.68                                  | 29999.98                   | 1                  |
|                     | ON UNIT # 3 | 72.00                                       | 9.50                                   |                            |                    |
| ARTICULATION PT # 3 | ON UNIT # 3 | 0.0   | 0.0                                    | 999999.88                  | 1                  |
|                     | ON UNIT # 4 | 138.78                                      | 34.23                                  |                            |                    |

LINKED ARTICULATION: GAIN: 0.001 STIFFNESS: 1000000.000 (IN-LB/DEG GAMMA2)

TYPE OF CONSTRAINT : 01 CONVENTIONAL 5TH WHEEL  
 02 INVERTED 5TH WHEEL  
 03 PINTLE HOOK  
 04 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00  
TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00  
MECHANICAL TRAIL (IN) = 1.00  
# OF POINTS IN PATH TABLE = 4

| X (FEET) | Y (FEET) |
|----------|----------|
| 0.0      | 0.0      |
| 45.00    | 0.0      |
| 50.00    | 0.0      |
| 1500.00  | 0.0      |

RTAC 6 axle C-train Doubles (43t/95k GCW), conf. 2.2. var. 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 1 AXLE # 2 AXLE # 3 AXLE #  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 9921.00 12676.50 12676.50

AXLE WEIGHT (LB.) 1200.00 2500.00 2500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 3700.00 5100.00 5100.00

X DIST FROM SP MASS CG (IN) 55.00 -105.00 -165.00

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 18.25 33.00 33.00

HALF SPRING SPACING (IN) 16.00 19.00 19.00

HALF TRACK - INNER TIRES (IN) 40.00 29.50 29.50

DUAL TIRE SPACING (IN) 0.0 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.22 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 3824.00 30000.00 85000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 475.00 1000.00 1000.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 22.26 0.0 0.0

SPRING TABLE # 1 2 2

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1



RTAC 6 axle C-train Doubles (43t/95k GCW), conf. 2.2, var. 1.00

UNIT # 2

\*\*\*\*\*

# OF AXLES ON THIS UNIT = 1

WEIGHT OF SPRUNG MASS = 35614.80 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 119730.81 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 959056.31 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1011193.50 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 78.18 INCHES

AXLE # 4 AXLE #  
\*\*\*\*\*

|  |          |
|--|----------|
| LOAD ON EACH AXLE (LB.)                        | 19841.00 |
| AXLE WEIGHT (LB.)                              | 1500.00  |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 4100.00  |
| X DIST FROM SP MASS CG (IN)                    | -130.96  |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00    |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 27.00    |
| HALF SPRING SPACING (IN)                       | 22.00    |
| HALF TRACK - INNER TIRES (IN)                  | 32.50    |
| DUAL TIRE SPACING (IN)                         | 13.00    |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00  |
| ROLL STEER COEFFICIENT                         | 0.23     |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 9000.00  |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 975.00   |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 0.0      |
| SPRING TABLE #                                 | 3        |
| CORNERING FORCE TABLE #                        | 1        |
| ALIGNING TORQUE TABLE #                        | 1        |

RTAC 6 axle C-train Doubles (43t/95k GCW), conf. 2.2, var. 1.00

UNIT # 3  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 1

WEIGHT OF SPRUNG MASS = 1000.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 10000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 5000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 6000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 5 AXLE # \*\*\*\*\*  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 19841.00

AXLE WEIGHT (LB.) 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00

X DIST FROM SP MASS CG (IN) 0.0

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00

HALF SPRING SPACING (IN) 22.00

HALF TRACK - INNER TIRES (IN) 32.50

DUAL TIRE SPACING (IN) 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00

ROLL STEER COEFFICIENT 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0

SPRING TABLE # 3

CORNERING FORCE TABLE # 1

ALIGNING TORQUE TABLE # 1

AXLE 5 IS SELF STEERING

PRIMARY STIFFNESS, IN-LB/DEG: 400000.00  
COULOMB FRICTION, IN-LB: 15000.00  
MECHANICAL TRAIL, INCHES: 6.00

STEERING TORQUE AND DISPLACEMENT BOUNDARIES

| TORQUE, IN-LB | ANGLE, DEG |
|---------------|------------|
| -56700.00     | -30.000    |
| -13200.00     | -1.000     |
| -400.00       | -0.500     |
| 0.0           | 0.0        |
| 400.00        | 0.500      |
| 13200.00      | 1.000      |
| 56700.00      | 30.000     |

RTAC 6 axle C-train Doubles (43t/95k GCW), conf. 2.2, var. 1.00

UNIT # 4  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 1

WEIGHT OF SPRUNG MASS = 35681.90 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 119995.25 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 960830.88 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1013005.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 78.23 INCHES

AXLE # 6 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 19841.00

AXLE WEIGHT (LB.) 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00

X DIST FROM SP MASS CG (IN) -131.22

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00

HALF SPRING SPACING (IN) 22.00

HALF TRACK - INNER TIRES (IN) 32.50

DUAL TIRE SPACING (IN) 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00

ROLL STEER COEFFICIENT 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0

SPRING TABLE # 3

CORNERING FORCE TABLE # 1

ALIGNING TORQUE TABLE # 1

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLE

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |



ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC 6 axle C-train Doubles (43t/95k GCW), conf. 2.2, var. 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 4  
\* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 17274.0  
FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr4.511.5 ; Hitch: ST6T:H1.5thWheel  
WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
LENGTH: EffWbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 186.3

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 9921.0 ; SuspKey: 0

AXLE 1 -- Load: 9921.0; AxleLoc[x]: 0.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.IHref.Frt ST6T:Sp.IHref.Frt  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.StrAxle ST6T:Br.StrAxle  
ALOCK :

SUSPENSION # 1; SuspFile: ST6T:Su.HknWk8m44 ; SuspLoad: 25353.0; SuspKey: 2

AXLE 1 -- Load: 12676.5; AxleLoc[x]: 160.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRte440 ST6T:Sp.HknRte440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

AXLE 2 -- Load: 12676.5; AxleLoc[x]: 220.0

Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRte440 ST6T:Sp.HknRte440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.1  
FILES: Tare: ST6T:Se.27FtSngl ; Load: ST6T:SL.Se9t ; Hitch: ST6T:H1.BDo11yRef  
WEIGHT: Total: 37114.9; Sprung: 35614.8; Payload: 30614.8  
XINERT: Total: 136453 ; Sprung: 119731 ; Payload: 85092  
YINERT: Total: 1035598 ; Sprung: 959056 ; Payload: 709996  
ZINERT: Total: 1079213 ; Sprung: 1011194 ; Payload: 762397  
CGXLOC: Total: 144.3; Sprung: 139.0; Payload: 136.1  
CGZLOC: Total: 75.8; Sprung: 78.2; Payload: 78.9  
LENGTH: EffWbse: 270.0; Last Wlbse: 270.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21Bsngl ; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 270.0

Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 3 -- DOLLY: # of Rear Suspensions: 1; Rear HitchLoad: 17341.0  
 FILES: Tare: ST6T:Do.ConvrtfAx ; Load: ST6T:SL.Do9t ; Hitch: ST6T:HI.5thWheel  
 WEIGHT: Total: 2500.1 ; Sprung: 1000.0 ; Payload: 0.0  
 XINERT: Total: 14995 ; Sprung: 10000 ; Payload: 0  
 YINERT: Total: 5895 ; Sprung: 5000 ; Payload: 0  
 ZINERT: Total: 10100 ; Sprung: 6000 ; Payload: 0  
 CGXLOC: Total: 72.0; Sprung: 72.0; Payload: 0.0  
 CGZLOC: Total: 29.6; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 72.0; Last Wlbse: 72.0; HitchLoc[x]: 72.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21Bsngl ; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 72.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 4 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.0  
 FILES: Tare: ST6T:Se.27FtSngl ; Load: ST6T:SL.Segt ; Hitch:  
 WEIGHT: Total: 37182.0; Sprung: 35681.9; Payload: 30681.9  
 XINERT: Total: 136739 ; Sprung: 119995 ; Payload: 85350  
 YINERT: Total: 1037654 ; Sprung: 960831 ; Payload: 711624  
 ZINERT: Total: 1081284 ; Sprung: 1013005 ; Payload: 764068  
 CGXLOC: Total: 144.1; Sprung: 138.8; Payload: 135.8  
 CGZLOC: Total: 75.9; Sprung: 78.2; Payload: 78.9  
 LENGTH: EffWlbse: 270.0; Last Wlbse: 270.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21Bsngl ; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 270.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

\*\*\*\*\*  
 \* RTAC STUDY \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC mixed (7 axle) C-Train (53.5t/118k GCW), conf. 2.3, var. 1.00

# OF SPRUNG MASSES = 4  
 TOTAL # OF AXLES = 7  
 GROSS VEHICLE WEIGHT = 117944.75 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

| ARTICULATION PT # | ON UNIT # | DISTANCE AHEAD OF SPRUNG MASS C.G. (INCHES) | HEIGHT BELOW SPRUNG MASS C.G. (INCHES) | ROLL STIFFNESS (IN.LB/DEG) | TYPE OF CONSTRAINT |
|-------------------|-----------|---|--|----------------------------|--------------------|
| 1                 | 1         | -117.25                                     | 0.0                                    | 999999.88                  | 1                  |
| 2                 | 2         | 129.18                                      | 49.45                                  |                            |                    |
| 3                 | 2         | -170.82                                     | 58.95                                  | 299999.98                  | 1                  |
| 4                 | 3         | 72.00                                       | 9.50                                   |                            |                    |
| 5                 | 3         | 0.0   | 0.0                                    | 999999.88                  | 1                  |
| 6                 | 4         | 138.78                                      | 34.23                                  |                            |                    |

LINKED ARTICULATION: GAIN: 0.001 STIFFNESS: 1000000.000 (IN-LB/DEG GAMMA2)

TYPE OF CONSTRAINT :  
 O1 CONVENTIONAL 5TH WHEEL  
 O2 INVERTED 5TH WHEEL  
 O3 PINTLE HOOK  
 O4 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00  
TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00  
MECHANICAL TRAIL (IN) = 1.00  
# OF POINTS IN PATH TABLE = 4

| X (FEET) | Y (FEET) |
|----------|----------|
| 0.0      | 0.0      |
| 45.00    | 0.0      |
| 50.00    | 0.0      |
| 1500.00  | 0.0      |

RTAC mixed (7 axle) C-Train (53.5t/118k GCW), conf. 2.3, var. 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

|  | AXLE # 1 | AXLE # 2 | AXLE # 3 | AXLE # |
|--|----------|----------|----------|--------|
|  | *****    | *****    | *****    | *****  |

|                         |          |          |          |
|-------------------------|----------|----------|----------|
| LOAD ON EACH AXLE (LB.) | 12125.00 | 16534.50 | 16534.50 |
|-------------------------|----------|----------|----------|

|                   |         |         |         |
|-------------------|---------|---------|---------|
| AXLE WEIGHT (LB.) | 1200.00 | 2500.00 | 2500.00 |
|-------------------|---------|---------|---------|

|                              |         |         |         |
|------------------------------|---------|---------|---------|
| AXLE ROLL M.I (LB.IN.SEC**2) | 3700.00 | 5100.00 | 5100.00 |
|------------------------------|---------|---------|---------|

|                             |       |         |         |
|-----------------------------|-------|---------|---------|
| X DIST FROM SP MASS CG (IN) | 55.00 | -105.00 | -165.00 |
|-----------------------------|-------|---------|---------|

|   |       |       |       |
|---|-------|-------|-------|
| HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) | 20.00 | 20.00 | 20.00 |
|---|-------|-------|-------|

|   |       |       |       |
|---|-------|-------|-------|
| HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) | 18.25 | 33.00 | 33.00 |
|---|-------|-------|-------|

|                          |       |       |       |
|--------------------------|-------|-------|-------|
| HALF SPRING SPACING (IN) | 16.00 | 19.00 | 19.00 |
|--------------------------|-------|-------|-------|

|                               |       |       |       |
|-------------------------------|-------|-------|-------|
| HALF TRACK - INNER TIRES (IN) | 40.00 | 29.50 | 29.50 |
|-------------------------------|-------|-------|-------|

|                        |     |       |       |
|------------------------|-----|-------|-------|
| DUAL TIRE SPACING (IN) | 0.0 | 13.00 | 13.00 |
|------------------------|-----|-------|-------|

|                                |         |         |         |
|--------------------------------|---------|---------|---------|
| STIFFNESS OF EACH TIRE (LB/IN) | 4500.00 | 4500.00 | 4500.00 |
|--------------------------------|---------|---------|---------|

|                        |     |      |      |
|------------------------|-----|------|------|
| ROLL STEER COEFFICIENT | 0.0 | 0.22 | 0.23 |
|------------------------|-----|------|------|

|                                |         |          |          |
|--------------------------------|---------|----------|----------|
| AUX ROLL STIFFNESS (IN.LB/DEG) | 3824.00 | 30000.00 | 85000.00 |
|--------------------------------|---------|----------|----------|

|   |        |         |         |
|---|--------|---------|---------|
| SPRING COULOMB FRICTION - PER SPRING (LB) | 475.00 | 1000.00 | 1000.00 |
|---|--------|---------|---------|

|  |       |     |     |
|--|-------|-----|-----|
| VISCOUS DAMPING PER SPRING (LB.SEC/IN) | 22.26 | 0.0 | 0.0 |
|--|-------|-----|-----|

|                |   |   |   |
|----------------|---|---|---|
| SPRING TABLE # | 1 | 2 | 2 |
|----------------|---|---|---|

|                         |   |   |   |
|-------------------------|---|---|---|
| CORNERING FORCE TABLE # | 1 | 1 | 1 |
|-------------------------|---|---|---|

|                         |   |   |   |
|-------------------------|---|---|---|
| ALIGNING TORQUE TABLE # | 1 | 1 | 1 |
|-------------------------|---|---|---|

RTAC mixed (7 axle) C-Train (53.5t/118k GCW), conf. 2.3, var. 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 57262.90 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 242473.88 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 1549794.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1577604.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 93.45 INCHES

AXLE # 4 AXLE # 5 AXLE #  
\*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

LOAD ON EACH AXLE (LB.) 16534.50 16534.50

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -92.82 -140.82

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

RTAC mixed (7 axle) C-Train (53.5t/118k GCW), conf. 2.3, var. 1.00

UNIT # 3  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 1

WEIGHT OF SPRUNG MASS = 1000.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 10000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 5000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 6000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 6 AXLE #  
\*\*\*\*\*

|  |          |
|--|----------|
| LOAD ON EACH AXLE (LB.)                        | 19841.00 |
| AXLE WEIGHT (LB.)                              | 1500.00  |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 4100.00  |
| X DIST FROM SP MASS CG (IN)                    | 0.0      |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00    |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 27.00    |
| SO<br>∞  |          |
| HALF SPRING SPACING (IN)                       | 22.00    |
| HALF TRACK - INNER TIRES (IN)                  | 32.50    |
| DUAL TIRE SPACING (IN)                         | 13.00    |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00  |
| ROLL STEER COEFFICIENT                         | 0.23     |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 9000.00  |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 975.00   |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 0.0      |
| SPRING TABLE #                                 | 3        |
| CORNERING FORCE TABLE #                        | 1        |
| ALIGNING TORQUE TABLE #                        | 1        |



AXLE 6 IS SELF STEERING

PRIMARY STIFFNESS, IN-LB/DEG: 400000.00  
COULOMB FRICTION, IN-LB: 15000.00  
MECHANICAL TRAIL, INCHES: 6.00

STEERING TORQUE AND DISPLACEMENT BOUNDRIES

| TORQUE, IN-LB | ANGLE, DEG |
|---------------|------------|
| -56700.00     | -30.000    |
| -13200.00     | -1.000     |
| -400.00       | -0.500     |
| 0.0           | 0.0        |
| 400.00        | 0.500      |
| 13200.00      | 1.000      |
| 56700.00      | 30.000     |

RTAC mixed (7 axle) C-Train (53.5t/118k GCW), conf. 2.3, var. 1.00

UNIT # 4

\*\*\*\*\*

# OF AXLES ON THIS UNIT = 1

WEIGHT OF SPRUNG MASS = 35681.90 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 119995.25 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 960830.88 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1013005.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 78.23 INCHES

AXLE # 7 AXLE #  
\*\*\*\*\*

|  |          |
|--|----------|
| LOAD ON EACH AXLE (LB.)                        | 19841.00 |
| AXLE WEIGHT (LB.)                              | 1500.00  |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 4100.00  |
| X DIST FROM SP MASS CG (IN)                    | -131.22  |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00    |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 27.00    |
| 100<br>HALF SPRING SPACING (IN)                | 22.00    |
| HALF TRACK - INNER TIRES (IN)                  | 32.50    |
| DUAL TIRE SPACING (IN)                         | 13.00    |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00  |
| ROLL STEER COEFFICIENT                         | 0.23     |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 9000.00  |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 975.00   |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 0.0      |
| SPRING TABLE #                                 | 3        |
| CORNERING FORCE TABLE #                        | 1        |
| ALIGNING TORQUE TABLE #                        | 1        |

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC mixed (7 axle) C-Train (53.5t/118k GCW), conf. 2.3, var. 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 4  
\* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 27194.0  
FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr5.5t15t ; Hitch: ST6T:H1.5thWheel  
WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
LENGTH: EffWbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 172.2

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

AXLE 1 -- Load: 12125.0; AxleLoc[x]: 0.0 Rhs  
Axle Files  
-----  
SPRING : ST6T:Sp.IHref.Frt  
TIRE : ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.StrAxle  
ALOCK :

SUSPENSION # 1; SuspFile: ST6T:Su.HknWk8m44 ; SuspLoad: 33069.0; SuspKey: 2

AXLE 1 -- Load: 16534.5; AxleLoc[x]: 160.0 Rhs  
Axle Files  
-----  
SPRING : ST6T:Sp.HknRte440  
TIRE : ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle  
ALOCK :

AXLE 2 -- Load: 16534.5; AxleLoc[x]: 220.0 Rhs  
Axle Files  
-----  
SPRING : ST6T:Sp.HknRte440  
TIRE : ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle  
ALOCK :

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.1  
FILES: Tare: ST6T:Se.27FtTndm ; Load: ST6T:SL.Se15t ; Hitch: ST6T:H1.Bdo11yRef  
WEIGHT: Total: 60262.9; Sprung: 57262.9; Payload: 51762.9  
XINERT: Total: 290504 ; Sprung: 242474 ; Payload: 195241  
YINERT: Total: 1694866 ; Sprung: 1549794 ; Payload: 1251816  
ZINERT: Total: 1691046 ; Sprung: 1577604 ; Payload: 1289045  
CGXLOC: Total: 135.0; Sprung: 129.2; Payload: 125.4  
CGZLOC: Total: 89.8; Sprung: 93.4; Payload: 96.0  
LENGTH: EffWbse: 246.0; Last Wlbse: 246.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 33069.0; SuspKey: 1

AXLE 1 -- Load: 16534.5; AxleLoc[x]: 222.0



Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

AXLE 2 -- Load: 16534.5; AxleLoc[x]: 270.0  
 Axle Files Lhs Rhs

SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 3 -- DOLLY: # of Rear Suspensions: 1; Rear HitchLoad: 17341.0  
 FILES: Tare: ST6T:Do.Convrt1Ax; Load: ST6T:SL.Dogt; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 2500.1; Sprung: 1000.0; Payload: 0.0  
 XINERT: Total: 14995; Sprung: 10000; Payload: 0  
 YINERT: Total: 5895; Sprung: 5000; Payload: 0  
 ZINERT: Total: 10100; Sprung: 6000; Payload: 0  
 CGXLOC: Total: 72.0; Sprung: 72.0; Payload: 0.0  
 CGZLOC: Total: 29.6; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWbse: 72.0; Last Wlbse: 72.0; HitchLoc[x]: 72.0

SUSPENSION # 1: SuspFile: ST6T:Su.Rc21Bsngl; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 72.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 4 -- SEMI: # of Rear Suspensions: 1; Rear HitchLoad: 0.0  
 FILES: Tare: ST6T:Se.27FtSngl; Load: ST6T:SL.Se9t; Hitch:  
 WEIGHT: Total: 37182.0; Sprung: 35681.9; Payload: 30681.9  
 XINERT: Total: 136739; Sprung: 119995; Payload: 85350  
 YINERT: Total: 1037654; Sprung: 960831; Payload: 711624  
 ZINERT: Total: 1081284; Sprung: 1013005; Payload: 764068  
 CGXLOC: Total: 144.1; Sprung: 138.8; Payload: 135.8  
 CGZLOC: Total: 75.9; Sprung: 78.2; Payload: 78.9  
 LENGTH: EffWbse: 270.0; Last Wlbse: 270.0; HitchLoc[x]: 300.0

SUSPENSION # 1: SuspFile: ST6T:Su.Rc21Bsngl; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 270.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

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 \* RTAC STUDY \*  
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 \*DIRECTIONAL RESPONSE SIMULATION\*  
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RTAC Turnpike Doubles (56t/123k GCW), conf. 2.4, var. 1.00

# OF SPRUNG MASSES = 4  
 TOTAL # OF AXLES = 9  
 GROSS VEHICLE WEIGHT = 123458.00 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

| ARTICULATION PT # | ON UNIT # | DISTANCE AHEAD OF SPRUNG MASS C.G. (INCHES) | HEIGHT BELOW SPRUNG MASS C.G. (INCHES) | ROLL STIFFNESS (IN.LB/DEG) | TYPE OF CONSTRAINT |
|-------------------|-----------|---|--|----------------------------|--------------------|
| 1                 | 1         | -132.19                                     | 0.0                                    | 999999.88                  | 1                  |
| 2                 | 2         | 252.10                                      | 26.62                                  |                            |                    |
| 3                 | 3         | -287.90                                     | 36.12                                  | 0.0                        | 1                  |
| 4                 | 4         | 72.00                                       | 9.50                                   |                            |                    |
| 5                 | 5         | 0.0   | 0.0                                    | 999999.88                  | 1                  |
| 6                 | 6         | 250.66                                      | 26.72                                  |                            |                    |

TYPE OF CONSTRAINT : O1 CONVENTIONAL 5TH WHEEL  
 O2 INVERTED 5TH WHEEL  
 O3 PINTLE HOOK  
 O4 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN. LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00

# OF POINTS IN PATH TABLE = 4

| X (FEET) | Y (FEET) |
|----------|----------|
| 0.0      | 0.0      |
| 45.00    | 0.0      |
| 50.00    | 0.0      |
| 1500.00  | 0.0      |

RTAC Turnpike Doubles (56t/123k GCW), conf. 2.4, var. 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

|  | AXLE # 1<br>***** | AXLE # 2<br>***** | AXLE # 3<br>***** | AXLE #<br>***** | ***** | ***** | ***** | ***** |
|--|-------------------|-------------------|-------------------|-----------------|-------|-------|-------|-------|
| LOAD ON EACH AXLE (LB.)                        | 9921.00           | 15432.00          | 15432.00          |                 |       |       |       |       |
| AXLE WEIGHT (LB.)                              | 1200.00           | 2500.00           | 2500.00           |                 |       |       |       |       |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 3700.00           | 5100.00           | 5100.00           |                 |       |       |       |       |
| X DIST FROM SP MASS CG (IN)                    | 55.00             | -105.00           | -165.00           |                 |       |       |       |       |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00             | 20.00             | 20.00             |                 |       |       |       |       |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 18.25             | 33.00             | 33.00             |                 |       |       |       |       |
| 110<br>HALF SPRING SPACING (IN)                | 16.00             | 19.00             | 19.00             |                 |       |       |       |       |
| HALF TRACK - INNER TIRES (IN)                  | 40.00             | 29.50             | 29.50             |                 |       |       |       |       |
| DUAL TIRE SPACING (IN)                         | 0.0               | 13.00             | 13.00             |                 |       |       |       |       |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00           | 4500.00           | 4500.00           |                 |       |       |       |       |
| ROLL STEER COEFFICIENT                         | 0.0               | 0.22              | 0.23              |                 |       |       |       |       |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 3824.00           | 30000.00          | 85000.00          |                 |       |       |       |       |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 475.00            | 1000.00           | 1000.00           |                 |       |       |       |       |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 22.26             | 0.0               | 0.0               |                 |       |       |       |       |
| SPRING TABLE #                                 | 1                 | 2                 | 2                 |                 |       |       |       |       |
| CORNERING FORCE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |
| ALIGNING TORQUE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |

RTAC Turnpike Doubles (56t/123k GCW). conf. 2.4, var. 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 47343.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 170667.44 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 3701742.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 3775191.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 70.62 INCHES

AXLE # 4 AXLE # 5 AXLE #  
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\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 13779.00 13779.00

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -209.90 -257.90

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

RTAC Turnpike Doubles (56t/123k GCW), conf. 2.4, var. 1.00

UNIT # 3  
 \*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 1500.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 10000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 9000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 10000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

|  | AXLE # 6<br>***** | AXLE # 7<br>***** | AXLE #<br>***** | ***** | ***** | ***** | ***** | ***** |
|--|-------------------|-------------------|-----------------|-------|-------|-------|-------|-------|
| LOAD ON EACH AXLE (LB.)                        | 13778.50          | 13778.50          |                 |       |       |       |       |       |
| AXLE WEIGHT (LB.)                              | 1500.00           | 1500.00           |                 |       |       |       |       |       |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 4100.00           | 4100.00           |                 |       |       |       |       |       |
| X DIST FROM SP MASS CG (IN)                    | 24.00             | -24.00            |                 |       |       |       |       |       |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00             | 20.00             |                 |       |       |       |       |       |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 27.00             | 27.00             |                 |       |       |       |       |       |
| 112<br>HALF SPRING SPACING (IN)                | 22.00             | 22.00             |                 |       |       |       |       |       |
| HALF TRACK - INNER TIRES (IN)                  | 32.50             | 32.50             |                 |       |       |       |       |       |
| DUAL TIRE SPACING (IN)                         | 13.00             | 13.00             |                 |       |       |       |       |       |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00           | 4500.00           |                 |       |       |       |       |       |
| ROLL STEER COEFFICIENT                         | 0.23              | 0.23              |                 |       |       |       |       |       |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 9000.00           | 9000.00           |                 |       |       |       |       |       |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 975.00            | 975.00            |                 |       |       |       |       |       |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 0.0               | 0.0               |                 |       |       |       |       |       |
| SPRING TABLE #                                 | 3                 | 3                 |                 |       |       |       |       |       |
| CORNERING FORCE TABLE #                        | 1                 | 1                 |                 |       |       |       |       |       |
| ALIGNING TORQUE TABLE #                        | 1                 | 1                 |                 |       |       |       |       |       |

RTAC Turnpike Doubles (56t/123k GCW), conf. 2.4, var. 1.00

UNIT # 4  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 47615.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 171469.56 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 3726140.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 3800009.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 70.72 INCHES

AXLE # 8 AXLE # 9 AXLE #  
\*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

LOAD ON EACH AXLE (LB.) 13779.00 13779.00

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -211.34 -259.34

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |



SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\* \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGL

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
\*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

| 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|---------|---------|---------|---------|---------|---------|
| 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
| 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
| 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
| 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
| 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC Turnpike Doubles (56t/123k GCW), conf. 2.4, var. 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 4  
 \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKR: # of Rear Suspensions: 1; Rear HitchLoad: 22785.0  
 FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr4.5t14t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
 XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
 YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
 ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
 CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
 CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 187.2

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 9921.0 ; SuspKey: 0

AXLE 1 -- Load: 9921.0; AxleLoc[x]: 0.0 Rhs  
 Axle Files  
 -----  
 SPRING : ST6T:Sp.IHref.Frt ST6T:Sp.IHref.Frt  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.StrAxle ST6T:Br.StrAxle  
 ALOCK :

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkM44 ; SuspLoad: 30864.0; SuspKey: 2

AXLE 1 -- Load: 15432.0; AxleLoc[x]: 160.0 Rhs  
 Axle Files  
 -----  
 SPRING : ST6T:Sp.HknRte440 ST6T:Sp.HknRte440  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

AXLE 2 -- Load: 15432.0; AxleLoc[x]: 220.0 Rhs  
 Axle Files  
 -----

SPRING : ST6T:Sp.HknRte440 ST6T:Sp.HknRte440  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.0  
 FILES: Tare: ST6T:Se.48FtIndm ; Load: ST6T:SL.Se12.5t ; Hitch: ST6T:H1.ADolly  
 WEIGHT: Total: 50343.0; Sprung: 47343.0; Payload: 36543.0  
 XINERT: Total: 197594 ; Sprung: 170667 ; Payload: 90662  
 YINERT: Total: 4124702 ; Sprung: 3701742 ; Payload: 2625389  
 ZINERT: Total: 4187625 ; Sprung: 3775191 ; Payload: 2698844  
 CGXLOC: Total: 266.0; Sprung: 252.1; Payload: 238.5  
 CGZLOC: Total: 67.6; Sprung: 70.6; Payload: 70.5  
 LENGTH: EffWlbse: 486.0; Last Wlbse: 486.0; HitchLoc[x]: 540.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 27558.0; SuspKey: 1

AXLE 1 -- Load: 13779.0; AxleLoc[x]: 462.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 13779.0; AxleLoc[x]: 510.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

UNIT # 3 -- DOLLY; # of Rear Suspensions: 1; Rear HitchLoad: 23057.0

FILES: Tare: ST6T:Do.Convrt2Ax ; Load: ST6T:SL.Do12.5t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 4500.0 ; Sprung: 1500.0 ; Payload: 0.0  
 XINERT: Total: 19692 ; Sprung: 10000 ; Payload: 0  
 YINERT: Total: 14967 ; Sprung: 9000 ; Payload: 0  
 ZINERT: Total: 22676 ; Sprung: 10000 ; Payload: 0  
 CGXL0C: Total: 72.0; Sprung: 72.0; Payload: 0.0  
 CGZL0C: Total: 28.0; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 72.0; Last Wlbse: 72.0; HitchLoc[x]: 72.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 27557.0; SuspKey: 1

AXLE 1 -- Load: 13778.5; AxleLoc[x]: 48.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 13778.5; AxleLoc[x]: 96.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

UNIT # 4 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.0

FILES: Tare: ST6T:Se.48FtTndm ; Load: ST6T:SL.Se12.5t ; Hitch:  
 WEIGHT: Total: 50615.0; Sprung: 47615.0; Payload: 36815.0  
 XINERT: Total: 198473 ; Sprung: 171470 ; Payload: 91467  
 YINERT: Total: 4154252 ; Sprung: 3726140 ; Payload: 2645060  
 ZINERT: Total: 4217518 ; Sprung: 3800009 ; Payload: 2718932  
 CGXL0C: Total: 264.6; Sprung: 250.7; Payload: 236.8  
 CGZL0C: Total: 67.7; Sprung: 70.7; Payload: 70.6  
 LENGTH: EffWlbse: 486.0; Last Wlbse: 486.0; HitchLoc[x]: 540.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 27558.0; SuspKey: 1

AXLE 1 -- Load: 13779.0; AxleLoc[x]: 462.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |



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 \* RTAC STUDY \*  
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 \*DIRECTIONAL RESPONSE SIMULATION\*  
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RTAC Rocky-Mountain C-Train (53.5t/118k GCW), conf. 2.5, var. 1.00

# OF SPRUNG MASSES = 4  
 TOTAL # OF AXLES = 7  
 GROSS VEHICLE WEIGHT = 117944.75 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

| ARTICULATION PT # | ON UNIT # | DISTANCE AHEAD OF SPRUNG MASS C.G. (INCHES) | HEIGHT BELOW SPRUNG MASS C.G. (INCHES) | ROLL STIFFNESS (IN. LB/DEG) | TYPE OF CONSTRAINT |
|-------------------|-----------|---|--|-----------------------------|--------------------|
| 1                 | 1         | -117.25                                     | 0.0                                    | 999999.88                   | 1                  |
| 2                 | 2         | 255.20                                      | 30.24                                  |                             |                    |
| 3                 | 2         | -284.80                                     | 39.74                                  | 29999.98                    | 1                  |
| 4                 | 3         | 72.00                                       | 9.50                                   |                             |                    |
| 5                 | 3         | 0.0   | 0.0                                    | 999999.88                   | 1                  |
| 6                 | 4         | 138.78                                      | 34.23                                  |                             |                    |

LINKED ARTICULATION: GAIN: 0.001 STIFFNESS: 1000000.000 (IN-LB/DEG GAMMA2)

TYPE OF CONSTRAINT : O1 CONVENTIONAL 5TH WHEEL  
 O2 INVERTED 5TH WHEEL  
 O3 PINTLE HOOK  
 O4 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00



STEERING STIFFNESS (IN.LB/DEG) = 11000.00  
 TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00  
 MECHANICAL TRAIL (IN) = 1.00  
 # OF POINTS IN PATH TABLE = 4

| X (FEET) | Y (FEET) |
|----------|----------|
| 0.0      | 0.0      |
| 45.00    | 0.0      |
| 50.00    | 0.0      |
| 1500.00  | 0.0      |

RTAC Rocky-Mountain C-Train (53.5t/118k GCW), conf. 2.5, var. 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

|  | AXLE # 1<br>***** | AXLE # 2<br>***** | AXLE # 3<br>***** | AXLE #<br>***** | ***** | ***** | ***** | ***** | ***** |
|--|-------------------|-------------------|-------------------|-----------------|-------|-------|-------|-------|-------|
| LOAD ON EACH AXLE (LB.)                        | 12125.00          | 16534.50          | 16534.50          |                 |       |       |       |       |       |
| AXLE WEIGHT (LB.)                              | 1200.00           | 2500.00           | 2500.00           |                 |       |       |       |       |       |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 3700.00           | 5100.00           | 5100.00           |                 |       |       |       |       |       |
| X DIST FROM SP MASS CG (IN)                    | 55.00             | -105.00           | -165.00           |                 |       |       |       |       |       |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00             | 20.00             | 20.00             |                 |       |       |       |       |       |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 18.25             | 33.00             | 33.00             |                 |       |       |       |       |       |
| 124<br>HALF SPRING SPACING (IN)                | 16.00             | 19.00             | 19.00             |                 |       |       |       |       |       |
| HALF TRACK - INNER TIRES (IN)                  | 40.00             | 29.50             | 29.50             |                 |       |       |       |       |       |
| DUAL TIRE SPACING (IN)                         | 0.0               | 13.00             | 13.00             |                 |       |       |       |       |       |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00           | 4500.00           | 4500.00           |                 |       |       |       |       |       |
| ROLL STEER COEFFICIENT                         | 0.0               | 0.22              | 0.23              |                 |       |       |       |       |       |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 3824.00           | 30000.00          | 85000.00          |                 |       |       |       |       |       |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 475.00            | 1000.00           | 1000.00           |                 |       |       |       |       |       |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 22.26             | 0.0               | 0.0               |                 |       |       |       |       |       |
| SPRING TABLE #                                 | 1                 | 2                 | 2                 |                 |       |       |       |       |       |
| CORNERING FORCE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |       |
| ALIGNING TORQUE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |       |

RTAC Rocky-Mountain C-Train (53.5t/118k GCW), conf. 2.5, var. 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 57262.90 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 202381.38 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 4408332.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 4494619.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 74.24 INCHES

AXLE # 4 AXLE # 5 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 16534.50 16534.50

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -206.80 -254.80

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

25

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

RTAC Rocky-Mountain C-Train (53.5t/118k GCW), conf. 2.5, var. 1.00

UNIT # 3  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 1

WEIGHT OF SPRUNG MASS = 1000.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 10000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 5000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 6000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 6 AXLE #  
\*\*\*\*\*

|  |          |
|--|----------|
| LOAD ON EACH AXLE (LB.)                        | 19841.00 |
| AXLE WEIGHT (LB.)                              | 1500.00  |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 4100.00  |
| X DIST FROM SP MASS CG (IN)                    | 0.0      |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00    |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 27.00    |
| 126<br>HALF SPRING SPACING (IN)                | 22.00    |
| HALF TRACK - INNER TIRES (IN)                  | 32.50    |
| DUAL TIRE SPACING (IN)                         | 13.00    |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00  |
| ROLL STEER COEFFICIENT                         | 0.23     |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 9000.00  |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 975.00   |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 0.0      |
| SPRING TABLE #                                 | 3        |
| CORNERING FORCE TABLE #                        | 1        |
| ALIGNING TORQUE TABLE #                        | 1        |

AXLE 6 IS SELF STEERING

PRIMARY STIFFNESS, IN-LB/DEG: 400000.00  
COULOMB FRICTION, IN-LB: 15000.00  
MECHANICAL TRAIL, INCHES: 6.00

STEERING TORQUE AND DISPLACEMENT BOUNDRIES

| TORQUE, IN-LB | ANGLE, DEG |
|---------------|------------|
| -56700.00     | -30.000    |
| -13200.00     | -1.000     |
| -400.00       | -0.500     |
| 0.0           | 0.0        |
| 400.00        | 0.500      |
| 13200.00      | 1.000      |
| 56700.00      | 30.000     |

RTAC Rocky-Mountain C-Train (53.5t/118k GCW), conf. 2.5, var. 1.00

UNIT # 4  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 1

WEIGHT OF SPRUNG MASS = 35681.90 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 119995.25 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 960830.88 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1013005.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 78.23 INCHES

AXLE # 7 AXLE #  
\*\*\*\*\*

|  |          |
|--|----------|
| LOAD ON EACH AXLE (LB.)                        | 19841.00 |
| AXLE WEIGHT (LB.)                              | 1500.00  |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 4100.00  |
| X DIST FROM SP MASS CG (IN)                    | -131.22  |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00    |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 27.00    |
| 120<br>∞<br>HALF SPRING SPACING (IN)           | 22.00    |
| HALF TRACK - INNER TIRES (IN)                  | 32.50    |
| DUAL TIRE SPACING (IN)                         | 13.00    |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00  |
| ROLL STEER COEFFICIENT                         | 0.23     |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 9000.00  |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 975.00   |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 0.0      |
| SPRING TABLE #                                 | 3        |
| CORNERING FORCE TABLE #                        | 1        |
| ALIGNING TORQUE TABLE #                        | 1        |

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |



SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

| 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|---------|--------|---------|---------|---------|---------|
| 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
| 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
| 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC Rocky-Mountain C-Train (53.5t/118k GCW), conf. 2.5, var. 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

- \* Number of units: 4
- \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 27194.0  
FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr5.5t15t ; Hitch: ST6T:H1.5thWheel  
WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 172.2

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

AXLE 1 -- Load: 12125.0; AxleLoc[x]: 0.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.IHref.Frnt ST6T:Sp.IHref.Frnt  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.StrAxle ST6T:Br.StrAxle  
ALOCK :

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkBm44 ; SuspLoad: 33069.0; SuspKey: 2

AXLE 1 -- Load: 16534.5; AxleLoc[x]: 160.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRte440 ST6T:Sp.HknRte440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

AXLE 2 -- Load: 16534.5; AxleLoc[x]: 220.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRte440 ST6T:Sp.HknRte440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.1  
FILES: Tare: ST6T:Se.48FtTndm ; Load: ST6T:SL.Se15t ; Hitch: ST6T:H1.BdollyRef  
WEIGHT: Total: 60262.9; Sprung: 57262.9; Payload: 46462.9  
XINERT: Total: 232305 ; Sprung: 202381 ; Payload: 122019  
YINERT: Total: 4827825 ; Sprung: 4408332 ; Payload: 3344818  
ZINERT: Total: 4900588 ; Sprung: 4494619 ; Payload: 3431467  
CGXLOC: Total: 266.7; Sprung: 255.2; Payload: 245.3  
CGZLOC: Total: 71.5; Sprung: 74.2; Payload: 75.0  
LENGTH: EffWlbse: 486.0; Last Wlbse: 486.0; HitchLoc[x]: 540.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 33069.0; SuspKey: 1

AXLE 1 -- Load: 16534.5; AxleLoc[x]: 462.0

Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

AXLE 2 -- Load: 16534.5; AxleLoc[x]: 510.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 3 -- DOLLY: # of Rear Suspensions: 1; Rear HitchLoad: 17341.0  
 FILES: Tare: ST6T:Do.Convrt1Ax; Load: ST6T:SL.Do9t; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 2500.1; Sprung: 1000.0; Payload: 0.0  
 XINERT: Total: 14995; Sprung: 10000; Payload: 0  
 YINERT: Total: 5895; Sprung: 5000; Payload: 0  
 ZINERT: Total: 10100; Sprung: 6000; Payload: 0  
 CGXLOC: Total: 72.0; Sprung: 72.0; Payload: 0.0  
 CGZLOC: Total: 29.6; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 72.0; Last Wlbse: 72.0; HitchLoc[x]: 72.0  
 SUSPENSION # 1; SuspFlle: ST6T:Su.Rc21Bsn9l; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 72.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 4 -- SEMI: # of Rear Suspensions: 1; Rear HitchLoad: 0.0  
 FILES: Tare: ST6T:Se.27FtSngl; Load: ST6T:SL.Se9t; Hitch:  
 WEIGHT: Total: 37182.0; Sprung: 35681.9; Payload: 30681.9  
 XINERT: Total: 136739; Sprung: 119995; Payload: 85350  
 YINERT: Total: 1037654; Sprung: 960831; Payload: 711624  
 ZINERT: Total: 1081284; Sprung: 1013005; Payload: 764068  
 CGXLOC: Total: 144.1; Sprung: 138.8; Payload: 135.8  
 CGZLOC: Total: 75.9; Sprung: 78.2; Payload: 78.9  
 LENGTH: EffWlbse: 270.0; Last Wlbse: 270.0; HitchLoc[x]: 300.0  
 SUSPENSION # 1; SuspFlle: ST6T:Su.Rc21Bsn9l; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 270.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

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 \* RTAC STUDY \*  
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\*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC two-semi 8 axle B-train (56.5t/125k GCW), conf. 3.1, var. 1.00

# OF SPRUNG MASSES = 3  
 TOTAL # OF AXLES = 8  
 GROSS VEHICLE WEIGHT = 124559.88 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

|                     |             | DISTANCE AHEAD<br>OF SPRUNG MASS<br>C.G. (INCHES) | HEIGHT BELOW<br>SPRUNG MASS<br>C.G. (INCHES) | ROLL STIFFNESS<br>(IN.LB/DEG) | TYPE OF<br>CONSTRAINT |
|---------------------|-------------|---|--|-------------------------------|-----------------------|
| ARTICULATION PT # 1 | ON UNIT # 1 | -117.25   | 0.0  | 999999.88                     | 1                     |
|                     | ON UNIT # 2 | 112.57  | 39.55  |                               |                       |
| ARTICULATION PT # 2 | ON UNIT # 2 | -215.43   | 39.55  | 999999.88                     | 1                     |
|                     | ON UNIT # 3 | 153.01  | 42.55  |                               |                       |

TYPE OF CONSTRAINT : 01 CONVENTIONAL 5TH WHEEL  
 02 INVERTED 5TH WHEEL  
 03 PINTLE HOOK  
 04 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00

# OF POINTS IN PATH TABLE = 4

RTAC two-semi 8 axle B-train (56.5t/125k GCW), conf. 3.1, var. 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 1 AXLE # 2 AXLE # 3 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 12125.00 16534.50 16534.50

AXLE WEIGHT (LB.) 1200.00 2500.00 2500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 3700.00 5100.00 5100.00

X DIST FROM SP MASS CG (IN) 55.00 -105.00 -165.00

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 18.25 33.00 33.00

HALF SPRING SPACING (IN) 16.00 19.00 19.00

HALF TRACK - INNER TIRES (IN) 40.00 29.50 29.50

DUAL TIRE SPACING (IN) 0.0 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.22 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 3824.00 30000.00 85000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 475.00 1000.00 1000.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 22.26 0.0 0.0

SPRING TABLE # 1 2 2

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1

RTAC two-semi 8 axle B-train (56.5t/125k GCW), conf. 3.1, var. 1.00

UNIT # 2  
 \*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 50717.44 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 210770.63 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 1538856.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1576125.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 83.55 INCHES

|  | AXLE # 4<br>***** | AXLE # 5<br>***** | AXLE # 6<br>***** | AXLE #<br>***** | ***** | ***** | ***** | ***** | ***** |
|--|-------------------|-------------------|-------------------|-----------------|-------|-------|-------|-------|-------|
| LOAD ON EACH AXLE (LB.)                        | 15432.00          | 15432.50          | 15432.50          |                 |       |       |       |       |       |
| AXLE WEIGHT (LB.)                              | 1500.00           | 1500.00           | 1500.00           |                 |       |       |       |       |       |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 4100.00           | 4100.00           | 4100.00           |                 |       |       |       |       |       |
| X DIST FROM SP MASS CG (IN)                    | -119.43           | -167.43           | -215.43           |                 |       |       |       |       |       |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00             | 20.00             | 20.00             |                 |       |       |       |       |       |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 27.00             | 27.00             | 27.00             |                 |       |       |       |       |       |
| 130<br>HALF SPRING SPACING (IN)                | 22.00             | 22.00             | 22.00             |                 |       |       |       |       |       |
| HALF TRACK - INNER TIRES (IN)                  | 32.50             | 32.50             | 32.50             |                 |       |       |       |       |       |
| DUAL TIRE SPACING (IN)                         | 13.00             | 13.00             | 13.00             |                 |       |       |       |       |       |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00           | 4500.00           | 4500.00           |                 |       |       |       |       |       |
| ROLL STEER COEFFICIENT                         | 0.23              | 0.23              | 0.23              |                 |       |       |       |       |       |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 9000.00           | 9000.00           | 9000.00           |                 |       |       |       |       |       |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 975.00            | 975.00            | 975.00            |                 |       |       |       |       |       |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 0.0               | 0.0               | 0.0               |                 |       |       |       |       |       |
| SPRING TABLE #                                 | 3                 | 3                 | 3                 |                 |       |       |       |       |       |
| CORNERING FORCE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |       |
| ALIGNING TORQUE TABLE #                        | 1                 | 1                 | 1                 |                 |       |       |       |       |       |



RTAC two-semi 8 axle B-train (56.5t/125k GCW). conf. 3.1, var. 1.00

UNIT # 3  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 48342.46 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 183761.44 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 1291085.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1337545.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 86.55 INCHES

AXLE # 7 AXLE # 8 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 16534.50 16534.50

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -68.99 -116.99

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

| 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|---------|--------|---------|---------|---------|---------|
| 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
| 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
| 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC two-sem1 8 axle B-train (56.5t/125k GCW), conf. 3.1, var. 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 3  
 \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKR; # of Rear Suspensions: 1; Rear HitchLoad: 27194.0  
 FILES: Tare: ST6T:Tr.3Ax190wb ; Load: ST6T:SL.Tr5.5t15t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
 XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
 YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
 ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
 CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
 CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 172.2

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

|        |    |                |                   |  |                   |
|--------|----|----------------|-------------------|--|-------------------|
| AXLE 1 | -- | Load: 12125.0; | AxleLoc[x]: 0.0   |  |                   |
|        |    | Axle Files     | Lhs               |  | Rhs               |
| -----  |    |                |                   |  |                   |
|        |    | SPRING :       | ST6T:Sp.IHref.Frt |  | ST6T:Sp.IHref.Frt |
|        |    | TIRE :         | ST6T:T1.XZA11R225 |  | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.StrAxle   |  | ST6T:Br.StrAxle   |
|        |    | ALOCK :        |                   |  |                   |

SUSPENSION # 1; SuspFile: ST6T:Su.HknWk8m44 ; SuspLoad: 33069.0; SuspKey: 2

|        |    |                |                   |  |                   |
|--------|----|----------------|-------------------|--|-------------------|
| AXLE 1 | -- | Load: 16534.5; | AxleLoc[x]: 160.0 |  |                   |
|        |    | Axle Files     | Lhs               |  | Rhs               |
| -----  |    |                |                   |  |                   |
|        |    | SPRING :       | ST6T:Sp.HknRTE440 |  | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         | ST6T:T1.XZA11R225 |  | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.DualsAxle |  | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |  |                   |

|        |    |                |                   |  |                   |
|--------|----|----------------|-------------------|--|-------------------|
| AXLE 2 | -- | Load: 16534.5; | AxleLoc[x]: 220.0 |  |                   |
|        |    | Axle Files     | Lhs               |  | Rhs               |
| -----  |    |                |                   |  |                   |
|        |    | SPRING :       | ST6T:Sp.HknRTE440 |  | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         | ST6T:T1.XZA11R225 |  | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.DualsAxle |  | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |  |                   |

UNIT # 2 -- SEMI ; # of Rear Suspensions: 2; Rear HitchLoad: 18273.5  
 FILES: Tare: ST6T:Se.B27FtTrdm ; Load: ST6T:SL.Se7t14t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 55217.5; Sprung: 50717.4; Payload: 42217.4  
 XINERT: Total: 266308 ; Sprung: 210771 ; Payload: 137663  
 YINERT: Total: 1900059 ; Sprung: 1538856 ; Payload: 999398  
 ZINERT: Total: 1906391 ; Sprung: 1576125 ; Payload: 1051336  
 CGXLOC: Total: 126.2; Sprung: 112.6; Payload: 100.2  
 CGZLOC: Total: 78.4; Sprung: 83.6; Payload: 88.3  
 LENGTH: EffWlbse: 280.0; Last Wlbse: 304.0; HitchLoc[x]: 328.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21Bsn1 ; SuspLoad: 15432.0; SuspKey: 0

|        |    |                |                   |  |  |
|--------|----|----------------|-------------------|--|--|
| AXLE 1 | -- | Load: 15432.0; | AxleLoc[x]: 232.0 |  |  |
|--------|----|----------------|-------------------|--|--|

```

Axle Files          Lhs          Rhs
-----
SPRING :           ST6T:Sp.MTC.Reyco
TIRE    :           ST6T:T1.XZA11R225
WHLBRK :           ST6T:Br.DualsAx1e
ALOCK   :

```

SUSPENSION # 2; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 30865.0; SuspKey: 1

```

AXLE 1  -- Load: 15432.5; AxleLoc[x]: 280.0
Axle Files          Lhs          Rhs
-----
SPRING :           ST6T:Sp.MTC.Reyco
TIRE    :           ST6T:T1.XZA11R225
WHLBRK :           ST6T:Br.DualsAx1e
ALOCK   :

```

```

AXLE 2  -- Load: 15432.5; AxleLoc[x]: 328.0
Axle Files          Lhs          Rhs
-----
SPRING :           ST6T:Sp.MTC.Reyco
TIRE    :           ST6T:T1.XZA11R225
WHLBRK :           ST6T:Br.DualsAx1e
ALOCK   :

```

```

UNIT # 3  -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.0
FILES: Tare: ST6T:Se.27ftIndm ; Load: ST6T:SL.Se15t ; Hitch:
WEIGHT: Total: 51342.5; Sprung: 48342.5; Payload: 42842.5
XINERT: Total: 224361 ; Sprung: 183761 ; Payload: 140999
YINERT: Total: 1391220 ; Sprung: 1291085 ; Payload: 1015491
ZINERT: Total: 1413480 ; Sprung: 1337545 ; Payload: 1066900
CGXLOC: Total: 158.4; Sprung: 153.0; Payload: 151.5
CGZLOC: Total: 82.7; Sprung: 86.5; Payload: 88.8
LENGTH: EffW1bse: 246.0; Last W1bse: 246.0; HitchLoc[x]: 300.0

```

```

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 33069.0; SuspKey: 1
AXLE 1  -- Load: 16534.5; AxleLoc[x]: 222.0
Axle Files          Lhs          Rhs
-----
SPRING :           ST6T:Sp.MTC.Reyco
TIRE    :           ST6T:T1.XZA11R225
WHLBRK :           ST6T:Br.DualsAx1e
ALOCK   :

```

```

AXLE 2  -- Load: 16534.5; AxleLoc[x]: 270.0
Axle Files          Lhs          Rhs
-----
SPRING :           ST6T:Sp.MTC.Reyco
TIRE    :           ST6T:T1.XZA11R225
WHLBRK :           ST6T:Br.DualsAx1e
ALOCK   :

```



\*\*\*\*\*  
 \* RTAC STUDY \*  
 \*\*\*\*\*  
 \*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC two-semi 7 axle B-train (53.5t/118k GCW), conf. 3.2, var. 1.00

# OF SPRUNG MASSES = 3  
 TOTAL # OF AXLES = 7  
 GROSS VEHICLE WEIGHT = 117947.00 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

| ARTICULATION PT # | ON UNIT # | DISTANCE AHEAD OF SPRUNG MASS C.G. (INCHES) | HEIGHT BELOW SPRUNG MASS C.G. (INCHES) | ROLL STIFFNESS (IN.LB/DEG) | TYPE OF CONSTRAINT |
|-------------------|-----------|---|--|----------------------------|--------------------|
| 1                 | 1         | -118.58                                     | 0.0                                    | 999999.88                  | 1                  |
| 2                 | 2         | 111.70                                      | 38.53                                  |                            |                    |
| 3                 | 2         | -216.30                                     | 38.53                                  | 999999.88                  | 1                  |
| 4                 | 3         | 173.40                                      | 40.59                                  |                            |                    |

TYPE OF CONSTRAINT :  
 O1 CONVENTIONAL 5TH WHEEL  
 O2 INVERTED 5TH WHEEL  
 O3 PINTLE HOOK  
 O4 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00  
 # OF POINTS IN PATH TABLE = 4

RTAC two-sem1 7 axle B-train (53.5t/118k GCW), conf. 3.2, var. 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 1 AXLE # 2 AXLE # 3 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 12125.00 17637.00 17637.00 17637.00

AXLE WEIGHT (LB.) 1200.00 2500.00 2500.00 2500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 3700.00 5100.00 5100.00 5100.00

X DIST FROM SP MASS CG (IN) 55.00 -105.00 -165.00

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 18.25 33.00 33.00

HALF SPRING SPACING (IN) 16.00 19.00 19.00

HALF TRACK - INNER TIRES (IN) 40.00 29.50 29.50

DUAL TIRE SPACING (IN) 0.0 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.22 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 3824.00 30000.00 85000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 475.00 1000.00 1000.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 22.26 0.0 0.0

SPRING TABLE # 1 2 2

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1

RTAC two-sem1 7 axle B-train (53.5t/118k GCW), conf. 3.2, var. 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 48161.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 192557.31 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 1436088.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1478896.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 82.53 INCHES

AXLE # 4 AXLE # 5 AXLE #  
\*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

LOAD ON EACH AXLE (LB.) 17637.00 17637.00

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -168.30 -216.30

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

RTAC two-semi 7 axle B-train (53.5t/118k GCW), conf. 3.2, var. 1.00

UNIT # 3  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 45786.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 169458.75 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 1223433.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1272714.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 84.59 INCHES

|  | AXLE # 6<br>***** | AXLE # 7<br>***** | AXLE #<br>***** | ***** | ***** | ***** | ***** | ***** |
|--|-------------------|-------------------|-----------------|-------|-------|-------|-------|-------|
| LOAD ON EACH AXLE (LB.)                        | 17637.00          | 17637.00          |                 |       |       |       |       |       |
| AXLE WEIGHT (LB.)                              | 1500.00           | 1500.00           |                 |       |       |       |       |       |
| AXLE ROLL M.I (LB.IN.SEC**2)                   | 4100.00           | 4100.00           |                 |       |       |       |       |       |
| X DIST FROM SP MASS CG (IN)                    | -48.60            | -96.60            |                 |       |       |       |       |       |
| HEIGHT OF AXLE C.G. ABOVE<br>GROUND (INCHES)   | 20.00             | 20.00             |                 |       |       |       |       |       |
| HEIGHT OF ROLL CENTER ABOVE<br>GROUND (INCHES) | 27.00             | 27.00             |                 |       |       |       |       |       |
| 5<br>O<br>HALF SPRING SPACING (IN)             | 22.00             | 22.00             |                 |       |       |       |       |       |
| HALF TRACK - INNER TIRES (IN)                  | 32.50             | 32.50             |                 |       |       |       |       |       |
| DUAL TIRE SPACING (IN)                         | 13.00             | 13.00             |                 |       |       |       |       |       |
| STIFFNESS OF EACH TIRE (LB/IN)                 | 4500.00           | 4500.00           |                 |       |       |       |       |       |
| ROLL STEER COEFFICIENT                         | 0.23              | 0.23              |                 |       |       |       |       |       |
| AUX ROLL STIFFNESS (IN.LB/DEG)                 | 9000.00           | 9000.00           |                 |       |       |       |       |       |
| SPRING COULOMB FRICTION -<br>PER SPRING (LB)   | 975.00            | 975.00            |                 |       |       |       |       |       |
| VISCOUS DAMPING PER SPRING<br>(LB.SEC/IN)      | 0.0               | 0.0               |                 |       |       |       |       |       |
| SPRING TABLE #                                 | 3                 | 3                 |                 |       |       |       |       |       |
| CORNERING FORCE TABLE #                        | 1                 | 1                 |                 |       |       |       |       |       |
| ALIGNING TORQUE TABLE #                        | 1                 | 1                 |                 |       |       |       |       |       |

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |



ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|
| 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
| 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
| 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
| 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
| 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
| 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 3  
 \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 29399.0  
 FILES: Tare: ST6T:Tr.3Ax190wb ; Load: ST6T:SL.Tr5.5t16t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
 XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
 ZINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
 CGXLOC: Total: 387605 ; Sprung: 170000 ; Payload: 0  
 CGZLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
 LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 173.6

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

|        |    |                |                   |  |                   |
|--------|----|----------------|-------------------|--|-------------------|
| AXLE 1 | -- | Load: 12125.0; | AxleLoc[x]: 0.0   |  |                   |
|        |    | Axle Files     |                   |  | Rhs               |
|        |    | -----          |                   |  |                   |
|        |    | SPRING :       | ST6T:Sp.IHref.Frt |  | ST6T:Sp.IHref.Frt |
|        |    | TIRE :         | ST6T:T1.XZA11R225 |  | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.StrAxle   |  | ST6T:Br.StrAxle   |
|        |    | ALOCK :        |                   |  |                   |

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkM44 ; SuspLoad: 35274.0; SuspKey: 2

|        |    |                |                   |  |                   |
|--------|----|----------------|-------------------|--|-------------------|
| AXLE 1 | -- | Load: 17637.0; | AxleLoc[x]: 160.0 |  |                   |
|        |    | Axle Files     |                   |  | Rhs               |
|        |    | -----          |                   |  |                   |
|        |    | SPRING :       | ST6T:Sp.HknRTE440 |  | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         | ST6T:T1.XZA11R225 |  | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.DualsAxle |  | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |  |                   |

|        |    |                |                   |  |                   |
|--------|----|----------------|-------------------|--|-------------------|
| AXLE 2 | -- | Load: 17637.0; | AxleLoc[x]: 220.0 |  |                   |
|        |    | Axle Files     |                   |  | Rhs               |
|        |    | -----          |                   |  |                   |
|        |    | SPRING :       | ST6T:Sp.HknRTE440 |  | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         | ST6T:T1.XZA11R225 |  | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.DualsAxle |  | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |  |                   |

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 13512.0  
 FILES: Tare: ST6T:Se.B27ftIndm ; Load: ST6T:SL.Se16t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 51161.0; Sprung: 48161.0; Payload: 40161.0  
 XINERT: Total: 229359 ; Sprung: 192557 ; Payload: 127082  
 ZINERT: Total: 1739659 ; Sprung: 1436088 ; Payload: 946841  
 CGXLOC: Total: 1762065 ; Sprung: 1478896 ; Payload: 1000124  
 CGZLOC: Total: 123.0; Sprung: 111.7; Payload: 100.5  
 LENGTH: EffWlbse: 304.0; Last Wlbse: 304.0; HitchLoc[x]: 328.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 35274.0; SuspKey: 1

|        |    |                |                   |  |  |
|--------|----|----------------|-------------------|--|--|
| AXLE 1 | -- | Load: 17637.0; | AxleLoc[x]: 280.0 |  |  |
|--------|----|----------------|-------------------|--|--|

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 17637.0; AxleLoc[x]: 328.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

UNIT # 3 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.0  
 FILES: Tare: ST6T:Se.27ftTndm ; Load: ST6T:SL.Se16t ; Hitch:  
 WEIGHT: Total: 48786.0; Sprung: 45786.0; Payload: 40286.0  
 XINERT: Total: 208086 ; Sprung: 169459 ; Payload: 127708  
 YINERT: Total: 1296768 ; Sprung: 1223433 ; Payload: 950019  
 ZINERT: Total: 1323823 ; Sprung: 1272714 ; Payload: 1003237  
 CGXLOC: Total: 177.9; Sprung: 173.4; Payload: 174.5  
 CGZLOC: Total: 80.6; Sprung: 84.6; Payload: 86.7  
 LENGTH: EffWlbse: 246.0; Last Wlbse: 246.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 35274.0; SuspKey: 1

AXLE 1 -- Load: 17637.0; AxleLoc[x]: 222.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 17637.0; AxleLoc[x]: 270.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

\*\*\*\*\*  
 \* RTAC STUDY \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC two-semi 6 axle B-train (41.5t/91.5k GCW), conf. 3.3, var. 1.00

# OF SPRUNG MASSES = 3  
 TOTAL # OF AXLES = 6  
 GROSS VEHICLE WEIGHT = 93695.88 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

|                     |             | DISTANCE AHEAD<br>OF SPRUNG MASS<br>C.G. (INCHES) | HEIGHT BELOW<br>SPRUNG MASS<br>C.G. (INCHES) | ROLL STIFFNESS<br>(IN.LB/DEG) | TYPE OF<br>CONSTRAINT |
|---------------------|-------------|---|--|-------------------------------|-----------------------|
| ARTICULATION PT # 1 | ON UNIT # 1 | -131.89   | 0.0  | 999999.88                     | 1                     |
|                     | ON UNIT # 2 | 136.73  | 31.91  |                               |                       |
| ARTICULATION PT # 2 | ON UNIT # 2 | -191.27   | 31.91  | 999999.88                     | 1                     |
|                     | ON UNIT # 3 | 155.47  | 31.53  |                               |                       |

TYPE OF CONSTRAINT : 01 CONVENTIONAL 5TH WHEEL  
 02 INVERTED 5TH WHEEL  
 03 PINTLE HOOK  
 04 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00  
 # OF POINTS IN PATH TABLE = 4

RTAC two-semi 6 axle B-train (41.5t/91.5k GCW), conf. 3.3, var. 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 1 AXLE # 2 AXLE # 3 AXLE #  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 9921.00 14330.00 14330.00

AXLE WEIGHT (LB.) 1200.00 2500.00 2500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 3700.00 5100.00 5100.00

X DIST FROM SP MASS CG (IN) 55.00 -105.00 -165.00

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 18.25 33.00 33.00

HALF SPRING SPACING (IN) 16.00 19.00 19.00

HALF TRACK - INNER TIRES (IN) 40.00 29.50 29.50

DUAL TIRE SPACING (IN) 0.0 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.22 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 3824.00 30000.00 85000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 475.00 1000.00 1000.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 22.26 0.0 0.0

SPRING TABLE # 1 2 2

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1

RTAC two-semi 6 axle B-train (41.5t/91.5k GCW), conf. 3.3, var. 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 39343.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 147953.50 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 1158153.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1205963.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 75.91 INCHES

AXLE # 4 AXLE # 5 AXLE #  
\*\*\*\*\*  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 17637.00 17637.00

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -143.27 -191.27

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

RTAC two-semi 6 axle B-train (41.5t/91.5k GCW), conf. 3.3, var. 1.00

UNIT # 3  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 1

WEIGHT OF SPRUNG MASS = 31852.90 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 105740.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 863457.38 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 912690.50 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 75.53 INCHES

AXLE # 6 AXLE # \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

LOAD ON EACH AXLE (LB.) 19841.00

AXLE WEIGHT (LB.) 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00

X DIST FROM SP MASS CG (IN) -114.53

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00

HALF SPRING SPACING (IN) 22.00

HALF TRACK - INNER TIRES (IN) 32.50

DUAL TIRE SPACING (IN) 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00

ROLL STEER COEFFICIENT 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0

SPRING TABLE # 3

CORNERING FORCE TABLE # 1

ALIGNING TORQUE TABLE # 1

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |



SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\*  
 \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGL

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |

ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC two-semi 6 axle B-train (41.5t/91.5k GCW), conf. 3.3, var. 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

- \* Number of units: 3
- \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 20581.0  
 FILES: Tare: ST6T:Tr.3Ax190wb ; Load: ST6T:SL.Tr4.5t13t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
 XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
 YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
 ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
 CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
 CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 186.9

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 9921.0 ; SuspKey: 0

|        |    |               |                   |                   |
|--------|----|---------------|-------------------|-------------------|
| AXLE 1 | -- | Load: 9921.0; | AxleLoc[x]: 0.0   |                   |
|        |    | Axle Files    | Lhs               | Rhs               |
| -----  |    |               |                   |                   |
|        |    | SPRING :      | ST6T:Sp.IHref.Frt | ST6T:Sp.IHref.Frt |
|        |    | TIRE :        | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :      | ST6T:Br.StrAxle   | ST6T:Br.StrAxle   |
|        |    | ALOCK :       |                   |                   |

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkBm44 ; SuspLoad: 28660.0; SuspKey: 2

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|        |    |                |                   |                   |
|--------|----|----------------|-------------------|-------------------|
| AXLE 1 | -- | Load: 14330.0; | AxleLoc[x]: 160.0 |                   |
|        |    | Axle Files     | Lhs               | Rhs               |
| -----  |    |                |                   |                   |
|        |    | SPRING :       | ST6T:Sp.HknRTE440 | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |                   |

|        |    |                |                   |                   |
|--------|----|----------------|-------------------|-------------------|
| AXLE 2 | -- | Load: 14330.0; | AxleLoc[x]: 220.0 |                   |
|        |    | Axle Files     | Lhs               | Rhs               |
| -----  |    |                |                   |                   |
|        |    | SPRING :       | ST6T:Sp.HknRTE440 | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |                   |

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 13512.0  
 FILES: Tare: ST6T:Se.B27ftTndm ; Load: ST6T:SL.Se16t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 42343.0; Sprung: 39343.0; Payload: 31343.0  
 XINERT: Total: 178721 ; Sprung: 147954 ; Payload: 87922  
 YINERT: Total: 1387192 ; Sprung: 1158153 ; Payload: 727689  
 ZINERT: Total: 1420635 ; Sprung: 1205963 ; Payload: 780531  
 CGXLOC: Total: 148.6; Sprung: 136.7; Payload: 128.7  
 CGZLOC: Total: 71.9; Sprung: 75.9; Payload: 79.5  
 LENGTH: EffWlbse: 304.0; Last Wlbse: 304.0; HitchLoc[x]: 328.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B481n ; SuspLoad: 35274.0; SuspKey: 1

|        |    |                |                   |  |
|--------|----|----------------|-------------------|--|
| AXLE 1 | -- | Load: 17637.0; | AxleLoc[x]: 280.0 |  |
|--------|----|----------------|-------------------|--|

```

Axle Files                                     Lhs                                     Rhs
-----
SPRING :                                     STGT:Sp.MTC.Reyco
TIRE   :                                     STGT:T1.XZA11R225
WHLBRK :                                     STGT:Br.DualsAxle
ALOCK  :

```

AXLE 2 -- Load: 17637.0; AxleLoc[x]: 328.0

```

Axle Files                                     Lhs                                     Rhs
-----
SPRING :                                     STGT:Sp.MTC.Reyco
TIRE   :                                     STGT:T1.XZA11R225
WHLBRK :                                     STGT:Br.DualsAxle
ALOCK  :

```

UNIT # 3 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.0

FILES: Tare: STGT:Se.27ftSngl ; Load: STGT:SL.Segt ; Hitch:

WEIGHT: Total: 33353.0; Sprung: 31852.9; Payload: 26852.9

XINERT: Total: 121281 ; Sprung: 105740 ; Payload: 71329

YINERT: Total: 923557 ; Sprung: 863457 ; Payload: 619445

ZINERT: Total: 965449 ; Sprung: 912691 ; Payload: 668714

CGXLOC: Total: 160.6; Sprung: 155.5; Payload: 155.2

CGZLOC: Total: 73.0; Sprung: 75.5; Payload: 75.8

LENGTH: EffWbse: 270.0; Last Wlbse: 270.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: STGT:Su.Rc21BSngl ; SuspLoad: 19841.0; SuspKey: 0

```

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 270.0
Axle Files                                     Lhs                                     Rhs
-----
SPRING :                                     STGT:Sp.MTC.Reyco
TIRE   :                                     STGT:T1.XZA11R225
WHLBRK :                                     STGT:Br.DualsAxle
ALOCK  :

```

\*\*\*\*\*  
 \* RTAC STUDY \*  
 \*\*\*\*\*

\*\*\*\*\*  
 \*DIRECTIONAL RESPONSE SIMULATION\*  
 \*\*\*\*\*

RTAC two-semi belly-axle B-train (61.5t/135k GCW), conf. 3.4, var. 1.00

# OF SPRUNG MASSES = 3  
 TOTAL # OF AXLES = 8  
 GROSS VEHICLE WEIGHT = 135583.88 LB.  
 FORWARD VELOCITY = 62.14 M.P.H

PEAK FRICTIONAL COEFFICIENT = 0.79

|                     |             | DISTANCE AHEAD<br>OF SPRUNG MASS<br>C.G. (INCHES) | HEIGHT BELOW<br>SPRUNG MASS<br>C.G. (INCHES) | ROLL STIFFNESS<br>(IN.LB/DEG) | TYPE OF<br>CONSTRAINT |
|---------------------|-------------|---|--|-------------------------------|-----------------------|
| ARTICULATION PT # 1 | ON UNIT # 1 | -118.58   | 0.0  | 999999.88                     | 1                     |
|                     | ON UNIT # 2 | 101.11  | 38.69  |                               |                       |
| ARTICULATION PT # 2 | ON UNIT # 2 | -216.89   | 38.69  | 999999.88                     | 1                     |
|                     | ON UNIT # 3 | 186.29  | 45.93  |                               |                       |

TYPE OF CONSTRAINT : 01 CONVENTIONAL 5TH WHEEL  
 02 INVERTED 5TH WHEEL  
 03 PINTLE HOOK  
 04 KING PIN(RIGID IN ROLL & PITCH)

CLOSED LOOP PATH FOLLOWER INPUT  
 \*\*\*\*\*

DRIVER LAG = 0.0 SEC  
 PREVIEW INTERVAL = 0.30 SEC  
 CLOSED LOOP TIME = 10.00 SEC  
 RAMP-STEER RATE = 2.00 DEG/SEC

STEERING GEAR RATIO = 30.00

STEERING STIFFNESS (IN.LB/DEG) = 11000.00

TIE ROD STIFFNESS (IN.LB/DEG) = 11000.00

MECHANICAL TRAIL (IN) = 1.00  
 # OF POINTS IN PATH TABLE = 4

RTAC two-semi belly-axle B-train (61.5t/135k GCW), conf. 3.4, var. 1.00

UNIT # 1  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 11800.00 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 26000.00 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 170000.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 44.00 INCHES

AXLE # 1 AXLE # 2 AXLE # 3 AXLE #  
\*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

LOAD ON EACH AXLE (LB.) 12125.00 17637.00 17637.00

AXLE WEIGHT (LB.) 1200.00 2500.00 2500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 3700.00 5100.00 5100.00

X DIST FROM SP MASS CG (IN) 55.00 -105.00 -165.00

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 18.25 33.00 33.00

HALF SPRING SPACING (IN) 16.00 19.00 19.00

HALF TRACK - INNER TIRES (IN) 40.00 29.50 29.50

DUAL TIRE SPACING (IN) 0.0 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.22 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 3824.00 30000.00 85000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 475.00 1000.00 1000.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 22.26 0.0 0.0

SPRING TABLE # 1 2 2

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1



RTAC two-semi belly-axle B-train (61.5t/135k GCW), conf. 3.4, var. 1.00

UNIT # 2  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 2

WEIGHT OF SPRUNG MASS = 46676.31 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 187433.63 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 1396043.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 1436804.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 82.69 INCHES

AXLE # 4 AXLE # 5 AXLE #  
\*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\* \*\*\*\*\*

LOAD ON EACH AXLE (LB.) 17637.00 17637.00

AXLE WEIGHT (LB.) 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00

X DIST FROM SP MASS CG (IN) -168.89 -216.89

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00

ROLL STEER COEFFICIENT 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0

SPRING TABLE # 3 3

CORNERING FORCE TABLE # 1 1

ALIGNING TORQUE TABLE # 1 1

RTAC two-sem1 belly-axle B-train (61.5t/135k GCW), conf. 3.4, var. 1.00

UNIT # 3  
\*\*\*\*\*

# OF AXLES ON THIS UNIT = 3

WEIGHT OF SPRUNG MASS = 63407.59 LB.

ROLL MOMENT OF INERTIA OF SPRUNG MASS = 257128.50 LB.IN.SEC\*\*2

PITCH MOMENT OF INERTIA OF SPRUNG MASS = 2350415.00 LB.IN.SEC\*\*2

YAW MOMENT OF INERTIA OF SPRUNG MASS = 2394173.00 LB.IN.SEC\*\*2

HEIGHT OF SPRUNG MASS CG ABOVE GROUND = 89.93 INCHES

AXLE # 6 AXLE # 7 AXLE # 8 AXLE #  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

LOAD ON EACH AXLE (LB.) 17637.00 17637.00 17637.00 17637.00

AXLE WEIGHT (LB.) 1500.00 1500.00 1500.00 1500.00

AXLE ROLL M.I (LB.IN.SEC\*\*2) 4100.00 4100.00 4100.00 4100.00

X DIST FROM SP MASS CG (IN) 42.29 -83.71 -131.71

HEIGHT OF AXLE C.G. ABOVE GROUND (INCHES) 20.00 20.00 20.00

HEIGHT OF ROLL CENTER ABOVE GROUND (INCHES) 29.00 27.00 27.00

HALF SPRING SPACING (IN) 22.00 22.00 22.00

HALF TRACK - INNER TIRES (IN) 32.50 32.50 32.50

DUAL TIRE SPACING (IN) 13.00 13.00 13.00

STIFFNESS OF EACH TIRE (LB/IN) 4500.00 4500.00 4500.00

ROLL STEER COEFFICIENT 0.0 0.23 0.23

AUX ROLL STIFFNESS (IN.LB/DEG) 83000.00 9000.00 9000.00

SPRING COULOMB FRICTION - PER SPRING (LB) 380.00 975.00 975.00

VISCOUS DAMPING PER SPRING (LB.SEC/IN) 0.0 0.0 0.0

SPRING TABLE # 4 3 3

CORNERING FORCE TABLE # 1 1 1

ALIGNING TORQUE TABLE # 1 1 1

AXLE 6 IS SELF STEERING

PRIMARY STIFFNESS, IN-LB/DEG: 400000.00

COULOMB FRICTION, IN-LB: 15000.00

MECHANICAL TRAIL, INCHES: 6.00

STEERING TORQUE AND DISPLACEMENT BOUNDRIES

| TORQUE, IN-LB | ANGLE, DEG |
|---------------|------------|
| -56700.00     | -30.000    |
| -13200.00     | -1.000     |
| -400.00       | -0.500     |
| 0.0           | 0.0        |
| 400.00        | 0.500      |
| 13200.00      | 1.000      |
| 56700.00      | 30.000     |

SPRING TABLE # 1  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20550.00   | -15.00               |
| -1170.00    | -0.75                |
| -150.00     | 0.0                  |
| 1250.00     | 1.00                 |
| 2550.00     | 2.00                 |
| 3825.00     | 3.00                 |
| 7240.00     | 5.50                 |
| 11127.50    | 8.50                 |
| 20076.50    | 15.50                |

SPRING TABLE # 2  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -8107.50    | -2.00                |
| -25.00      | -0.25                |
| 225.00      | 0.0                  |
| 625.00      | 0.25                 |
| 1355.00     | 0.50                 |
| 2375.00     | 0.75                 |
| 4475.00     | 1.00                 |
| 19086.00    | 2.25                 |
| 50753.50    | 5.00                 |

SPRING TABLE # 3  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -26660.15   | -10.00               |
| -97.65      | -1.50                |
| -50.00      | 0.0                  |
| 1150.00     | 0.25                 |
| 3000.00     | 0.50                 |
| 5375.00     | 0.75                 |
| 39542.85    | 4.50                 |

SPRING TABLE # 4  
\*\*\*\*\*

| FORCE<br>LB | DEFLECTION<br>INCHES |
|-------------|----------------------|
| -20750.00   | -2.50                |
| 5100.00     | -1.37                |
| 6400.00     | -0.50                |
| 7000.00     | 0.0                  |
| 7737.50     | 0.50                 |
| 9437.50     | 1.50                 |
| 28268.75    | 3.00                 |

CORNERING FORCE TABLE # 1  
 \*\*\*\*\* \*\*\*\*\*

LATERAL FORCE VS. SLIP ANGLL

|  | 0.0     | 1.00   | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|--------|---------|---------|---------|---------|
|  | 1983.00 | 356.94 | 634.56  | 1070.82 | 1526.91 | 1804.53 |
|  | 5967.00 | 835.38 | 1611.09 | 2804.49 | 3938.22 | 4355.91 |
|  | 9441.00 | 944.10 | 1793.79 | 3398.76 | 5192.55 | 5759.01 |



ALIGNING TORQUE TABLE # 1  
 \*\*\*\*\* \*\*\*\*\*

ALIGNING TORQUE VS. SLIP ANGLE

|  | 0.0     | 1.00    | 2.00    | 4.00    | 8.00    | 12.00   |
|--|---------|---------|---------|---------|---------|---------|
|  | 2000.00 | 336.00  | 528.00  | 660.00  | 444.00  | 252.00  |
|  | 3980.00 | 1020.00 | 1716.00 | 2256.00 | 1728.00 | 1092.00 |
|  | 5970.00 | 1764.00 | 3156.00 | 4344.00 | 3240.00 | 2184.00 |
|  | 7950.00 | 2484.00 | 4608.00 | 6720.00 | 5304.00 | 3576.00 |
|  | 9440.00 | 3000.00 | 5616.00 | 8604.00 | 7104.00 | 4620.00 |

RTAC two-semi belly-axle B-train (61.5t/135k GCW), conf. 3.4, var. 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 3  
 \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR: # of Rear Suspensions: 1; Rear HitchLoad: 29399.0  
 FILES: Tare: ST6T:Tr.3Ax190wb ; Load: ST6T:SL.Tr5.5t16t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
 XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
 YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
 ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
 CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
 CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 173.6

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 12125.0; SuspKey: 0

|        |    |                |                   |     |                   |
|--------|----|----------------|-------------------|-----|-------------------|
| AXLE 1 | -- | Load: 12125.0; | AxleLoc[x]: 0.0   |     |                   |
|        |    | Axle Files     |                   | Lhs | Rhs               |
| -----  |    |                |                   |     |                   |
|        |    | SPRING :       | ST6T:Sp.IHref.Frt |     | ST6T:Sp.IHref.Frt |
|        |    | TIRE :         | ST6T:T1.XZA11R225 |     | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.StrAxle   |     | ST6T:Br.StrAxle   |
|        |    | ALOCK :        |                   |     |                   |

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkBm44 ; SuspLoad: 35274.0; SuspKey: 2

|        |    |                |                   |     |                   |
|--------|----|----------------|-------------------|-----|-------------------|
| AXLE 1 | -- | Load: 17637.0; | AxleLoc[x]: 160.0 |     |                   |
|        |    | Axle Files     |                   | Lhs | Rhs               |
| -----  |    |                |                   |     |                   |
|        |    | SPRING :       | ST6T:Sp.HknRTE440 |     | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         | ST6T:T1.XZA11R225 |     | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.DualsAxle |     | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |     |                   |

|        |    |                |                   |     |                   |
|--------|----|----------------|-------------------|-----|-------------------|
| AXLE 2 | -- | Load: 17637.0; | AxleLoc[x]: 220.0 |     |                   |
|        |    | Axle Files     |                   | Lhs | Rhs               |
| -----  |    |                |                   |     |                   |
|        |    | SPRING :       | ST6T:Sp.HknRTE440 |     | ST6T:Sp.HknRTE440 |
|        |    | TIRE :         | ST6T:T1.XZA11R225 |     | ST6T:T1.XZA11R225 |
|        |    | WHLBRK :       | ST6T:Br.DualsAxle |     | ST6T:Br.DualsAxle |
|        |    | ALOCK :        |                   |     |                   |

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 14996.7  
 FILES: Tare: ST6T:Se.B26ftTndm ; Load: ST6T:SL.Se16t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 49676.3; Sprung: 46676.3; Payload: 38886.3  
 XINERT: Total: 224325 ; Sprung: 187434 ; Payload: 123513  
 YINERT: Total: 1700836 ; Sprung: 1396043 ; Payload: 853198  
 ZINERT: Total: 1721106 ; Sprung: 1436804 ; Payload: 904326  
 CGXLOC: Total: 112.8; Sprung: 101.1; Payload: 84.5  
 CGZLOC: Total: 78.9; Sprung: 82.7; Payload: 86.8  
 LENGTH: EffWlbse: 294.0; Last Wlbse: 294.0; HitchLoc[x]: 318.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21B48In ; SuspLoad: 35274.0; SuspKey: 1

|        |    |                |                   |  |  |
|--------|----|----------------|-------------------|--|--|
| AXLE 1 | -- | Load: 17637.0; | AxleLoc[x]: 270.0 |  |  |
|--------|----|----------------|-------------------|--|--|

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 17637.0; AxleLoc[x]: 318.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

UNIT # 3 -- SEMI ; # of Rear Suspensions: 2; Rear HitchLoad: 0.0  
 FILES: Tare: ST6T:Se.32ftBelly ; Load: ST6T:SL.Se8t16t ; Hitch:  
 WEIGHT: Total: 67907.7; Sprung: 63407.6; Payload: 56645.6  
 XINERT: Total: 322653 ; Sprung: 257128 ; Payload: 200330  
 YINERT: Total: 2502626 ; Sprung: 2350415 ; Payload: 1875931  
 ZINERT: Total: 2505460 ; Sprung: 2394173 ; Payload: 1929999  
 CGXLOC: Total: 190.1; Sprung: 186.3; Payload: 187.0  
 CGZLOC: Total: 85.3; Sprung: 89.9; Payload: 92.7  
 LENGTH: EffWibse: 244.0; Last Wibse: 294.0; HitchLoc[x]: 348.0

SUSPENSION # 1; SuspFile: ST6T:Su.A9517.16S ; SuspLoad: 17637.0; SuspKey: 0

AXLE 1 -- Load: 17637.0; AxleLoc[x]: 144.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.AR9517.16 | ST6T:Sp.AR9517.16 |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

SUSPENSION # 2; SuspFile: ST6T:Su.Rc21B48in ; SuspLoad: 35274.0; SuspKey: 1

AXLE 1 -- Load: 17637.0; AxleLoc[x]: 270.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 17637.0; AxleLoc[x]: 318.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRACTOR PARAMETERS

WHEELBASE - DISTANCE FROM FRONT AXLE TO CENTER OF REAR SUSPENSION (IN) 190.00  
 BASE VEHICLE CURB WEIGHT ON FRONT SUSPENSION (LB) 9584.21  
 BASE VEHICLE CURB WEIGHT ON REAR SUSPENSION (LB) 8415.79  
 SPRUNG MASS CG HEIGHT (IN. ABOVE GROUND) 44.00  
 SPRUNG MASS ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 26000.00  
 SPRUNG MASS PITCH MOMENT OF INERTIA (IN-LB-SEC\*\*2) 170000.00  
 SPRUNG MASS YAW MOMENT OF INERTIA (IN-LB-SEC\*\*2) 170000.00  
 PAYLOAD WEIGHT (LB) 0.0

\*\*\* ZERO ENTRY INDICATES NO PAYLOAD \*\*\*  
 \*\*\* FIVE PAYLOAD DESCRIPTION PARAMETERS ARE NOT ENTERED \*\*\*

FIFTH WHEEL LOCATION (IN. AHEAD OF REAR SUSP. CENTER) 4.25  
 FIFTH WHEEL HEIGHT ABOVE GROUND (IN) 44.00  
 TRACTOR FRAME STIFFNESS (IN-LB/DEG) 1000000.00  
 TRACTOR FRAME TORSIONAL AXIS HEIGHT ABOVE GROUND (IN) 38.00

TRACTOR FRONT SUSPENSION AND AXLE PARAMETERS

|           |            |
|-----------|------------|
| LEFT SIDE | RIGHT SIDE |
| -----     | -----      |

|  |        |        |
|--|--------|--------|
| SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE)         | -1.00  | -1.00  |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***   |        |        |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***     |        |        |
| SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE) | 22.26  | 22.26  |
| COULOMB FRICTION (LB/SIDE/AXLE)                  | 475.00 | 475.00 |

AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 3700.00  
 ROLL CENTER HEIGHT (IN. ABOVE GROUND) 18.25  
 ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL) 0.0  
 AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE) 3824.00  
 LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN) 32.00  
 TRACK WIDTH (IN) 80.00  
 UNSPRUNG WEIGHT (LB) 1200.00  
 STEERING GEAR RATIO (DEG STEERING WHEEL/DEG ROAD WHEEL) 30.00  
 STEERING STIFFNESS (IN-LB/DEG) 11000.00  
 TIE ROD STIFFNESS (IN-LB/DEG) 11000.00  
 MECHANICAL TRAIL (IN) 1.00  
 TORSIONAL WRAP-UP STIFFNESS (IN-LB/IN) 150000.00  
 LATERAL OFFSET OF STEERING AXIS (IN) 3.00

TRACTOR FRONT TIRES AND WHEELS

|           |            |
|-----------|------------|
| LEFT SIDE | RIGHT SIDE |
| -----     | -----      |

|  |          |          |
|--|----------|----------|
| CORNERING STIFFNESS (LB/DEG/TIRE)              | -2.00    | -2.00    |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED *** |          |          |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***   |          |          |
| LONGITUDINAL STIFFNESS (LB/SLIP/TIRE)          | -52.00   | -52.00   |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED *** |          |          |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***   |          |          |
| CAMBER STIFFNESS (LB/DEG/TIRE)                 | 0.0      | 0.0      |
| ALIGNING MOMENT (IN-LB/DEG/TIRE)               | -1320.84 | -1320.84 |
| *** NEGATIVE ALIGNING MOMENT ENTRY ***         |          |          |

\*\*\* ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000)  
 TIRE SPRING RATE (LB/IN/TIRE) 4500.00 4500.00  
 TIRE LOADED RADIUS (IN) 20.00 20.00  
 POLAR MOMENT OF INERTIA (IN-LB-SEC\*\*2/WHEEL) 103.00 103.00

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRACTOR REAR SUSPENSION AND AXLE PARAMETERS

| LEADING TANDEM AXLE |            | TRAILING TANDEM AXLE |            |
|---------------------|------------|----------------------|------------|
| LEFT SIDE           | RIGHT SIDE | LEFT SIDE            | RIGHT SIDE |

SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM  
 TANDEM AXLE SEPARATION (IN BETWEEN LEADING AND TRAILING AXLES) 2  
 STATIC LOAD TRANSFER (PERCENT LOAD ON LEAD AXLE) 60.00  
 DYNAMIC LOAD TRANSFER (% BRAKE TORQUE REACTED AS TANDEM AXLE LOAD TRANSFER) 50.00  
 SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE) -3.00 -3.00 -3.00 -3.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE) 0.0 0.0 0.0 0.0  
 COULOMB FRICTION (LB/SIDE/AXLE) 2000.00 2000.00 2000.00 2000.00  
 AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 5100.00 5100.00  
 ROLL CENTER HEIGHT (IN, ABOVE GROUND) 33.00 33.00  
 ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL) 0.22 0.23  
 AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE) 30000.00 85000.00  
 LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN) 38.00 38.00  
 TRACK WIDTH (IN) 72.00 72.00  
 UNSPRUNG WEIGHT (LB) 2500.00 2500.00

TRACTOR REAR TIRES AND WHEELS

|   | LEFT SIDE | RIGHT SIDE            |
|---|-----------|-----------------------|
| DUAL TIRE SEPARATION (IN)   | 13.00     | 13.00                 |
| CORNERING STIFFNESS (LB/DEG/TIRE)                                       | -2.00     | -2.00                 |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***                          |           |                       |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***                            |           |                       |
| LONGITUDINAL STIFFNESS (LB/SLIP/TIRE)                                   | -52.00    | -52.00                |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***                          |           |                       |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***                            |           |                       |
| CAMBER STIFFNESS (LB/DEG/TIRE)  | 0.0       | 0.0                   |
| ALIGNING MOMENT (IN-LB/DEG/TIRE)  | -1320.84  | --1320.84             |
| *** NEGATIVE ALIGNING MOMENT ENTRY ***                                  |           |                       |
| *** ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( | 0.0       | 8.0000 5.0000 0.8000) |
| TIRE SPRING RATE (LB/IN/TIRE)   | 4500.00   | 4500.00               |
| TIRE LOADED RADIUS (IN)   | 20.00     | 20.00                 |
| POLAR MOMENT OF INERTIA (IN-LB-SEC**2/WHEEL)                            | 103.00    | 103.00                |

\*\*\* ZERO LINES IN TREADLE PRESSURE TABLE INDICATES NO BRAKING \*\*\*  
 \*\*\* THREE BRAKE PARAMETERS PER AXLE ARE DELETED AT THIS POINT \*\*\*

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRAILER NO. 1 PARAMETERS

WHEELBASE - DISTANCE FROM KINGPIN TO CENTER OF REAR SUSPENSION ( IN) 270.00  
 BASE VEHICLE KINGPIN STATIC LOAD (LB) 2092.69  
 BASE VEHICLE CURB WEIGHT ON REAR SUSPENSION (LB) 4407.41  
 SPRUNG MASS CG HEIGHT (IN. ABOVE GROUND) 74.00  
 SPRUNG MASS ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 34375.00  
 SPRUNG MASS PITCH MOMENT OF INERTIA (IN-LB-SEC\*\*2) 243940.00  
 SPRUNG MASS YAW MOMENT OF INERTIA (IN-LB-SEC\*\*2) 243940.00  
 PAYLOAD WEIGHT (LB) 26205.80  
 PAYLOAD DISTANCE AHEAD OF REAR SUSPENSION CENTER(IN) 133.70  
 PAYLOAD CG HEIGHT (IN. ABOVE GROUND) 75.29  
 PAYLOAD ROLL MOMENT OF INERTIA(IN-LB-SEC\*\*2) 69097.69  
 PAYLOAD PITCH MOMENT OF INERTIA(IN-LB-SEC\*\*2) 604005.50  
 PAYLOAD YAW MOMENT OF INERTIA(IN-LB-SEC\*\*2) 652599.75  
 LOCATION OF PINTLE HOOK (IN BEHIND REAR SUSP. CENTER) 30.00  
 HEIGHT OF PINTLE HOOK (IN ABOVE GROUND) 34.50

TRAILER NO. 1 REAR SUSPENSION AND AXLE PARAMETERS

LEFT SIDE RIGHT SIDE

SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM 0  
 SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE) -4.00 -4.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE) 0.0 0.0  
 COULOMB FRICTION (LB/SIDE/AXLE) 975.00 975.00

AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 4100.00  
 ROLL CENTER HEIGHT (IN. ABOVE GROUND) 27.00  
 ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL) 0.23  
 AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE) 9000.00  
 LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN) 44.00  
 TRACK WIDTH (IN) 78.00  
 UNSPRUNG WEIGHT (LB) 1500.00

TRAILER NO. 1 REAR TIRES AND WHEELS

LEFT SIDE RIGHT SIDE

DUAL TIRE SEPARATION (IN) 13.00 13.00  
 CORNERING STIFFNESS (LB/DEG/TIRE) -2.00 -2.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 LONGITUDINAL STIFFNESS (LB/SLIP/TIRE) -52.00 -52.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 CAMBER STIFFNESS (LB/DEG/TIRE) 0.0 0.0  
 ALIGNING MOMENT (IN-LB/DEG/TIRE) -1320.84 -1320.84  
 \*\*\* NEGATIVE ALIGNING MOMENT ENTRY \*\*\*  
 \*\*\* ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000)  
 TIRE SPRING RATE (LB/IN/TIRE) 4500.00 4500.00

TIRE LOADED RADIUS (IN)  
POLAR MOMENT OF INERTIA (IN-LB-SEC\*\*2/WHEEL)

20.00  
103.00

20.00  
103.00



RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRAILER NO. 2 PARAMETERS

```

# OF PINTLE HOOKS: 1 = A-DOLLY, 2 = B-DOLLY
B-DOLLY HOOKS & FRAME PARAMETERS: --
TOTAL YAW LASH AT PINTLE HOOKS (DEG)
TOTAL ROLL LASH AT PINTLE HOOKS (DEG)
YAW STIFFNESS BEYOND LASH (IN-LB/DEG)
YAW DAMPING BEYOND LASH (IN-LB/DEG/SEC)
TORSIONAL (ROLL) STIFFNESS BEYOND LASH (IN-LB/DEG)
B-DOLLY SELF-STEER AXLE PARAMETERS: --
CENTERING STIFFNESS (IN-LB/DEG/AXLE)
COULOMB FRICTION (IN-LB/AXLE)
VISCOUS DAMPING (IN-LB/DEG/SEC/AXLE)
MECHANICAL TRAIL (IN)
LATERAL KINGPIN OFFSET (IN)
DOLLY KEY: 1 = CONVERTER DOLLY, 2 = FIXED DOLLY
DISTANCE FROM DOLLY SUSPENSION TO PINTLE HOOK (IN)
TURNTABLE LOCATION (IN AHEAD OF SUSP. CENTER)
TURNTABLE HEIGHT ABOVE GROUND (IN)
WHEELBASE - DISTANCE FROM CENTER OF FRONT SUSP. TO CENTER OF REAR SUSP. (IN)
BASE VEHICLE CURB WEIGHT ON FRONT SUSPENSION (LB)
BASE VEHICLE CURB WEIGHT ON REAR SUSPENSION (LB)
SPRUNG MASS CG HEIGHT (IN. ABOVE GROUND)
SPRUNG MASS ROLL MOMENT OF INERTIA (IN-LB-SEC**2)
SPRUNG MASS PITCH MOMENT OF INERTIA (IN-LB-SEC**2)
SPRUNG MASS YAW MOMENT OF INERTIA (IN-LB-SEC**2)
PAYLOAD WEIGHT (LB)
PAYLOAD DISTANCE AHEAD OF REAR SUSPENSION CENTER(IN)
PAYLOAD CG HEIGHT (IN. ABOVE GROUND)
PAYLOAD ROLL MOMENT OF INERTIA(IN-LB-SEC**2)
PAYLOAD PITCH MOMENT OF INERTIA(IN-LB-SEC**2)
PAYLOAD YAW MOMENT OF INERTIA(IN-LB-SEC**2)
LOCATION OF PINTLE HOOK (IN BEHIND REAR SUSP. CENTER)
HEIGHT OF PINTLE HOOK (IN ABOVE GROUND)
    
```

```

2
0.0
0.0
1000000.00
1000.00
30000.00
4500.00
15000.00
50.00
6.00
14.40
72.00
0.0
44.00
270.00
4592.79
4407.41
69.00
59968.97
243940.00
245882.50
26275.80
134.06
75.34
69337.25
605673.88
654342.94
30.00
34.50
    
```

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRAILER NO. 2 FRONT SUSPENSION AND AXLE PARAMETERS

SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM  
 SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE) 0 -4.00 -4.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE) 0.0 0.0  
 COULOMB FRICTION (LB/SIDE/AXLE) 975.00 975.00

AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 4100.00  
 ROLL CENTER HEIGHT (IN. ABOVE GROUND) 27.00  
 ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL) 0.23  
 AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE) 9000.00  
 LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN) 44.00  
 TRACK WIDTH (IN) 78.00  
 UNSPRUNG WEIGHT (LB) 1500.00

TRAILER NO. 2 FRONT TIRES AND WHEELS

DUAL TIRE SEPARATION (IN) 13.00 13.00  
 CORNERING STIFFNESS (LB/DEG/TIRE) -2.00 -2.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 LONGITUDINAL STIFFNESS (LB/SLIP/TIRE) -52.00 -52.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 CAMBER STIFFNESS (LB/DEG/TIRE) 0.0 0.0  
 ALIGNING MOMENT (IN-LB/DEG/TIRE) -1320.84 -1320.84  
 \*\*\* NEGATIVE ALIGNING MOMENT ENTRY \*\*\*  
 \*\*\* ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000)  
 TIRE SPRING RATE (LB/IN/TIRE) 4500.00 4500.00  
 TIRE LOADED RADIUS (IN) 20.00 20.00  
 POLAR MOMENT OF INERTIA (IN-LB-SEC\*\*2/WHEEL) 103.00 103.00

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRAILER NO. 2 REAR SUSPENSION AND AXLE PARAMETERS

|   | LEFT SIDE | RIGHT SIDE |
|---|-----------|------------|
| SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM | 0         |            |
| SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE)  | -4.00     | -4.00      |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***                                    |           |            |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***                                      |           |            |
| SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE)                                  | 0.0       | 0.0        |
| COULOMB FRICTION (LB/SIDE/AXLE)   | 975.00    | 975.00     |
| AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC**2)  |           | 4100.00    |
| ROLL CENTER HEIGHT (IN. ABOVE GROUND)   |           | 27.00      |
| ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL)                                     |           | 0.23       |
| AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE)   |           | 9000.00    |
| LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN)                                  |           | 44.00      |
| TRACK WIDTH (IN)  |           | 78.00      |
| UNSPRUNG WEIGHT (LB)  |           | 1500.00    |

TRAILER NO. 2 REAR TIRES AND WHEELS

|  | LEFT SIDE | RIGHT SIDE |
|--|-----------|------------|
| DUAL TIRE SEPARATION (IN)                      | 13.00     | 13.00      |
| CORNERING STIFFNESS (LB/DEG/TIRE)              | -2.00     | -2.00      |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED *** |           |            |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***   |           |            |
| LONGITUDINAL STIFFNESS (LB/SLIP/TIRE)          | -52.00    | -52.00     |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED *** |           |            |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***   |           |            |
| CAMBER STIFFNESS (LB/DEG/TIRE)                 | 0.0       | 0.0        |
| ALIGNING MOMENT (IN-LB/DEG/TIRE)               | -1320.84  | -1320.84   |
| *** NEGATIVE ALIGNING MOMENT ENTRY ***         |           |            |
| TIRE SPRING RATE (LB/IN/TIRE)                  | 0.0       | 8.0000     |
| TIRE LOADED RADIUS (IN)                        | 4500.00   | 5.0000     |
| POLAR MOMENT OF INERTIA (IN-LB-SEC**2/WHEEL)   | 20.00     | 4500.00    |
|  | 103.00    | 20.00      |
|  |           | 103.00     |

\*\*\* ZERO LINES IN TREADLE PRESSURE TABLE INDICATES NO BRAKING \*\*\*  
 \*\*\* THREE BRAKE PARAMETERS PER AXLE ARE DELETED AT THIS POINT \*\*\*

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRAILER NO. 3 PARAMETERS

|  |            |
|--|------------|
| # OF PINTLE HOOKS: 1 = A-DOLLY, 2 = B-DOLLY                                  | 2          |
| B-DOLLY HOOKS & FRAME PARAMETERS: --   |            |
| TOTAL YAW LASH AT PINTLE HOOKS (DEG)   | 0.0        |
| TOTAL ROLL LASH AT PINTLE HOOKS (DEG)  | 0.0        |
| YAW STIFFNESS BEYOND LASH (IN-LB/DEG)  | 1000000.00 |
| YAW DAMPING BEYOND LASH (IN-LB/DEG/SEC)                                      | 1000.00    |
| TORSIONAL (ROLL) STIFFNESS BEYOND LASH (IN-LB/DEG)                           | 30000.00   |
| B-DOLLY SELF-STEER AXLE PARAMETERS: --                                       |            |
| CENTERING STIFFNESS (IN-LB/DEG/AXLE)   | 4500.00    |
| COULOMB FRICTION (IN-LB/AXLE)  | 15000.00   |
| VISCOUS DAMPING (IN-LB/DEG/SEC/AXLE)   | 50.00      |
| MECHANICAL TRAIL (IN)  | 6.00       |
| LATERAL KINGPIN OFFSET (IN)  | 14.40      |
| DOLLY KEY: 1 = CONVERTER DOLLY, 2 = FIXED DOLLY                              | 1          |
| DISTANCE FROM DOLLY SUSPENSION TO PINTLE HOOK (IN)                           | 72.00      |
| TURNABLE LOCATION (IN AHEAD OF SUSP. CENTER)                                 | 0.0        |
| TURNABLE HEIGHT ABOVE GROUND (IN)  | 44.00      |
| WHEELBASE - DISTANCE FROM CENTER OF FRONT SUSP. TO CENTER OF REAR SUSP. (IN) | 270.00     |
| BASE VEHICLE CURB WEIGHT ON FRONT SUSPENSION (LB)                            | 4592.79    |
| BASE VEHICLE CURB WEIGHT ON REAR SUSPENSION (LB)                             | 4407.41    |
| SPRUNG MASS CG HEIGHT (IN. ABOVE GROUND)                                     | 69.00      |
| SPRUNG MASS ROLL MOMENT OF INERTIA (IN-LB-SEC**2)                            | 59968.97   |
| SPRUNG MASS PITCH MOMENT OF INERTIA (IN-LB-SEC**2)                           | 243940.00  |
| SPRUNG MASS YAW MOMENT OF INERTIA (IN-LB-SEC**2)                             | 245882.50  |
| PAYLOAD WEIGHT (LB)  | 26275.90   |
| PAYLOAD DISTANCE AHEAD OF REAR SUSPENSION CENTER(IN)                         | 134.06     |
| PAYLOAD CG HEIGHT (IN. ABOVE GROUND)   | 75.34      |
| PAYLOAD ROLL MOMENT OF INERTIA(IN-LB-SEC**2)                                 | 69337.56   |
| PAYLOAD PITCH MOMENT OF INERTIA(IN-LB-SEC**2)                                | 605676.25  |
| PAYLOAD YAW MOMENT OF INERTIA(IN-LB-SEC**2)                                  | 654345.44  |

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRAILER NO. 3 FRONT SUSPENSION AND AXLE PARAMETERS

LEFT SIDE RIGHT SIDE

SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM  
 SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE) 0 -4.00 -4.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE) 0.0 0.0  
 COULOMB FRICTION (LB/SIDE/AXLE) 975.00 975.00

AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 4100.00  
 ROLL CENTER HEIGHT (IN. ABOVE GROUND) 27.00  
 ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL) 0.23  
 AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE) 9000.00  
 LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN) 44.00  
 TRACK WIDTH (IN) 78.00  
 UNSPRUNG WEIGHT (LB) 1500.00

TRAILER NO. 3 FRONT TIRES AND WHEELS

LEFT SIDE RIGHT SIDE

DUAL TIRE SEPARATION (IN) 13.00 13.00  
 CORNERING STIFFNESS (LB/DEG/TIRE) -2.00 -2.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 LONGITUDINAL STIFFNESS (LB/SLIP/TIRE) -52.00 -52.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 CAMBER STIFFNESS (LB/DEG/TIRE) 0.0 0.0  
 ALIGNING MOMENT (IN-LB/DEG/TIRE) -1320.84 -1320.84  
 \*\*\* NEGATIVE ALIGNING MOMENT ENTRY \*\*\*  
 TIRE SPRING RATE (LB/IN/TIRE) ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000)  
 TIRE LOADED RADIUS (IN) 4500.00 4500.00  
 POLAR MOMENT OF INERTIA (IN-LB-SEC\*\*2/WHEEL) 20.00 20.00  
 103.00 103.00

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRAILER NO. 3 REAR SUSPENSION AND AXLE PARAMETERS

SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM  
 SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE) 0 -4.00 -4.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE) 0.0 0.0  
 COULOMB FRICTION (LB/SIDE/AXLE) 975.00 975.00

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AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 4100.00  
 ROLL CENTER HEIGHT (IN. ABOVE GROUND) 27.00  
 ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL) 0.23  
 AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE) 9000.00  
 LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN) 44.00  
 TRACK WIDTH (IN) 78.00  
 UNSPRUNG WEIGHT (LB) 1500.00

TRAILER NO. 3 REAR TIRES AND WHEELS

DUAL TIRE SEPARATION (IN) 13.00 13.00  
 CORNERING STIFFNESS (LB/DEG/TIRE) -2.00 -2.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 LONGITUDINAL STIFFNESS (LB/SLIP/TIRE) -52.00 -52.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 CAMBER STIFFNESS (LB/DEG/TIRE) 0.0 0.0  
 ALIGNING MOMENT (IN-LB/DEG/TIRE) -1320.84 -1320.84  
 \*\*\* NEGATIVE ALIGNING MOMENT ENTRY \*\*\*  
 TIRE SPRING RATE (LB/IN/TIRE) ( 0.0 8.0000 5.0000 0.8000 ) ( 0.0 8.0000 5.0000 0.8000 )  
 TIRE LOADED RADIUS (IN) 4500.00 4500.00  
 POLAR MOMENT OF INERTIA (IN-LB-SEC\*\*2/WHEEL) 20.00 20.00  
 103.00 103.00

\*\*\* ZERO LINES IN TREADLE PRESSURE TABLE INDICATES NO BRAKING \*\*\*  
 \*\*\* THREE BRAKE PARAMETERS PER AXLE ARE DELETED AT THIS POINT \*\*\*

ANTILOCK KEY: 1 INDICATES ANTILOCK WILL BE USED

0

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

TRAILER NO. 3                      PAYLOAD = 26275.898 LBS.                      EMPTY                      LOADED

DISTANCE FROM TRAILER SPRUNG MASS CENTER TO REAR SUSPENSION (IN)                      139.171                      135.008

DISTANCE FROM TRAILER SPRUNG MASS CENTER TO GROUND (IN)                      69.000                      74.165

ROLL MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC\*\*2)                      59968.969                      129815.750

PITCH MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC\*\*2)                      243939.938                      850455.750

YAW MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC\*\*2)                      245882.438                      900557.250

TRAILER NO. 2                      PAYLOAD = 26275.801 LBS.                      EMPTY                      LOADED

DISTANCE FROM TRAILER SPRUNG MASS CENTER TO REAR SUSPENSION (IN)                      139.171                      135.009

DISTANCE FROM TRAILER SPRUNG MASS CENTER TO GROUND (IN)                      69.000                      74.165

ROLL MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC\*\*2)                      59968.969                      129815.438

PITCH MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC\*\*2)                      243939.938                      850453.500

YAW MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC\*\*2)                      245882.438                      900555.000

TRAILER NO. 1                      PAYLOAD = 26205.801 LBS.                      EMPTY                      LOADED

DISTANCE FROM TRAILER SPRUNG MASS CENTER TO REAR SUSPENSION (IN)                      113.003                      130.380

DISTANCE FROM TRAILER SPRUNG MASS CENTER TO GROUND (IN)                      74.000                      75.081

ROLL MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC\*\*2)                      34374.996                      103490.625

PITCH MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC\*\*2)                      243939.938                      852620.250

YAW MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC\*\*2)                      243939.938                      901197.000

TRACTOR                      PAYLOAD = 0.0 LBS                      EMPTY                      LOADED

DISTANCE FROM TRACTOR SPRUNG MASS CENTER TO REAR SUSPENSION (IN)                      135.000                      135.000

DISTANCE FROM TRACTOR SPRUNG MASS CENTER TO GROUND (IN)                      44.000                      44.000

ROLL MOMENT OF INERTIA OF TRACTOR SPRUNG MASS (IN-LB-SEC\*\*2)                      25999.996                      25999.996

PITCH MOMENT OF INERTIA OF TRACTOR SPRUNG MASS (IN-LB-SEC\*\*2)                      169999.938                      169999.938

YAW MOMENT OF INERTIA OF TRACTOR SPRUNG MASS (IN-LB-SEC\*\*2)                      169999.938                      169999.938

THE STATIC LOADS ON THE AXLES ARE:

| AXLE NUMBER | LOAD      |
|-------------|-----------|
| NS(1.1,1)   | 9920.969  |
| NS(1.2,1)   | 11574.027 |
| NS(1.2,2)   | 11574.027 |
| NS(2.2,1)   | 17636.875 |
| NS(3.1,1)   | 17639.117 |
| NS(3.2,1)   | 17636.883 |

NS(4,1,1) 17639.066  
NS(4,2,1) 17637.031  
-----  
TOTAL 121257.938

THE TRACTOR TOTAL MASS CENTER IS 88.833 INCHES BEHIND THE FRONT AXLE  
THE TOTAL YAW MOMENT OF INERTIA IS 387657.625 IN-LB-SEC\*\*2

THE FIRST TRAILER TOTAL MASS CENTER IS 145.599 INCHES BEHIND THE KINGPIN  
THE TOTAL YAW MOMENT OF INERTIA IS 968325.000 IN-LB-SEC\*\*2

THE SECOND TRAILER TOTAL MASS CENTER IS 134.991 INCHES BEHIND THE TURNTABLE CENTER  
THE TOTAL YAW MOMENT OF INERTIA IS 1050399.000 IN-LB-SEC\*\*2

THE THIRD TRAILER TOTAL MASS CENTER IS 134.992 INCHES BEHIND THE TURNTABLE CENTER  
THE TOTAL YAW MOMENT OF INERTIA IS 1050402.000 IN-LB-SEC\*\*2



HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.  
 RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

| SPRING TABLES                        | NO. OF LINES | FORCE (LB)    | DEFLECTION (IN)      | TABLE NO. |
|--------------------------------------|--------------|---------------|----------------------|-----------|
|                                      | 9            | -20550.00     | -15.00               | -1        |
|                                      |              | -1170.00      | -0.75                |           |
|                                      |              | -150.00       | 0.0                  |           |
|                                      |              | 1250.00       | 1.00                 |           |
|                                      |              | 2550.00       | 2.00                 |           |
|                                      |              | 3825.00       | 3.00                 |           |
|                                      |              | 7240.00       | 5.50                 |           |
|                                      |              | 11127.50      | 8.50                 |           |
|                                      |              | 20076.50      | 15.50                |           |
| SPRING STATIC EQUILIBRIUM CONDITION: | 4360.48 LB,  | 3.39 INCHES.  | UNIT 1 SUSP 1 AXLE 1 |           |
|                                      | 9            | -16215.00     | -2.00                | -3        |
|                                      |              | -50.00        | -0.25                |           |
|                                      |              | 450.00        | 0.0                  |           |
|                                      |              | 1250.00       | 0.25                 |           |
|                                      |              | 2710.00       | 0.50                 |           |
|                                      |              | 4750.00       | 0.75                 |           |
|                                      |              | 8950.00       | 1.00                 |           |
|                                      |              | 38172.00      | 2.25                 |           |
|                                      |              | 101507.00     | 5.00                 |           |
| SPRING STATIC EQUILIBRIUM CONDITION: | 9074.02 LB,  | 1.01 INCHES.  | UNIT 1 SUSP 2 AXLE 1 |           |
| SPRING STATIC EQUILIBRIUM CONDITION: | 4537.01 LB,  | -0.00 INCHES. | UNIT 1 SUSP 2 AXLE 2 |           |
|                                      | 7            | -26660.15     | -10.00               | -4        |
|                                      |              | -97.65        | -1.50                |           |
|                                      |              | -50.00        | 0.0                  |           |
|                                      |              | 1150.00       | 0.25                 |           |
|                                      |              | 3000.00       | 0.50                 |           |
|                                      |              | 5375.00       | 0.75                 |           |
|                                      |              | 39542.85      | 4.50                 |           |
| SPRING STATIC EQUILIBRIUM CONDITION: | 8068.44 LB,  | 1.05 INCHES.  | UNIT 2 SUSP 2 AXLE 1 |           |
| SPRING STATIC EQUILIBRIUM CONDITION: | 8069.56 LB,  | 1.05 INCHES.  | UNIT 3 SUSP 1 AXLE 1 |           |
| SPRING STATIC EQUILIBRIUM CONDITION: | 8068.44 LB,  | 1.05 INCHES.  | UNIT 3 SUSP 2 AXLE 1 |           |
| SPRING STATIC EQUILIBRIUM CONDITION: | 8069.53 LB,  | 1.05 INCHES.  | UNIT 4 SUSP 1 AXLE 1 |           |
| SPRING STATIC EQUILIBRIUM CONDITION: | 8068.52 LB,  | 1.05 INCHES.  | UNIT 4 SUSP 2 AXLE 1 |           |

HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

MU-Y VS ALPHA TABLES

NO. OF LOADS NO. OF VELOCITIES TABLE NO.

-2

3  
 VELOCITY = 58.70 FT/SEC LOAD = 1983.00 LB  
 ALPHA (DEG) MU - Y

0.0  
 1.00  
 2.00  
 4.00  
 8.00  
 12.00

VELOCITY = 58.70 FT/SEC LOAD = 5967.00 LB  
 ALPHA (DEG) MU - Y

0.0  
 1.00  
 2.00  
 4.00  
 8.00  
 12.00

VELOCITY = 58.70 FT/SEC LOAD = 9441.00 LB  
 ALPHA (DEG) MU - Y

0.0  
 1.00  
 2.00  
 4.00  
 8.00  
 12.00

ROLL-OFF TABLE

| ALPHA | 0.0  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
|-------|------|------|------|------|------|------|------|------|------|------|------|
| 0.0   | 0.0  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.87 | 0.40 | 0.38 | 0.17 | 0.06 |
| 1.00  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.83 | 0.40 | 0.38 | 0.38 | 0.17 | 0.06 |
| 2.00  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.81 | 0.39 | 0.38 | 0.38 | 0.17 | 0.06 |

|       |      |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
| 4.00  | 1.00 | 0.97 | 0.75 | 0.39 | 0.38 | 0.17 | 0.06 |
| 6.00  | 1.00 | 0.96 | 0.79 | 0.45 | 0.44 | 0.21 | 0.07 |
| 8.00  | 1.00 | 0.97 | 0.84 | 0.52 | 0.50 | 0.25 | 0.09 |
| 12.00 | 1.00 | 0.97 | 0.89 | 0.63 | 0.62 | 0.33 | 0.12 |
| 16.00 | 1.00 | 0.98 | 0.92 | 0.71 | 0.70 | 0.40 | 0.15 |

HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.  
 RTAC 8 axle C-train Triples (55t/12k GCW), conf. 4.1, var. 1.00

MU-X VS. SLIP TABLES

NO. OF LOADS NO. OF VELOCITIES

3  
 VELOCITY = 29.30 FT/SEC LOAD = 3020.00 LB  
 SLIP MU - X

0.0  
 0.04  
 0.10  
 0.21  
 0.25  
 0.50  
 1.00

VELOCITY = 58.70 FT/SEC LOAD = 3020.00 LB  
 SLIP MU - X

0.0  
 0.04  
 0.10  
 0.21  
 0.25  
 0.50  
 1.00

VELOCITY = 80.70 FT/SEC LOAD = 3020.00 LB  
 SLIP MU - X

0.0  
 0.04  
 0.10  
 0.21  
 0.25  
 0.50  
 1.00

TABLE NO.

-52

HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

VELOCITY = 29.30 FT/SEC LOAD = 6040.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.37 |
| 0.10 | 0.71 |
| 0.24 | 0.80 |
| 0.25 | 0.80 |
| 0.50 | 0.74 |
| 1.00 | 0.54 |

VELOCITY = 58.70 FT/SEC LOAD = 6040.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.33 |
| 0.10 | 0.69 |
| 0.24 | 0.79 |
| 0.25 | 0.79 |
| 0.50 | 0.72 |
| 1.00 | 0.48 |

VELOCITY = 80.70 FT/SEC LOAD = 6040.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.30 |
| 0.10 | 0.67 |
| 0.24 | 0.79 |
| 0.25 | 0.78 |
| 0.50 | 0.70 |
| 1.00 | 0.44 |

VELOCITY = 29.30 FT/SEC LOAD = 9060.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.24 |
| 0.10 | 0.59 |
| 0.24 | 0.74 |
| 0.25 | 0.74 |
| 0.50 | 0.69 |
| 1.00 | 0.46 |

HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

VELOCITY = 58.70 FT/SEC LOAD = 9060.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.22 |
| 0.10 | 0.55 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.67 |
| 1.00 | 0.41 |

VELOCITY = 80.70 FT/SEC LOAD = 9060.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.20 |
| 0.10 | 0.52 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.65 |
| 1.00 | 0.36 |

ROLL-OFF TABLE

| ALPHA | 0.0  | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
|-------|------|------|------|------|------|------|------|
| 0.0   | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1.00  | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2.00  | 1.00 | 1.00 | 0.96 | 0.99 | 0.99 | 1.00 | 1.00 |
| 4.00  | 1.00 | 0.93 | 0.87 | 0.96 | 0.97 | 0.99 | 1.00 |
| 6.00  | 0.79 | 0.78 | 0.77 | 0.92 | 0.93 | 0.98 | 0.99 |
| 8.00  | 0.64 | 0.65 | 0.67 | 0.87 | 0.88 | 0.96 | 0.99 |
| 12.00 | 0.44 | 0.47 | 0.52 | 0.77 | 0.78 | 0.92 | 0.98 |
| 16.00 | 0.34 | 0.37 | 0.41 | 0.66 | 0.68 | 0.87 | 0.96 |

RTAC 8 axle C-train Triples (55t/121k GCW), conf. 4.1, var. 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

\* Number of units: 6  
 \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKR; # of Rear Suspensions: 1; Rear HitchLoad: 15069.0  
 FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr4.510.5 ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
 XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
 YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
 ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
 CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
 CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 185.8

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 9921.0 ; SuspKey: 0

AXLE 1 -- Load: 9921.0; AxleLoc[x]: 0.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.IHref.Frt ST6T:Sp.IHref.Frt  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.StrAxle ST6T:Br.StrAxle  
 ALOCK :

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkM44 ; SuspLoad: 23148.0; SuspKey: 2

AXLE 1 -- Load: 11574.0; AxleLoc[x]: 160.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

AXLE 2 -- Load: 11574.0; AxleLoc[x]: 220.0  
 Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.1  
 FILES: Tare: ST6T:Se.27FtSngl ; Load: ST6T:SL.Se8t ; Hitch: ST6T:H1.BdollyRef  
 WEIGHT: Total: 32705.9; Sprung: 31205.8; Payload: 26205.8  
 XINERT: Total: 118838 ; Sprung: 103491 ; Payload: 69098  
 YINERT: Total: 926867 ; Sprung: 852621 ; Payload: 604006  
 ZINERT: Total: 968296 ; Sprung: 901198 ; Payload: 652600  
 CGXLOC: Total: 145.6; Sprung: 139.6; Payload: 136.3  
 CGZLOC: Total: 72.6; Sprung: 75.1; Payload: 75.3  
 LENGTH: EffWlbse: 270.0; Last Wlbse: 270.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21BSngl ; SuspLoad: 17637.0; SuspKey: 0

AXLE 1 -- Load: 17637.0; AxleLoc[x]: 270.0

Axle Files Lhs Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 3 -- DOLLY: # of Rear Suspensions: 1; Rear HitchLoad: 15139.0  
 FILES: Tare: ST6T:Do.ConvrtIAx ; Load: ST6T:SL.Dobt ; Hitch: ST6T:HI.5thWheel  
 WEIGHT: Total: 2500.1 ; Sprung: 1000.0 ; Payload: 0.0  
 XINERT: Total: 14995 ; Sprung: 10000 ; Payload: 0  
 YINERT: Total: 5895 ; Sprung: 5000 ; Payload: 0  
 ZINERT: Total: 10100 ; Sprung: 6000 ; Payload: 0  
 CGXLOC: Total: 72.0; Sprung: 72.0; Payload: 0.0  
 CGZLOC: Total: 29.6; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 72.0; Last Wlbse: 72.0; HitchLoc[x]: 72.0

SUSPENSION # 1: SuspFile: ST6T:Su.Rc21BSngl ; SuspLoad: 17639.0; SuspKey: 0

AXLE 1 -- Load: 17639.0; AxleLoc[x]: 72.0 Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 4 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.1  
 FILES: Tare: ST6T:Se.27FtSngl ; Load: ST6T:SL.Se8t ; Hitch: ST6T:HI.8do11yRef  
 WEIGHT: Total: 32775.9; Sprung: 31275.8; Payload: 26275.8  
 XINERT: Total: 119100 ; Sprung: 103732 ; Payload: 69337  
 YINERT: Total: 929034 ; Sprung: 854458 ; Payload: 605674  
 ZINERT: Total: 970515 ; Sprung: 903108 ; Payload: 654343  
 CGXLOC: Total: 145.3; Sprung: 139.3; Payload: 135.9  
 CGZLOC: Total: 72.6; Sprung: 75.1; Payload: 75.3  
 LENGTH: EffWlbse: 270.0; Last Wlbse: 270.0; HitchLoc[x]: 300.0

SUSPENSION # 1: SuspFile: ST6T:Su.Rc21BSngl ; SuspLoad: 17637.0; SuspKey: 0

AXLE 1 -- Load: 17637.0; AxleLoc[x]: 270.0 Rhs  
 -----  
 SPRING : ST6T:Sp.MTC.Reyco ST6T:Sp.MTC.Reyco  
 TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
 WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
 ALOCK :

UNIT # 5 -- DOLLY: # of Rear Suspensions: 1; Rear HitchLoad: 15139.0  
 FILES: Tare: ST6T:Do.ConvrtIAx ; Load: ST6T:SL.Dobt ; Hitch: ST6T:HI.5thWheel  
 WEIGHT: Total: 2500.1 ; Sprung: 1000.0 ; Payload: 0.0  
 XINERT: Total: 14995 ; Sprung: 10000 ; Payload: 0  
 YINERT: Total: 5895 ; Sprung: 5000 ; Payload: 0  
 ZINERT: Total: 10100 ; Sprung: 6000 ; Payload: 0  
 CGXLOC: Total: 72.0; Sprung: 72.0; Payload: 0.0  
 CGZLOC: Total: 29.6; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 72.0; Last Wlbse: 72.0; HitchLoc[x]: 72.0

SUSPENSION # 1: SuspFile: ST6T:Su.Rc21BSngl ; SuspLoad: 17639.0; SuspKey: 0

AXLE 1 -- Load: 17639.0; AxleLoc[x]: 72.0



```

Axle Files                                     Lhs                                     Rhs
-----
SPRING :                                     ST6T:Sp.MTC.Reyco
TIRE :                                       ST6T:T1.XZA11R225
WHLBRK :                                    ST6T:Br.DualsAxle
ALOCK :

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```

UNIT # 6 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.0
FILES: Tare: ST6T:Se.27FtSngl ; Load: ST6T:SL.Se8t ; Hitch:
WEIGHT: Total: 32776.0; Sprung: 31275.9; Payload: 26275.9
XINERT: Total: 119100 ; Sprung: 103732 ; Payload: 69338
YINERT: Total: 929036 ; Sprung: 854461 ; Payload: 605676
ZINERT: Total: 970517 ; Sprung: 903110 ; Payload: 654345
CGXLOC: Total: 145.3; Sprung: 139.3; Payload: 135.9
CGZLOC: Total: 72.6; Sprung: 75.1; Payload: 75.3
LENGTH: EffWlbse: 270.0; Last Wlbse: 270.0; HitchLoc[x]: 300.0

```

```

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21BSngl ; SuspLoad: 17637.0; SuspKey: 0

```

```

AXLE 1 -- Load: 17637.0; AxleLoc[x]: 270.0
Axle Files                                     Lhs                                     Rhs
-----
SPRING :                                     ST6T:Sp.MTC.Reyco
TIRE :                                       ST6T:T1.XZA11R225
WHLBRK :                                    ST6T:Br.DualsAxle
ALOCK :

```

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRACTOR PARAMETERS

WHEELBASE - DISTANCE FROM FRONT AXLE TO CENTER OF REAR SUSPENSION (IN) 190.00  
 BASE VEHICLE CURB WEIGHT ON FRONT SUSPENSION (LB) 9584.21  
 BASE VEHICLE CURB WEIGHT ON REAR SUSPENSION (LB) 8415.79  
 SPRUNG MASS CG HEIGHT (IN. ABOVE GROUND) 44.00  
 SPRUNG MASS ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 26000.00  
 SPRUNG MASS PITCH MOMENT OF INERTIA (IN-LB-SEC\*\*2) 170000.00  
 SPRUNG MASS YAW MOMENT OF INERTIA (IN-LB-SEC\*\*2) 170000.00  
 PAYLOAD WEIGHT (LB) 0.0  
 \*\*\* ZERO ENTRY INDICATES NO PAYLOAD \*\*\*  
 \*\*\* FIVE PAYLOAD DESCRIPTION PARAMETERS ARE NOT ENTERED \*\*\*  
 FIFTH WHEEL LOCATION (IN. AHEAD OF REAR SUSP. CENTER)  
 FIFTH WHEEL HEIGHT ABOVE GROUND (IN) 3.96  
 TRACTOR FRAME STIFFNESS (IN-LB/DEG) 44.00  
 TRACTOR FRAME TORSIONAL AXIS HEIGHT ABOVE GROUND (IN) 100000.00  
 38.00

TRACTOR FRONT SUSPENSION AND AXLE PARAMETERS

SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE) -1.00 -1.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE) 22.26 22.26  
 COULOMB FRICTION (LB/SIDE/AXLE) 475.00 475.00

AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 3700.00  
 ROLL CENTER HEIGHT (IN. ABOVE GROUND) 18.25  
 ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL) 0.0  
 AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE) 3824.00  
 LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN) 32.00  
 TRACK WIDTH (IN) 80.00  
 UNSPRUNG WEIGHT (LB) 1200.00  
 STEERING GEAR RATIO (DEG STEERING WHEEL/DEG ROAD WHEEL) 30.00  
 STEERING STIFFNESS (IN-LB/DEG) 11000.00  
 TIE ROD STIFFNESS (IN-LB/DEG) 11000.00  
 MECHANICAL TRAIL (IN) 1.00  
 TORSIONAL WRAP-UP STIFFNESS (IN-LB/IN) 150000.00  
 LATERAL OFFSET OF STEERING AXIS (IN) 3.00

TRACTOR FRONT TIRES AND WHEELS

CORNERING STIFFNESS (LB/DEG/TIRE) -2.00 -2.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 LONGITUDINAL STIFFNESS (LB/SLIP/TIRE) -52.00 -52.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 CAMBER STIFFNESS (LB/DEG/TIRE) 0.0 0.0  
 ALIGNING MOMENT (IN-LB/DEG/TIRE) -1320.84 -1320.84  
 \*\*\* NEGATIVE ALIGNING MOMENT ENTRY \*\*\*

\*\*\* ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000)  
TIRE SPRING RATE (LB/IN/TIRE) 4500.00 4500.00  
TIRE LOADED RADIUS (IN) 20.00 20.00  
POLAR MOMENT OF INERTIA (IN-LB-SEC\*\*2/WHEEL) 103.00 103.00

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRACTOR REAR SUSPENSION AND AXLE PARAMETERS

|   | LEADING TANDEM AXLE |            | TRAILING TANDEM AXLE |            |
|---|---------------------|------------|----------------------|------------|
|   | LEFT SIDE           | RIGHT SIDE | LEFT SIDE            | RIGHT SIDE |
| SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM |                     |            |                      | 2          |
| TANDEM AXLE SEPARATION (IN BETWEEN LEADING AND TRAILING AXLES)                    |                     |            | 60.00                |            |
| STATIC LOAD TRANSFER (PERCENT LOAD ON LEAD AXLE)                                  |                     |            | 50.00                |            |
| DYNAMIC LOAD TRANSFER (% BRAKE TORQUE REACTED AS TANDEM AXLE LOAD TRANSFER)       |                     |            | 0.0                  |            |
| SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE)  | -3.00               | -3.00      | -3.00                | -3.00      |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***                                    |                     |            |                      |            |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***                                      |                     |            |                      |            |
| SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE)                                  | 0.0                 | 0.0        | 0.0                  | 0.0        |
| COULOMB FRICTION (LB/SIDE/AXLE)   | 2000.00             | 2000.00    | 2000.00              | 2000.00    |
| AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC**2)  | 5100.00             |            |                      | 5100.00    |
| ROLL CENTER HEIGHT (IN. ABOVE GROUND)   | 33.00               |            |                      | 33.00      |
| ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL)                                     | 0.22                |            |                      | 0.23       |
| AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE)   | 30000.00            |            |                      | 85000.00   |
| LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN)                                  | 38.00               |            |                      | 38.00      |
| TRACK WIDTH (IN)  | 72.00               |            |                      | 72.00      |
| UNSPRUNG WEIGHT (LB)  | 2500.00             |            |                      | 2500.00    |

TRACTOR REAR TIRES AND WHEELS

|   | LEFT SIDE | RIGHT SIDE |
|---|-----------|------------|
| DUAL TIRE SEPARATION (IN)   | 13.00     | 13.00      |
| CORNERING STIFFNESS (LB/DEG/TIRE)   | -2.00     | -2.00      |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***  |           |            |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***  |           |            |
| LONGITUDINAL STIFFNESS (LB/SLIP/TIRE)   | -52.00    | -52.00     |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***  |           |            |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***  |           |            |
| CAMBER STIFFNESS (LB/DEG/TIRE)  | 0.0       | 0.0        |
| ALIGNING MOMENT (IN-LB/DEG/TIRE)  | -1320.84  | -1320.84   |
| *** NEGATIVE ALIGNING MOMENT ENTRY ***  |           |            |
| *** ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000) |           |            |
| TIRE SPRING RATE (LB/IN/TIRE)   | 4500.00   | 4500.00    |
| TIRE LOADED RADIUS (IN)   | 20.00     | 20.00      |
| POLAR MOMENT OF INERTIA (IN-LB-SEC**2/WHEEL)  | 103.00    | 103.00     |

\*\*\* ZERO LINES IN TREADLE PRESSURE TABLE INDICATES NO BRAKING \*\*\*  
 \*\*\* THREE BRAKE PARAMETERS PER AXLE ARE DELETED AT THIS POINT \*\*\*

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RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRAILER NO. 1 PARAMETERS

WHEELBASE - DISTANCE FROM KINGPIN TO CENTER OF REAR SUSPENSION (IN) 246.00  
 BASE VEHICLE KINGPIN STATIC LOAD (LB) 1810.98  
 BASE VEHICLE CURB WEIGHT ON REAR SUSPENSION (LB) 6689.02  
 SPRUNG MASS CG HEIGHT (IN, ABOVE GROUND) 69.00  
 SPRUNG MASS ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 37813.00  
 SPRUNG MASS PITCH MOMENT OF INERTIA (IN-LB-SEC\*\*2) 268334.00  
 SPRUNG MASS YAW MOMENT OF INERTIA (IN-LB-SEC\*\*2) 268334.00  
 PAYLOAD WEIGHT (LB) 29716.90  
 PAYLOAD DISTANCE AHEAD OF REAR SUSPENSION CENTER(IN) 118.87  
 PAYLOAD CG HEIGHT (IN, ABOVE GROUND) 78.14  
 PAYLOAD ROLL MOMENT OF INERTIA(IN-LB-SEC\*\*2) 81679.31  
 PAYLOAD PITCH MOMENT OF INERTIA(IN-LB-SEC\*\*2) 688255.06  
 PAYLOAD YAW MOMENT OF INERTIA(IN-LB-SEC\*\*2) 740036.25  
 LOCATION OF PINTLE HOOK (IN BEHIND REAR SUSP. CENTER) 54.00  
 HEIGHT OF PINTLE HOOK (IN ABOVE GROUND) 34.50

TRAILER NO. 1 REAR SUSPENSION AND AXLE PARAMETERS

| LEADING TANDEM AXLE |            | TRAILING TANDEM AXLE |            |
|---------------------|------------|----------------------|------------|
| LEFT SIDE           | RIGHT SIDE | LEFT SIDE            | RIGHT SIDE |

SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM 1  
 TANDEM AXLE SEPARATION (IN BETWEEN LEADING AND TRAILING AXLES) 48.00  
 STATIC LOAD TRANSFER (PERCENT LOAD ON LEAD AXLE) 50.00  
 DYNAMIC LOAD TRANSFER (% BRAKE TORQUE REACTED AS TANDEM AXLE LOAD TRANSFER) -10.00  
 SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE) -4.00 -4.00 -4.00 -4.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE) 0.0 0.0 0.0 0.0  
 COULOMB FRICTION (LB/SIDE/AXLE) 975.00 975.00 975.00 975.00

| LEADING TANDEM AXLE |            | TRAILING TANDEM AXLE |            |
|---------------------|------------|----------------------|------------|
| LEFT SIDE           | RIGHT SIDE | LEFT SIDE            | RIGHT SIDE |
| 4100.00             | 4100.00    | 4100.00              | 4100.00    |
| 27.00               | 27.00      | 27.00                | 27.00      |
| 0.23                | 0.23       | 0.23                 | 0.23       |
| 9000.00             | 9000.00    | 9000.00              | 9000.00    |
| 44.00               | 44.00      | 44.00                | 44.00      |
| 78.00               | 78.00      | 78.00                | 78.00      |
| 1500.00             | 1500.00    | 1500.00              | 1500.00    |

TRAILER NO. 1 REAR TIRES AND WHEELS

| LEADING TANDEM AXLE |            | TRAILING TANDEM AXLE |            |
|---------------------|------------|----------------------|------------|
| LEFT SIDE           | RIGHT SIDE | LEFT SIDE            | RIGHT SIDE |

|        |        |        |        |
|--------|--------|--------|--------|
| 13.00  | 13.00  | 13.00  | 13.00  |
| -2.00  | -2.00  | -2.00  | -2.00  |
| -52.00 | -52.00 | -52.00 | -52.00 |

DUAL TIRE SEPARATION (IN)  
 CORNERING STIFFNESS (LB/DEG/TIRE) 13.00 13.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 LONGITUDINAL STIFFNESS (LB/SLIP/TIRE) -52.00 -52.00

\*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*

|  |     |          |          |         |          |                           |
|--|-----|----------|----------|---------|----------|---------------------------|
| CAMBER STIFFNESS (LB/DEG/TIRE)               |     | 0.0      | 0.0      |         | 0.0      | 0.0                       |
| ALIGNING MOMENT (IN-LB/DEG/TIRE)             |     | -1320.84 | -1320.84 |         | -1320.84 | -1320.84                  |
| *** NEGATIVE ALIGNING MOMENT ENTRY ***       |     |          |          |         |          |                           |
| *** ALIGNING MOMENT CURVE FIT PARAMETERS: (  | 0.0 | 8.0000   | 5.0000   | 0.8000) | (        | 0.0 8.0000 5.0000 0.8000) |
|  | (   |          |          |         |          |                           |
| *** NEGATIVE ALIGNING MOMENT ENTRY ***       |     |          |          |         |          |                           |
| *** ALIGNING MOMENT CURVE FIT PARAMETERS: (  | 0.0 | 8.0000   | 5.0000   | 0.8000) | (        | 0.0 8.0000 5.0000 0.8000) |
|  | (   |          |          |         |          |                           |
| TIRE SPRING RATE (LB/IN/TIRE)                |     | 4500.00  | 4500.00  |         | 4500.00  | 4500.00                   |
| TIRE LOADED RADIUS (IN)                      |     | 20.00    | 20.00    |         | 20.00    | 20.00                     |
| POLAR MOMENT OF INERTIA (IN-LB-SEC**2/WHEEL) |     | 103.00   | 103.00   |         | 103.00   | 103.00                    |

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRAILER NO. 2 PARAMETERS  
-----

|  |            |
|--|------------|
| # OF PINTLE HOOKS: 1 = A-DOLLY, 2 = B-DOLLY                                  | 2          |
| B-DOLLY HOOKS & FRAME PARAMETERS: --   |            |
| TOTAL YAW LASH AT PINTLE HOOKS (DEG)   | 0.0        |
| TOTAL ROLL LASH AT PINTLE HOOKS (DEG)  | 0.0        |
| YAW STIFFNESS BEYOND LASH (IN-LB/DEG)  | 1000000.00 |
| YAW DAMPING BEYOND LASH (IN-LB/DEG/SEC)                                      | 1000.00    |
| TORSIONAL (ROLL) STIFFNESS BEYOND LASH (IN-LB/DEG)                           | 30000.00   |
| B-DOLLY SELF-STEER AXLE PARAMETERS: --                                       |            |
| CENTERING STIFFNESS (IN-LB/DEG/AXLE)   | 4500.00    |
| COULOMB FRICTION (IN-LB/AXLE)  | 15000.00   |
| VISCOUS DAMPING (IN-LB/DEG/SEC/AXLE)   | 50.00      |
| MECHANICAL TRAIL (IN)  | 6.00       |
| LATERAL KINGPIN OFFSET (IN)  | 14.40      |
| DOLLY KEY: 1 = CONVERTER DOLLY, 2 = FIXED DOLLY                              | 1          |
| DISTANCE FROM DOLLY SUSPENSION TO PINTLE HOOK (IN)                           | 72.00      |
| TURNTABLE LOCATION (IN AHEAD OF SUSP. CENTER)                                | 0.0        |
| TURNTABLE HEIGHT ABOVE GROUND (IN)   | 44.00      |
| WHEELBASE - DISTANCE FROM CENTER OF FRONT SUSP. TO CENTER OF REAR SUSP. (IN) | 246.00     |
| BASE VEHICLE CURB WEIGHT ON FRONT SUSPENSION (LB)                            | 4311.07    |
| BASE VEHICLE CURB WEIGHT ON REAR SUSPENSION (LB)                             | 6689.02    |
| SPRUNG MASS CG HEIGHT (IN. ABOVE GROUND)                                     | 65.15      |
| SPRUNG MASS ROLL MOMENT OF INERTIA (IN-LB-SEC**2)                            | 66767.63   |
| SPRUNG MASS PITCH MOMENT OF INERTIA (IN-LB-SEC**2)                           | 268334.00  |
| SPRUNG MASS YAW MOMENT OF INERTIA (IN-LB-SEC**2)                             | 269703.69  |
| PAYLOAD WEIGHT (LB)  | 30886.90   |
| PAYLOAD DISTANCE AHEAD OF REAR SUSPENSION CENTER(IN)                         | 123.69     |
| PAYLOAD CG HEIGHT (IN. ABOVE GROUND)   | 79.09      |
| PAYLOAD ROLL MOMENT OF INERTIA(IN-LB-SEC**2)                                 | 86142.75   |
| PAYLOAD PITCH MOMENT OF INERTIA(IN-LB-SEC**2)                                | 716600.31  |
| PAYLOAD YAW MOMENT OF INERTIA(IN-LB-SEC**2)                                  | 769172.63  |
| LOCATION OF PINTLE HOOK (IN BEHIND REAR SUSP. CENTER)                        | 54.00      |
| HEIGHT OF PINTLE HOOK (IN ABOVE GROUND)                                      | 34.50      |

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRAILER NO. 2 FRONT SUSPENSION AND AXLE PARAMETERS

LEFT SIDE

RIGHT SIDE

|   |        |         |
|---|--------|---------|
| SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM | 0      |         |
| SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE)  | -4.00  | -4.00   |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***                                    |        |         |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***                                      |        |         |
| SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE)                                  | 0.0    | 0.0     |
| COULOMB FRICTION (LB/SIDE/AXLE)   | 975.00 | 975.00  |
| -----   |        |         |
| AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC**2)  |        | 4100.00 |
| ROLL CENTER HEIGHT (IN. ABOVE GROUND)   |        | 27.00   |
| ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL)                                     |        | 0.23    |
| AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE)   |        | 9000.00 |
| LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN)                                  |        | 44.00   |
| TRACK WIDTH (IN)  |        | 78.00   |
| UNSPRUNG WEIGHT (LB)  |        | 1500.00 |

TRAILER NO. 2 FRONT TIRES AND WHEELS

LEFT SIDE

RIGHT SIDE

|   |          |          |
|---|----------|----------|
| DUAL TIRE SEPARATION (IN)   | 13.00    | 13.00    |
| CORNERING STIFFNESS (LB/DEG/TIRE)   | -2.00    | -2.00    |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***  |          |          |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***  |          |          |
| LONGITUDINAL STIFFNESS (LB/SLIP/TIRE)   | -52.00   | -52.00   |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***  |          |          |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***  |          |          |
| CAMBER STIFFNESS (LB/DEG/TIRE)  | 0.0      | 0.0      |
| ALIGNING MOMENT (IN-LB/DEG/TIRE)  | -1320.84 | -1320.84 |
| *** NEGATIVE ALIGNING MOMENT ENTRY ***  |          |          |
| *** ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000) |          |          |
| TIRE SPRING RATE (LB/IN/TIRE)   | 4500.00  | 4500.00  |
| TIRE LOADED RADIUS (IN)   | 20.00    | 20.00    |
| POLAR MOMENT OF INERTIA (IN-LB-SEC**2/WHEEL)  | 103.00   | 103.00   |



RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRAILER NO. 2 REAR SUSPENSION AND AXLE PARAMETERS

| LEADING TANDEM AXLE |            | TRAILING TANDEM AXLE |            |
|---------------------|------------|----------------------|------------|
| LEFT SIDE           | RIGHT SIDE | LEFT SIDE            | RIGHT SIDE |
| 48.00               |            |                      |            |
| 50.00               |            |                      |            |
| -10.00              |            |                      |            |
|                     | -4.00      | -4.00                | -4.00      |
| 0.0                 | 0.0        | 0.0                  | 0.0        |
| 975.00              | 975.00     | 975.00               | 975.00     |
| 4100.00             |            |                      | 4100.00    |
| 27.00               |            |                      | 27.00      |
| 0.23                |            |                      | 0.23       |
| 9000.00             |            |                      | 9000.00    |
| 44.00               |            |                      | 44.00      |
| 78.00               |            |                      | 78.00      |
| 1500.00             |            |                      | 1500.00    |

SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM  
 TANDEM AXLE SEPARATION (IN BETWEEN LEADING AND TRAILING AXLES) 1  
 STATIC LOAD TRANSFER (PERCENT LOAD ON LEAD AXLE) 48.00  
 DYNAMIC LOAD TRANSFER (% BRAKE TORQUE REACTED AS TANDEM AXLE LOAD TRANSFER) 50.00  
 SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE) -10.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE)  
 COULOMB FRICTION (LB/SIDE/AXLE)

AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2)  
 ROLL CENTER HEIGHT (IN. ABOVE GROUND)  
 ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL)  
 AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE)  
 LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN)  
 TRACK WIDTH (IN)  
 UNSPRUNG WEIGHT (LB)

TRAILER NO. 2 REAR TIRES AND WHEELS

| LEADING TANDEM AXLE |            | TRAILING TANDEM AXLE |            |
|---------------------|------------|----------------------|------------|
| LEFT SIDE           | RIGHT SIDE | LEFT SIDE            | RIGHT SIDE |
| 13.00               | 13.00      | 13.00                | 13.00      |
| -2.00               | -2.00      | -2.00                | -2.00      |
| -52.00              | -52.00     | -52.00               | -52.00     |
| 0.0                 | 0.0        | 0.0                  | 0.0        |
| -1320.84            | -1320.84   | -1320.84             | -1320.84   |
| 0.0                 | 0.0        | 0.0                  | 0.0        |
| 5.0000              | 5.0000     | 5.0000               | 5.0000     |
| 8.0000              | 8.0000     | 8.0000               | 8.0000     |
| 0.0                 | 0.0        | 0.0                  | 0.0        |
| 5.0000              | 5.0000     | 5.0000               | 5.0000     |
| 8.0000              | 8.0000     | 8.0000               | 8.0000     |
| 4500.00             | 4500.00    | 4500.00              | 4500.00    |
| 20.00               | 20.00      | 20.00                | 20.00      |
| 103.00              | 103.00     | 103.00               | 103.00     |

DUAL TIRE SEPARATION (IN)  
 CORNERING STIFFNESS (LB/DEG/TIRE)  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 LONGITUDINAL STIFFNESS (LB/SLIP/TIRE)  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 CAMBER STIFFNESS (LB/DEG/TIRE)  
 ALIGNING MOMENT (IN-LB/DEG/TIRE)  
 \*\*\* NEGATIVE ALIGNING MOMENT ENTRY \*\*\*  
 \*\*\* ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000)  
 \*\*\* NEGATIVE ALIGNING MOMENT ENTRY \*\*\*  
 \*\*\* ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000)  
 TIRE SPRING RATE (LB/IN/TIRE)  
 TIRE LOADED RADIUS (IN)  
 POLAR MOMENT OF INERTIA (IN-LB-SEC\*\*2/WHEEL)

\*\*\* ZERO LINES IN TREADLE PRESSURE TABLE INDICATES NO BRAKING \*\*\*  
 \*\*\* THREE BRAKE PARAMETERS PER AXLE ARE DELETED AT THIS POINT \*\*\*

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRAILER NO. 3 PARAMETERS

|  |            |
|--|------------|
| # OF PINTLE HOOKS: 1 = A-DOLLY, 2 = B-DOLLY                                  | 2          |
| B-DOLLY HOOKS & FRAME PARAMETERS: --   |            |
| TOTAL YAW LASH AT PINTLE HOOKS (DEG)   | 0.0        |
| TOTAL ROLL LASH AT PINTLE HOOKS (DEG)  | 0.0        |
| YAW STIFFNESS BEYOND LASH (IN-LB/DEG)  | 1000000.00 |
| YAW DAMPING BEYOND LASH (IN-LB/DEG/SEC)                                      | 1000.00    |
| TORSIONAL (ROLL) STIFFNESS BEYOND LASH (IN-LB/DEG)                           | 30000.00   |
| B-DOLLY SELF-STEER AXLE PARAMETERS: --                                       |            |
| CENTERING STIFFNESS (IN-LB/DEG/AXLE)   | 4500.00    |
| COULOMB FRICTION (IN-LB/AXLE)  | 15000.00   |
| VISCOUS DAMPING (IN-LB/DEG/SEC/AXLE)   | 50.00      |
| MECHANICAL TRAIL (IN)  | 6.00       |
| LATERAL KINGPIN OFFSET (IN)  | 14.40      |
| DOLLY KEY: 1 = CONVERTER DOLLY, 2 = FIXED DOLLY                              | 1          |
| DISTANCE FROM DOLLY SUSPENSION TO PINTLE HOOK (IN)                           | 72.00      |
| TURNTABLE LOCATION (IN AHEAD OF SUSP. CENTER)                                | 0.0        |
| TURNTABLE HEIGHT ABOVE GROUND (IN)   | 44.00      |
| WHEELBASE - DISTANCE FROM CENTER OF FRONT SUSP. TO CENTER OF REAR SUSP. (IN) | 246.00     |
| BASE VEHICLE CURB WEIGHT ON FRONT SUSPENSION (LB)                            | 4311.07    |
| BASE VEHICLE CURB WEIGHT ON REAR SUSPENSION (LB)                             | 6689.02    |
| SPRUNG MASS CG HEIGHT (IN. ABOVE GROUND)                                     | 65.15      |
| SPRUNG MASS ROLL MOMENT OF INERTIA (IN-LB-SEC**2)                            | 66767.63   |
| SPRUNG MASS PITCH MOMENT OF INERTIA (IN-LB-SEC**2)                           | 268334.00  |
| SPRUNG MASS YAW MOMENT OF INERTIA (IN-LB-SEC**2)                             | 269703.69  |
| PAYLOAD WEIGHT (LB)  | 30887.00   |
| PAYLOAD DISTANCE AHEAD OF REAR SUSPENSION CENTER(IN)                         | 123.69     |
| PAYLOAD CG HEIGHT (IN. ABOVE GROUND)   | 79.09      |
| PAYLOAD ROLL MOMENT OF INERTIA(IN-LB-SEC**2)                                 | 86143.13   |
| PAYLOAD PITCH MOMENT OF INERTIA(IN-LB-SEC**2)                                | 716602.75  |
| PAYLOAD YAW MOMENT OF INERTIA(IN-LB-SEC**2)                                  | 769175.13  |

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RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRAILER NO. 3 FRONT SUSPENSION AND AXLE PARAMETERS

LEFT SIDE RIGHT SIDE

SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM  
 SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE) 0 -4.00 -4.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE) 0.0 0.0  
 COULOMB FRICTION (LB/SIDE/AXLE) 975.00 975.00  
 -----  
 AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC\*\*2) 4100.00  
 ROLL CENTER HEIGHT (IN. ABOVE GROUND) 27.00  
 ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL) 0.23  
 AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE) 9000.00  
 LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN) 44.00  
 TRACK WIDTH (IN) 78.00  
 UNSPRUNG WEIGHT (LB) 1500.00

TRAILER NO. 3 FRONT TIRES AND WHEELS

LEFT SIDE RIGHT SIDE

DUAL TIRE SEPARATION (IN) 13.00 13.00  
 CORNERING STIFFNESS (LB/DEG/TIRE) -2.00 -2.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 LONGITUDINAL STIFFNESS (LB/SLIP/TIRE) -52.00 -52.00  
 \*\*\* NEGATIVE ENTRY INDICATES TABLE ENTERED \*\*\*  
 \*\*\* ECHO WILL APPEAR ON TABLE INDEX PAGE \*\*\*  
 CAMBER STIFFNESS (LB/DEG/TIRE) 0.0 0.0  
 ALIGNING MOMENT (IN-LB/DEG/TIRE) -1320.84 -1320.84  
 \*\*\* NEGATIVE ALIGNING MOMENT ENTRY \*\*\*  
 \*\*\* ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000)  
 TIRE SPRING RATE (LB/IN/TIRE) 4500.00 4500.00  
 TIRE LOADED RADIUS (IN) 20.00 20.00  
 POLAR MOMENT OF INERTIA (IN-LB-SEC\*\*2/WHEEL) 103.00 103.00

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRAILER NO. 3 REAR SUSPENSION AND AXLE PARAMETERS

|   | LEADING TANDEM AXLE |            | TRAILING TANDEM AXLE |            |
|---|---------------------|------------|----------------------|------------|
|   | LEFT SIDE           | RIGHT SIDE | LEFT SIDE            | RIGHT SIDE |
| SUSPENSION KEY - 0 INDICATES SINGLE AXLE, 1 INDICATES FOUR SPRING, 2 WALKING BEAM |                     |            |                      | 1          |
| TANDEM AXLE SEPARATION (IN BETWEEN LEADING AND TRAILING AXLES)                    |                     |            |                      | 48.00      |
| STATIC LOAD TRANSFER (PERCENT LOAD ON LEAD AXLE)                                  |                     |            |                      | 50.00      |
| DYNAMIC LOAD TRANSFER (% BRAKE TORQUE REACTED AS TANDEM AXLE LOAD TRANSFER)       |                     |            |                      | -10.00     |
| SUSPENSION SPRING RATE (LB/IN/SIDE/AXLE)  | -4.00               | -4.00      | -4.00                | -4.00      |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***                                    |                     |            |                      |            |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***                                      |                     |            |                      |            |
| SUSPENSION VISCOUS DAMPING (LB-SEC/IN/SIDE/AXLE)                                  | 0.0                 | 0.0        | 0.0                  | 0.0        |
| COULOMB FRICTION (LB/SIDE/AXLE)   | 975.00              | 975.00     | 975.00               | 975.00     |
| AXLE ROLL MOMENT OF INERTIA (IN-LB-SEC**2)  | 4100.00             |            | 4100.00              |            |
| ROLL CENTER HEIGHT (IN. ABOVE GROUND)   | 27.00               |            | 27.00                |            |
| ROLL STEER COEFFICIENT (DEG. STEER/DEG. ROLL)                                     | 0.23                |            | 0.23                 |            |
| AUXILIARY ROLL STIFFNESS (IN-LB/DEG/AXLE)   | 9000.00             |            | 9000.00              |            |
| LATERAL DISTANCE BETWEEN SUSPENSION SPRINGS (IN)                                  | 44.00               |            | 44.00                |            |
| TRACK WIDTH (IN)  | 78.00               |            | 78.00                |            |
| UNSPRUNG WEIGHT (LB)  | 1500.00             |            | 1500.00              |            |

TRAILER NO. 3 REAR TIRES AND WHEELS

|   | LEADING TANDEM AXLE |            | TRAILING TANDEM AXLE |            |
|---|---------------------|------------|----------------------|------------|
|   | LEFT SIDE           | RIGHT SIDE | LEFT SIDE            | RIGHT SIDE |
| DUAL TIRE SEPARATION (IN)   | 13.00               | 13.00      | 13.00                | 13.00      |
| CORNERING STIFFNESS (LB/DEG/TIRE)   | -2.00               | -2.00      | -2.00                | -2.00      |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***  |                     |            |                      |            |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***  |                     |            |                      |            |
| LONGITUDINAL STIFFNESS (LB/SLIP/TIRE)   | -52.00              | -52.00     | -52.00               | -52.00     |
| *** NEGATIVE ENTRY INDICATES TABLE ENTERED ***  |                     |            |                      |            |
| *** ECHO WILL APPEAR ON TABLE INDEX PAGE ***  |                     |            |                      |            |
| CAMBER STIFFNESS (LB/DEG/TIRE)  | 0.0                 | 0.0        | 0.0                  | 0.0        |
| ALIGNING MOMENT (IN-LB/DEG/TIRE)  | -1320.84            | -1320.84   | -1320.84             | -1320.84   |
| *** NEGATIVE ALIGNING MOMENT ENTRY ***  |                     |            |                      |            |
| *** ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000) |                     |            |                      |            |
| *** NEGATIVE ALIGNING MOMENT ENTRY ***  |                     |            |                      |            |
| *** ALIGNING MOMENT CURVE FIT PARAMETERS: ( 0.0 8.0000 5.0000 0.8000) ( 0.0 8.0000 5.0000 0.8000) |                     |            |                      |            |
| TIRE SPRING RATE (LB/IN/TIRE)   | 4500.00             | 4500.00    | 4500.00              | 4500.00    |
| TIRE LOADED RADIUS (IN)   | 20.00               | 20.00      | 20.00                | 20.00      |
| POLAR MOMENT OF INERTIA (IN-LB-SEC**2/WHEEL)  | 103.00              | 103.00     | 103.00               | 103.00     |

\*\*\* ZERO LINES IN TREADLE PRESSURE TABLE INDICATES NO BRAKING \*\*\*  
 \*\*\* THREE BRAKE PARAMETERS PER AXLE ARE DELETED AT THIS POINT \*\*\*

ANTILOCK KEY: 1 INDICATES ANTILOCK WILL BE USED

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HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

TRAILER NO. 3      PAYLOAD = 30887.000 LBS.

|  | EMPTY      | LOADED      |
|--|------------|-------------|
| DISTANCE FROM TRAILER SPRUNG MASS CENTER TO REAR SUSPENSION (IN) | 106.387    | 120.681     |
| DISTANCE FROM TRAILER SPRUNG MASS CENTER TO GROUND (IN)          | 65.154     | 76.666      |
| ROLL MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC**2)     | 66767.625  | 155612.125  |
| PITCH MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC**2)    | 268333.938 | 991802.250  |
| YAW MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC**2)      | 269703.625 | 1043043.000 |

TRAILER NO. 2      PAYLOAD = 30886.898 LBS.

|  | EMPTY      | LOADED      |
|--|------------|-------------|
| DISTANCE FROM TRAILER SPRUNG MASS CENTER TO REAR SUSPENSION (IN) | 106.387    | 120.682     |
| DISTANCE FROM TRAILER SPRUNG MASS CENTER TO GROUND (IN)          | 65.154     | 76.666      |
| ROLL MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC**2)     | 66767.625  | 155611.750  |
| PITCH MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC**2)    | 268333.938 | 991800.000  |
| YAW MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC**2)      | 269703.625 | 1043040.750 |

TRAILER NO. 1      PAYLOAD = 29716.898 LBS.

|  | EMPTY      | LOADED      |
|--|------------|-------------|
| DISTANCE FROM TRAILER SPRUNG MASS CENTER TO REAR SUSPENSION (IN) | 81.000     | 112.959     |
| DISTANCE FROM TRAILER SPRUNG MASS CENTER TO GROUND (IN)          | 69.000     | 76.712      |
| ROLL MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC**2)     | 37812.996  | 120496.438  |
| PITCH MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC**2)    | 268333.938 | 974839.500  |
| YAW MOMENT OF INERTIA OF TRAILER SPRUNG MASS (IN-LB-SEC**2)      | 268333.938 | 1025616.000 |

TRACTOR      PAYLOAD = 0.0 LBS

|  | EMPTY      | LOADED     |
|--|------------|------------|
| DISTANCE FROM TRACTOR SPRUNG MASS CENTER TO REAR SUSPENSION (IN) | 135.000    | 135.000    |
| DISTANCE FROM TRACTOR SPRUNG MASS CENTER TO GROUND (IN)          | 44.000     | 44.000     |
| ROLL MOMENT OF INERTIA OF TRACTOR SPRUNG MASS (IN-LB-SEC**2)     | 25999.996  | 25999.996  |
| PITCH MOMENT OF INERTIA OF TRACTOR SPRUNG MASS (IN-LB-SEC**2)    | 169999.938 | 169999.938 |
| YAW MOMENT OF INERTIA OF TRACTOR SPRUNG MASS (IN-LB-SEC**2)      | 169999.938 | 169999.938 |

THE STATIC LOADS ON THE AXLES ARE:

| AXLE NUMBER | LOAD      |
|-------------|-----------|
| NS(1,1,1)   | 9920.996  |
| NS(1,2,1)   | 12125.000 |
| NS(1,2,2)   | 12125.000 |
| NS(2,2,1)   | 11022.945 |
| NS(2,2,2)   | 11022.945 |
| NS(3,1,1)   | 19841.160 |

|           |            |
|-----------|------------|
| NS(3,2,1) | 11022.918  |
| NS(3,2,2) | 11022.918  |
| NS(4,1,1) | 19841.086  |
| NS(4,2,1) | 11023.004  |
| NS(4,2,2) | 11023.004  |
| -----     |            |
| TOTAL     | 139990.813 |

THE TRACTOR TOTAL MASS CENTER IS 88.833 INCHES BEHIND THE FRONT AXLE  
 THE TOTAL YAW MOMENT OF INERTIA IS 387657.625 IN-LB-SEC\*\*2

THE FIRST TRAILER TOTAL MASS CENTER IS 141.908 INCHES BEHIND THE KINGPIN  
 THE TOTAL YAW MOMENT OF INERTIA IS 1129676.000 IN-LB-SEC\*\*2

THE SECOND TRAILER TOTAL MASS CENTER IS 129.474 INCHES BEHIND THE TURNTABLE CENTER  
 THE TOTAL YAW MOMENT OF INERTIA IS 1232163.000 IN-LB-SEC\*\*2

THE THIRD TRAILER TOTAL MASS CENTER IS 129.475 INCHES BEHIND THE TURNTABLE CENTER  
 THE TOTAL YAW MOMENT OF INERTIA IS 1232165.000 IN-LB-SEC\*\*2

HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.  
 RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

SPRING TABLES

| NO. OF LINES | FORCE (LB) | DEFLECTION (IN) | TABLE NO. |
|--------------|------------|-----------------|-----------|
| 9            | -20550.00  | -15.00          | -1        |
|              | -1170.00   | -0.75           |           |
|              | -150.00    | 0.0             |           |
|              | 1250.00    | 1.00            |           |
|              | 2550.00    | 2.00            |           |
|              | 3825.00    | 3.00            |           |
|              | 7240.00    | 5.50            |           |
|              | 11127.50   | 8.50            |           |
|              | 20076.50   | 15.50           |           |

SPRING STATIC EQUILIBRIUM CONDITION: 4360.50 LB, 3.39 INCHES. UNIT 1 SUSP 1 AXLE 1

|   |           |       |    |
|---|-----------|-------|----|
| 9 | -16215.00 | -2.00 | -3 |
|   | -50.00    | -0.25 |    |
|   | 450.00    | 0.0   |    |
|   | 1250.00   | 0.25  |    |
|   | 2710.00   | 0.50  |    |
|   | 4750.00   | 0.75  |    |
|   | 8950.00   | 1.00  |    |
|   | 38172.00  | 2.25  |    |
|   | 101507.00 | 5.00  |    |

SPRING STATIC EQUILIBRIUM CONDITION: 9625.00 LB, 1.03 INCHES. UNIT 1 SUSP 2 AXLE 1

SPRING STATIC EQUILIBRIUM CONDITION: 4812.50 LB, -0.00 INCHES. UNIT 1 SUSP 2 AXLE 2

|   |           |        |    |
|---|-----------|--------|----|
| 7 | -26660.15 | -10.00 | -4 |
|   | -97.65    | -1.50  |    |
|   | -50.00    | 0.0    |    |
|   | 1150.00   | 0.25   |    |
|   | 3000.00   | 0.50   |    |
|   | 5375.00   | 0.75   |    |
|   | 39542.85  | 4.50   |    |

SPRING STATIC EQUILIBRIUM CONDITION: 4761.47 LB, 0.69 INCHES. UNIT 2 SUSP 2 AXLE 1

SPRING STATIC EQUILIBRIUM CONDITION: 4761.47 LB, 0.69 INCHES. UNIT 2 SUSP 2 AXLE 2

SPRING STATIC EQUILIBRIUM CONDITION: 9170.58 LB, 1.17 INCHES. UNIT 3 SUSP 1 AXLE 1

SPRING STATIC EQUILIBRIUM CONDITION: 4761.46 LB, 0.69 INCHES. UNIT 3 SUSP 2 AXLE 1

SPRING STATIC EQUILIBRIUM CONDITION: 4761.46 LB, 0.69 INCHES. UNIT 3 SUSP 2 AXLE 2

|                                      |             |              |        |        |        |
|--------------------------------------|-------------|--------------|--------|--------|--------|
| SPRING STATIC EQUILIBRIUM CONDITION: | 9170.54 LB. | 1.17 INCHES. | UNIT 4 | SUSP 1 | AXLE 1 |
| SPRING STATIC EQUILIBRIUM CONDITION: | 4761.50 LB. | 0.69 INCHES. | UNIT 4 | SUSP 2 | AXLE 1 |
| SPRING STATIC EQUILIBRIUM CONDITION: | 4761.50 LB. | 0.69 INCHES. | UNIT 4 | SUSP 2 | AXLE 2 |



HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

MU-Y VS ALPHA TABLES

NO. OF LOADS NO. OF VELOCITIES TABLE NO.

-2

VELOCITY = 58.70 FT/SEC LOAD = 1983.00 LB  
 ALPHA (DEG) MU - Y

0.0 0.0  
 1.00 0.18  
 2.00 0.32  
 4.00 0.54  
 8.00 0.77  
 12.00 0.91

VELOCITY = 58.70 FT/SEC LOAD = 5967.00 LB  
 ALPHA (DEG) MU - Y

0.0 0.0  
 1.00 0.14  
 2.00 0.27  
 4.00 0.47  
 8.00 0.66  
 12.00 0.73

VELOCITY = 58.70 FT/SEC LOAD = 9441.00 LB  
 ALPHA (DEG) MU - Y

0.0 0.0  
 1.00 0.10  
 2.00 0.19  
 4.00 0.36  
 8.00 0.55  
 12.00 0.61

ROLL-OFF TABLE

| ALPHA | 0.0  | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
|-------|------|------|------|------|------|------|------|
| 0.0   | 1.00 | 1.00 | 0.87 | 0.40 | 0.38 | 0.17 | 0.06 |
| 1.00  | 1.00 | 1.00 | 0.83 | 0.40 | 0.38 | 0.17 | 0.06 |
| 2.00  | 1.00 | 1.00 | 0.81 | 0.39 | 0.38 | 0.17 | 0.06 |

|       |      |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
| 4.00  | 1.00 | 0.97 | 0.75 | 0.39 | 0.38 | 0.17 | 0.06 |
| 6.00  | 1.00 | 0.96 | 0.79 | 0.45 | 0.44 | 0.21 | 0.07 |
| 8.00  | 1.00 | 0.97 | 0.84 | 0.52 | 0.50 | 0.25 | 0.09 |
| 12.00 | 1.00 | 0.97 | 0.89 | 0.63 | 0.62 | 0.33 | 0.12 |
| 16.00 | 1.00 | 0.98 | 0.92 | 0.71 | 0.70 | 0.40 | 0.15 |

HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.  
 RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

MU-X VS. SLIP TABLES

TABLE NO.  
 -----  
 -52

NO. OF LOADS NO. OF VELOCITIES  
 -----  
 3 3  
 VELOCITY = 29.30 FT/SEC LOAD = 3020.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.58 |
| 0.10 | 0.81 |
| 0.21 | 0.86 |
| 0.25 | 0.86 |
| 0.50 | 0.79 |
| 1.00 | 0.62 |

VELOCITY = 58.70 FT/SEC LOAD = 3020.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.51 |
| 0.10 | 0.79 |
| 0.21 | 0.85 |
| 0.25 | 0.85 |
| 0.50 | 0.77 |
| 1.00 | 0.56 |

VELOCITY = 80.70 FT/SEC LOAD = 3020.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.46 |
| 0.10 | 0.78 |
| 0.21 | 0.84 |
| 0.25 | 0.84 |
| 0.50 | 0.76 |
| 1.00 | 0.52 |

HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

VELOCITY = 29.30 FT/SEC LOAD = 6040.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.37 |
| 0.10 | 0.71 |
| 0.24 | 0.80 |
| 0.25 | 0.80 |
| 0.50 | 0.74 |
| 1.00 | 0.54 |

VELOCITY = 58.70 FT/SEC LOAD = 6040.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.33 |
| 0.10 | 0.69 |
| 0.24 | 0.79 |
| 0.25 | 0.79 |
| 0.50 | 0.72 |
| 1.00 | 0.48 |

VELOCITY = 80.70 FT/SEC LOAD = 6040.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.30 |
| 0.10 | 0.67 |
| 0.24 | 0.79 |
| 0.25 | 0.78 |
| 0.50 | 0.70 |
| 1.00 | 0.44 |

VELOCITY = 29.30 FT/SEC LOAD = 9060.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.24 |
| 0.10 | 0.59 |
| 0.24 | 0.74 |
| 0.25 | 0.74 |
| 0.50 | 0.69 |
| 1.00 | 0.46 |

HSRI/MVMA BRAKING AND HANDLING SIMULATION OF TRUCKS, TRACTOR-SEMITRAILERS, DOUBLES, AND TRIPLES - PHASE 4.

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

VELOCITY = 58.70 FT/SEC LOAD = 9060.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.22 |
| 0.10 | 0.55 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.67 |
| 1.00 | 0.41 |

VELOCITY = 80.70 FT/SEC LOAD = 9060.00 LB  
 SLIP MU - X

|      |      |
|------|------|
| 0.0  | 0.0  |
| 0.04 | 0.20 |
| 0.10 | 0.52 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.65 |
| 1.00 | 0.36 |

ROLL-OFF TABLE

| ALPHA | 0.0  | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
|-------|------|------|------|------|------|------|------|
| 0.0   | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1.00  | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2.00  | 1.00 | 1.00 | 0.96 | 0.99 | 0.99 | 1.00 | 1.00 |
| 4.00  | 1.00 | 0.93 | 0.87 | 0.96 | 0.97 | 0.99 | 1.00 |
| 6.00  | 0.79 | 0.78 | 0.77 | 0.92 | 0.93 | 0.98 | 0.99 |
| 8.00  | 0.64 | 0.65 | 0.67 | 0.87 | 0.88 | 0.96 | 0.99 |
| 12.00 | 0.44 | 0.47 | 0.52 | 0.77 | 0.78 | 0.92 | 0.98 |
| 16.00 | 0.34 | 0.37 | 0.41 | 0.66 | 0.68 | 0.87 | 0.96 |

RTAC 11 axle C-train Triples (63.5t/140k GCW), conf. 4.2, var. 1.00

--- LOADED VEHICLE PARAMETERS SUMMARY ---

- \* Number of units: 6
- \* Axle loads were input; payloads were calculated.

UNIT # 1 -- TRKTR; # of Rear Suspensions: 1; Rear HitchLoad: 16171.0  
FILES: Tare: ST6T:Tr.3ax190wb ; Load: ST6T:SL.Tr4.5t11t ; Hitch: ST6T:HI.5thWheel  
WEIGHT: Total: 18000.0; Sprung: 11800.0; Payload: 0.0  
XINERT: Total: 45964 ; Sprung: 26000 ; Payload: 0  
YINERT: Total: 379769 ; Sprung: 170000 ; Payload: 0  
ZINERT: Total: 387605 ; Sprung: 170000 ; Payload: 0  
CGXLOC: Total: 88.8; Sprung: 55.0; Payload: 0.0  
CGZLOC: Total: 35.7; Sprung: 44.0; Payload: 0.0  
LENGTH: EffWlbse: 190.0; Last Wlbse: 190.0; HitchLoc[x]: 186.0

SUSPENSION # 0; SuspFile: ST6T:Su.IH12kFrnt ; SuspLoad: 9921.0 ; SuspKey: 0

AXLE 1 -- Load: 9921.0; AxleLoc[x]: 0.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.IHref.Frt ST6T:Sp.IHref.Frt  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.StrAxle ST6T:Br.StrAxle  
ALOCK :

SUSPENSION # 1; SuspFile: ST6T:Su.HknWkBm44 ; SuspLoad: 24250.0; SuspKey: 2

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AXLE 1 -- Load: 12125.0; AxleLoc[x]: 160.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

AXLE 2 -- Load: 12125.0; AxleLoc[x]: 220.0  
Axle Files Lhs Rhs  
-----  
SPRING : ST6T:Sp.HknRTE440 ST6T:Sp.HknRTE440  
TIRE : ST6T:T1.XZA11R225 ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle ST6T:Br.DualsAxle  
ALOCK :

UNIT # 2 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.1  
FILES: Tare: ST6T:Se.27FtTndm ; Load: ST6T:SL.Se10t ; Hitch: ST6T:HI.BdollyRef  
WEIGHT: Total: 38216.9; Sprung: 35216.9; Payload: 29716.9  
XINERT: Total: 151724 ; Sprung: 120496 ; Payload: 81679  
YINERT: Total: 1093700 ; Sprung: 974836 ; Payload: 688255  
ZINERT: Total: 1129649 ; Sprung: 1025613 ; Payload: 740036  
CGXLOC: Total: 141.9; Sprung: 133.0; Payload: 127.1  
CGZLOC: Total: 72.3; Sprung: 76.7; Payload: 78.1  
LENGTH: EffWlbse: 246.0; Last Wlbse: 246.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21b48In ; SuspLoad: 22046.0; SuspKey: 1

AXLE 1 -- Load: 11023.0; AxleLoc[x]: 222.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 11023.0; AxleLoc[x]: 270.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

UNIT # 3 -- DOLLY; # of Rear Suspensions: 1; Rear HitchLoad: 17341.0  
 FILES: Tare: ST6T:Do.Convrt1Ax ; Load: ST6T:SL.Do9t ; Hitch: ST6T:H1.5thWheel  
 WEIGHT: Total: 2500.1 ; Sprung: 1000.0 ; Payload: 0.0  
 XINERT: Total: 14995 ; Sprung: 10000 ; Payload: 0  
 YINERT: Total: 5895 ; Sprung: 5000 ; Payload: 0  
 ZINERT: Total: 10100 ; Sprung: 6000 ; Payload: 0  
 CGXLOC: Total: 72.0; Sprung: 72.0; Payload: 0.0  
 CGZLOC: Total: 29.6; Sprung: 44.0; Payload: 0.0  
 LENGTH: EffWlbse: 72.0; Last Wlbse: 72.0; HitchLoc[x]: 72.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21Bsngr1 ; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 72.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

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UNIT # 4 -- SEMI ; # of Rear Suspensions: 1; Rear HitchLoad: 0.1  
 FILES: Tare: ST6T:Se.27FtTndm ; Load: ST6T:SL.Se10t ; Hitch: ST6T:H1.BdollyRef  
 WEIGHT: Total: 39386.9; Sprung: 36386.9; Payload: 30886.9  
 XINERT: Total: 157172 ; Sprung: 125187 ; Payload: 86143  
 YINERT: Total: 1135124 ; Sprung: 1008201 ; Payload: 716600  
 ZINERT: Total: 1170879 ; Sprung: 1059543 ; Payload: 769173  
 CGXLOC: Total: 137.7; Sprung: 128.8; Payload: 122.3  
 CGZLOC: Total: 73.2; Sprung: 77.6; Payload: 79.1  
 LENGTH: EffWlbse: 246.0; Last Wlbse: 246.0; HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21b481n ; SuspLoad: 22046.0; SuspKey: 1

AXLE 1 -- Load: 11023.0; AxleLoc[x]: 222.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |
| WHLBRK :   | ST6T:Br.DualsAxle | ST6T:Br.DualsAxle |
| ALOCK :    |                   |                   |

AXLE 2 -- Load: 11023.0; AxleLoc[x]: 270.0

| Axle Files | Lhs               | Rhs               |
|------------|-------------------|-------------------|
| SPRING :   | ST6T:Sp.MTC.Reyco | ST6T:Sp.MTC.Reyco |
| TIRE :     | ST6T:T1.XZA11R225 | ST6T:T1.XZA11R225 |

WHLBRK : ST6T:Br.DualsAxle  
ALOCK :

ST6T:Br.DualsAxle

UNIT # 5 -- DOLLY: # of Rear Suspensions: 1; Rear HitchLoad: 17341.0  
FILES: Tare: ST6T:Do.Convrt1Ax ; Load: ST6T:SL.Do9t ; Hitch: ST6T:Hi.5thWheel  
WEIGHT: Total: 2500.1 ; Sprung: 1000.0 ; Payload: 0.0  
XINERT: Total: 14995 ; Sprung: 10000 ; Payload: 0  
ZINERT: Total: 5895 ; Sprung: 5000 ; Payload: 0  
CGXLOC: Total: 10100 ; Sprung: 6000 ; Payload: 0  
CGZLOC: Total: 72.0 ; Sprung: 72.0 ; Payload: 0.0  
LENGTH: EffWbse: 72.0; Last Wlbse: 72.0; HitchLoc[x]: 72.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21Bsngl ; SuspLoad: 19841.0; SuspKey: 0

AXLE 1 -- Load: 19841.0; AxleLoc[x]: 72.0  
Axle Files Lhs Rhs

SPRING : ST6T:Sp.MTC.Reyco  
TIRE : ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle  
ALOCK :

ST6T:Sp.MTC.Reyco  
ST6T:T1.XZA11R225  
ST6T:Br.DualsAxle

UNIT # 6 -- SEMI : # of Rear Suspensions: 1; Rear HitchLoad: 0.0  
FILES: Tare: ST6T:Se.27FtIndm ; Load: ST6T:SL.Se10t ; Hitch:  
WEIGHT: Total: 39387.0; Sprung: 36387.0; Payload: 30887.0  
XINERT: Total: 157173 ; Sprung: 125187 ; Payload: 86143  
ZINERT: Total: 1135125 ; Sprung: 1008203 ; Payload: 716603  
CGXLOC: Total: 1170880 ; Sprung: 1059545 ; Payload: 769175  
CGZLOC: Total: 137.7; Sprung: 128.8; Payload: 122.3  
LENGTH: EffWbse: 246.0; Last Wlbse: 77.6; Payload: 79.1  
HitchLoc[x]: 300.0

SUSPENSION # 1; SuspFile: ST6T:Su.Rc21b48In ; SuspLoad: 22046.0; SuspKey: 1

AXLE 1 -- Load: 11023.0; AxleLoc[x]: 222.0  
Axle Files Lhs Rhs

SPRING : ST6T:Sp.MTC.Reyco  
TIRE : ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle  
ALOCK :

ST6T:Sp.MTC.Reyco  
ST6T:T1.XZA11R225  
ST6T:Br.DualsAxle

AXLE 2 -- Load: 11023.0; AxleLoc[x]: 270.0  
Axle Files Lhs Rhs

SPRING : ST6T:Sp.MTC.Reyco  
TIRE : ST6T:T1.XZA11R225  
WHLBRK : ST6T:Br.DualsAxle  
ALOCK :

ST6T:Sp.MTC.Reyco  
ST6T:T1.XZA11R225  
ST6T:Br.DualsAxle



## APPENDIX B.2

### Conventions for Determining RTAC Tractor Inertial Properties

The sprung weight (units of lbs.) of conventional tandem-axle tractors with wheelbase L (units of in.) was determined by the formula:

$$W_{\text{Sprung Mass}} = 11800 + 1000 [ (L-190) / 30 ] . \quad (1)$$

This formula is based on the assumption, that the sprung weight of a baseline (190"-wheelbase) tandem-axle tractor is 11800 lbs. (yielding at a total weight of 18000 lbs.), and on the estimate that each additional 30" of wheelbase translates into an additional 1000 lbs. of sprung weight.

The sprung-mass Roll moment of inertia  $I_{xx}$  (in-lbs-sec<sup>2</sup>) was determined in all cases from the respective sprung weight  $W$ , assuming a constant value of 29" for the radius of gyration of the sprung mass, namely:

$$I_{xx} = 2.178 W . \quad (2)$$

The sprung-mass Pitch and Yaw moments of inertia  $I_{jj}$  ( $j = y, z$ ) was determined by the empirical formula proposed on p. 294 of reference [1], where:

$$I_{jj} = [ (W_f + 0.4 W_r) A_f^2 + 0.6 W_r A_r^2 ] / G , \quad (3)$$

where  $W_f$  and  $W_r$  are the equivalent partial sprung weights supported by the front and rear suspensions, and  $A_f$  and  $A_r$  are the absolute values of their respective distances from the sprung mass C.G.

Vertical location of the center of the tractor sprung-mass is always assumed to be 44.0 in above ground level.

Longitudinal location of the sprung-mass center for the baseline tractor (190. in. wheelbase) was taken to be 55 in. aft of the front axle centerline. For tractors of other wheelbases L, the respective longitudinal location X of the sprung mass C.G. was estimated by the relationship:

$$X = 55 + (L - 190) / 2 . \quad (4)$$

Tractor unsprung masses and roll (or yaw) moments of inertia were set as follows, respectively:

Front (steering) axle - 1200 lbs. and 3700 in-lbs-sec<sup>2</sup>.

Rear (driving) axles - 2500 lbs. and 5100 in-lbs-sec<sup>2</sup> per axle.

### Conventions for Determining RTAC Semitrailer Inertial Properties

The sprung weight (units of lbs.) of conventional tandem-axle semitrailers with cargo-bed length L (units of ft.) was determined by the formula:

$$W_{\text{Sprung Mass}} = 5500 + (10800-5500) [ (L-27) / (48-27) ] . \quad (5)$$

This formula is based on the scheme described in reference [2] (volume II, top of page 122), with parameters adjusted as follows:

|  |                                  |            |
|--|----------------------------------|------------|
| Sprung weight of a 48' tandem-axle semitrailer:                            | 10800. lbs.                      | (Fruehauf) |
| Sprung weight of a 27' tandem-axle semitrailer:                            | 5500. lbs.                       | (estimate) |
| Sprung weight of a 27'-bed 2-axle B-train semi:                            | 8000. lbs.                       | (estimate) |
| Sprung I <sub>xx</sub> of a 48' tandem-axle semitrailer:                   | 80000. in-lbs-sec <sup>2</sup>   | (estimate) |
| Sprung I <sub>yy</sub> = I <sub>zz</sub> of a 48' tandem-axle semitrailer: | 1000000. in-lbs-sec <sup>2</sup> | (estimate) |
| Sprung I <sub>xx</sub> of a 27'-bed 2-axle B-train semi:                   | 55000. in-lbs-sec <sup>2</sup>   | (estimate) |
| Sprung I <sub>yy</sub> = I <sub>zz</sub> of a 27'-bed 2-axle B-train semi: | 400000. in-lbs-sec <sup>2</sup>  | (estimate) |

For conventional semitrailers with N axles (0 < N < 5), the formula was generalized to yield:

$$W_{\text{Sprung Mass}} = 5500 + 5300 [ (L-27) / (21) ] + 500 (N-2) . \quad (6)$$

For the lead semitrailers in B-train configurations, the formula was further generalized to become:

$$W_{\text{Sprung Mass}} = W_{\text{Ref}} + 5300 [ (L - L_{\text{Ref}}) / (21) ] + 500 (N-2) , \quad (7)$$

where  $W_{\text{Ref}}$  is the sprung weight in the reference case (variation 1.00 in the simulation matrix), and  $L$  and  $L_{\text{Ref}}$  are the respective distances (units of ft.) from front kingpin to rear fifth wheel axis in the new and reference cases.

The new sprung-mass Roll moment of inertia  $I_{xx}$  for the lead B-train semitrailers was determined from the reference case value  $I_{xx_{\text{Ref}}}$  by the formula:

$$I_{xx} = I_{xx_{\text{Ref}}} (W / W_{\text{Ref}}) . \quad (8)$$

The new corresponding sprung-mass Pitch and Yaw moments of inertia  $I_{jj}$  ( $j=y, z$ ) was determined by:

$$I_{jj} = I_{jj_{\text{Ref}}} (W / W_{\text{Ref}}) (L / L_{\text{Ref}})^2 , \quad (9)$$

where  $L$  and  $L_{\text{Ref}}$  are bed lengths for conventional semis, or front--rear hitch distances for B-train lead semis, as above.

Location of the sprung mass center of the empty semitrailer was estimated by assuming this mass to consist of two distinct parts - a single mass representing the cargo "box" or bed, with its center at the half-length point and 80 in. above ground level, plus one or more "suspension-subframe" masses of 500 lbs for each installed axle, located directly above the corresponding axle and 36 in. above ground level. The resulting longitudinal and vertical location values were generally rounded to the nearest inch, and in certain cases adjusted by way of engineering judgement in order to accommodate special semitrailer types for which the above scheme is not directly applicable (such as lead B-train semis, whose box or bed and its associated uniform mass do not extend for the whole trailer length).

Trailer (and dolly) unsprung masses and roll (or yaw) moments of inertia were set at 1500 lbs. and 4100 in-lbs-sec<sup>2</sup> per axle, respectively.

### Conventions for Determining RTAC Dolly Inertial Properties

The sprung weight of A- and C-type converter dollies was assumed to be 1000 lbs. for a single axle dolly, 1500 lbs. for a tandem-axle dolly.

The dolly sprung-mass Roll moment of inertia  $I_{xx}$  was arbitrarily set to 10000 in-lbs-sec<sup>2</sup>, in order to ensure numerical stability in the Yaw/Roll program. The physical influence of an increased dolly roll moment of inertia (from a more realistic value of about 2000 in-lbs-sec<sup>2</sup> to the above value) on the dynamic response of the vehicle combination proves negligible since the two units are practically coupled in roll, with the "mass times the distance squared" terms being dominant in the compound dolly+semitrailer moment of inertia.

The dolly sprung-mass Pitch moment of inertia  $I_{yy}$  was assumed to be 5000 in-lbs-sec<sup>2</sup> for a single axle dolly, 9000 in-lbs-sec<sup>2</sup> for a tandem-axle dolly.

The dolly sprung-mass Yaw moment of inertia  $I_{zz}$  was assumed to be 6000 in-lbs-sec<sup>2</sup> for a single axle dolly, 10000 in-lbs-sec<sup>2</sup> for a tandem-axle dolly.

Vertical location of the center of the dolly sprung-mass was always assumed to be 44.0 in above ground level, while its longitudinal location was taken to be directly above the suspension centerline. Zero mechanical trail was assumed between the dolly fifth wheel articulation axis and the suspension centerline.

## REFERENCES FOR APPENDIX B

1. MacAdam, C.C., et al. "A Computerized Model for Simulating the Braking and Steering Dynamics of Trucks, Tractor-Semitrailers, Doubles, and Triples Combinations -- User's Manual -- Phase 4." MVMA Project 1197, UM-HSRI-80-58, September 1980.
2. Ervin, R.D., et al. "Influence of Size and Weight Variables on the Stability and Control Properties of Heavy Trucks." Final Report to FHWA, Contract No. FH-11-9577, UMTRI-83-10, March 1983.

APPENDIX B.3

PRINT-OUTS OF VEHICLE COMPONENT PARAMETERS  
(SUSPENSION, SPRING, TIRE, & SELF-STEERING AXLE DATA)

## SUSPENSION FILES

### LIST OF SUSPENSIONS:

IH "reference" 12k tractor front (leaf), @ 96 & 102" width  
Hendrickson RTE 440 tractor tandem (walking beam, leaf), @ various axle spreads and widths  
Hendrickson RTE 380 tractor tandem (walking beam, leaf)  
Mack "Camelback" SS38C tractor tandem (walking beam, leaf)  
Neway ARD 244 tractor tandem (4-spring, air), @ 16, 12 & 8 k/axle  
Neway AR 95-17 trailer tandem/single (4/2 spring, air), @ 24, 16 & 8 k/axle  
Reyco 21B trailer tandem/single (4/2 spring, leaf), @ various axle spreads and widths

### PARAMETER TERMINOLOGY:

Dynamic Load Transfer - Percentage of applied brake-torque reaction supplied by variation in vertical tire loads.

Auxiliary Roll Stiffness - Portion of total measured suspension roll stiffness provided indirectly, not by major vertical spring rates, but by additional mechanisms such as leaf-spring torsion and/or sideways warping, anti-roll-bars, etc.

Roll-steer coefficient - Unitless; indicated in degrees of axle-steer per one degree of sprung-mass-roll, with polarity according to SAE axis convention.

Suspension File

IH "Reference"-based RTAC Front Suspension.  
 Overall tire width : 96."  
 Filename = ST6T:Su.IH12kFrnt

| Front Suspension                        |                                |
|---|--------------------------------|
| Roll Moment of Inertia .....            | 3700 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....                     | 1200 lbs.                      |
| Center of Gravity Height .....          | 20 in.                         |
| Roll Center Height .....                | 18.25 in.                      |
| Track Width .....                       | 80 in.                         |
| Dual Tire Separation .....              | 0 in.                          |
| Spring Spread .....                     | 32 in.                         |
| Auxiliary Roll Stiffness .....          | 3824 in-lbs/deg                |
| Rollsteer Coefficient .....             | 0.000                          |
| Left Hand Viscous Damping Coefficient . | 22.26                          |
| Right Hand Viscous Damping Coefficient  | 22.26                          |



**Suspension File**

IH "Reference"-based RTAC Front Suspension.  
 Overall tire width : 102."  
 Created for conf. 1.1, variation 7.2  
 Filename = ST6T:Su.JH12kF102

| Front Suspension                        |                                |
|---|--------------------------------|
| Roll Moment of Inertia .....            | 4300 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....                     | 1200 lbs.                      |
| Center of Gravity Height .....          | 20 in.                         |
| Roll Center Height .....                | 18.25 in.                      |
| Track Width .....                       | 86 in.                         |
| Dual Tire Separation .....              | 0 in.                          |
| Spring Spread .....                     | 38 in.                         |
| Auxiliary Roll Stiffness .....          | 8700 in-lbs/deg                |
| Rollsteer Coefficient .....             | 0.000                          |
| Left Hand Viscous Damping Coefficient . | 28                             |
| Right Hand Viscous Damping Coefficient  | 28                             |

Suspension File

Hendrickson Walking Beam (44K, 60" axle spacing) Suspension.  
 Make and Model: Hendrickson RTE.440  
 Overall tire width: 96."  
 Filename = ST6T:Su.HknWkBr44

Walking Beam Tandem Rear Suspension

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 5100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 2500 lbs.                      |
| Axle Separation .....       | 60 in.                         |
| Static Load Distribution .  | 50 %                           |
| Dynamic Load Transfer .     | 0%                             |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 33 in.                         |
| Track Width .....           | 72 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 38 in.                         |
| Auxiliary Roll Stiffness .. | 30000 in-lbs/deg               |
| Rollsteer Coefficient ...   | 0.220                          |

| Trailing Axle             |                  |
|---------------------------|------------------|
| Auxiliary Roll Stiffness  | 85000 in-lbs/deg |
| Rollsteer Coefficient ... | 0.230            |

**Suspension File**

Hendrickson Walking Beam (44K, 48" axle spacing) Suspension.  
 Make and Model: Hendrickson RTE.440  
 Tractor Rear suspension. Created for conf. 1.1, variat. 3.15.  
 Filename = ST6T:Su.HnWB44.48

**Walking Beam Tandem Rear Suspension**

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 5100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 2500 lbs.                      |
| Axle Separation .....       | 48 in.                         |
| Static Load Distribution .. | 50 %                           |
| Dynamic Load Transfer ..    | 0%                             |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 33 in.                         |
| Track Width .....           | 72 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 38 in.                         |
| Auxiliary Roll Stiffness .. | 30000 in-lbs/deg               |
| Rollsteer Coefficient ...   | 0.220                          |
|                             |                                |
| Trailing Axle               |                                |
| Auxiliary Roll Stiffness    | 85000 in-lbs/deg               |
| Rollsteer Coefficient ..    | 0.230                          |
|                             |                                |

**Suspension File**

Hendrickson Walking Beam (44K, 72" axle spacing) Suspension.  
 Make and Model : Hendrickson RTE.440  
 Tractor Rear suspension. Created for conf. 1.1, variat. 3.16.  
 Filename = ST6T:Su.HnWB44.72

**Walking Beam Tandem Rear Suspension**

| Lead Axle                    |                                |
|------------------------------|--------------------------------|
| Roll Moment of Inertia . .   | 5100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass . . . . .      | 2500 lbs.                      |
| Axle Separation . . . . .    | 72 in.                         |
| Static Load Distribution .   | 50 %                           |
| Dynamic Load Transfer .      | 0%                             |
| Center of Gravity Height     | 20 in.                         |
| Roll Center Height . . . . . | 33 in.                         |
| Track Width . . . . .        | 72 in.                         |
| Dual Tire Separation . . . . | 13 in.                         |
| Spring Spread . . . . .      | 38 in.                         |
| Auxiliary Roll Stiffness . . | 30000 in-lbs/deg               |
| Rollsteer Coefficient . . .  | 0.220                          |
|                              |                                |
| Trailing Axle                |                                |
| Auxiliary Roll Stiffness     | 85000 in-lbs/deg               |
| Rollsteer Coefficient . .    | 0.230                          |
|                              |                                |

**Suspension File**

Hendrickson Walking Beam (44K, 60" axle spacing) Suspension.  
 Make and Model: Hendrickson RTE.440  
 Overall tire width: 96." Created for conf. 1.1, variation 7.02  
 Filename = ST6T:Su.Hkn44.102

**Walking Beam Tandem Rear Suspension**

| Lead Axle                   |                                   |
|-----------------------------|-----------------------------------|
| Roll Moment of Inertia ..   | 5985.42 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 2500 lbs.                         |
| Axle Separation .....       | 60 in.                            |
| Static Load Distribution .  | 50 %                              |
| Dynamic Load Transfer .     | 0%                                |
| Center of Gravity Height    | 20 in.                            |
| Roll Center Height .....    | 33 in.                            |
| Track Width .....           | 78 in.                            |
| Dual Tire Separation ....   | 13 in.                            |
| Spring Spread .....         | 44 in.                            |
| Auxiliary Roll Stiffness .. | 30000 in-lbs/deg                  |
| Rollsteer Coefficient ...   | 0.220                             |
|                             |                                   |
| Trailing Axle               |                                   |
| Auxiliary Roll Stiffness    | 85000 in-lbs/deg                  |
| Rollsteer Coefficient ..    | 0.230                             |
|                             |                                   |

**Suspension File**

Hendrickson Walking Beam (38K, 60" axle spacing) Suspension.  
 Make and Model : Hendrickson RTE.380  
 Overall tire width : 96."  
 Filename = ST6T:Su.HknWkBm38

**Walking Beam Tandem Rear Suspension**

| Lead Axle                    |                                |
|------------------------------|--------------------------------|
| Roll Moment of Inertia . .   | 5100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass . . . . .      | 2500 lbs.                      |
| Axle Separation . . . . .    | 60 in.                         |
| Static Load Distribution .   | 50 %                           |
| Dynamic Load Transfer .      | 0%                             |
| Center of Gravity Height     | 20 in.                         |
| Roll Center Height . . . .   | 33 in.                         |
| Track Width . . . . .        | 72 in.                         |
| Dual Tire Separation . . .   | 13 in.                         |
| Spring Spread . . . . .      | 38 in.                         |
| Auxiliary Roll Stiffness . . | 17000 in-lbs/deg               |
| Rollsteer Coefficient . . .  | 0.220                          |
|                              |                                |
| Trailing Axle                |                                |
| Auxiliary Roll Stiffness     | 17000 in-lbs/deg               |
| Rollsteer Coefficient . .    | 0.230                          |
|                              |                                |

Suspension File

Mack "Camel-Back" Walking Beam (60" axle spacing) Suspension.  
 Make and Model : Mack "Camel-Back" SS38C, 38K load rating.  
 Overall tire width : 96."  
 Filename = ST6T:Su.CamelBack

Walking Beam Tandem Rear Suspension

| Lead Axle                    |                                |
|------------------------------|--------------------------------|
| Roll Moment of Inertia . .   | 5100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass . . . . .      | 2300 lbs.                      |
| Axle Separation . . . . .    | 60 in.                         |
| Static Load Distribution .   | 50 %                           |
| Dynamic Load Transfer .      | 9.4%                           |
| Center of Gravity Height     | 20 in.                         |
| Roll Center Height . . . .   | 3 in.                          |
| Track Width . . . . .        | 72 in.                         |
| Dual Tire Separation . . .   | 13 in.                         |
| Spring Spread . . . . .      | 38.88 in.                      |
| Auxiliary Roll Stiffness . . | 7500 in-lbs/deg                |
| Rollsteer Coefficient . . .  | -0.135                         |
|                              |                                |
| Trailing Axle                |                                |
| Center of Gravity Height     | 20 in.                         |
| Roll Center Height . . . .   | 31 in.                         |
| Auxiliary Roll Stiffness . . | 5500 in-lbs/deg                |
| Rollsteer Coefficient . . .  | -0.030                         |

**Suspension File**

Tractor Rear suspension. Neway 244, 16000 Lbs/Axle  
 File created for conf. 1.1, variation 5.13.

FILE NAME = ST6T:Su.ARD244.16

**Four Spring Tandem Rear Suspension**

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 1500 lbs.                      |
| Axle Separation .....       | 48 in.                         |
| Static Load Distribution .  | 50 %                           |
| Dynamic Load Transfer .     | 0%                             |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 29.5 in.                       |
| Track Width .....           | 72 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 38 in.                         |
| Auxiliary Roll Stiffness .. | 15000 in-lbs/deg               |
| Rollsteer Coefficient ...   | 0.175                          |
|                             |                                |
| Trailing Axle               |                                |
| Auxiliary Roll Stiffness    | 51000 in-lbs/deg               |
| Rollsteer Coefficient ..    | 0.175                          |



**Suspension File**

Tractor Rear suspension. Neway 244, 12000 Lbs/Axle  
 File created for conf. 1.1, variation 5.13.

FILE NAME = ST6T:Su.ARD244.12

**Four Spring Tandem Rear Suspension**

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 1500 lbs.                      |
| Axle Separation .....       | 48 in.                         |
| Static Load Distribution .  | 50 %                           |
| Dynamic Load Transfer .     | 0%                             |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 29.5 in.                       |
| Track Width .....           | 72 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 38 in.                         |
| Auxiliary Roll Stiffness .. | 24000 in-lbs/deg               |
| Rollsteer Coefficient ...   | 0.175                          |

| Trailing Axle            |                  |
|--------------------------|------------------|
| Auxiliary Roll Stiffness | 48000 in-lbs/deg |
| Rollsteer Coefficient .. | 0.175            |

Suspension File

Tractor Rear suspension. Neway 244, 8000 Lbs/Axle  
 File created for conf. 1.1, variation 5.13.

FILE NAME = ST6T:Su.ARD244.8

Four Spring Tandem Rear Suspension

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 1500 lbs.                      |
| Axle Separation .....       | 48 in.                         |
| Static Load Distribution .  | 50 %                           |
| Dynamic Load Transfer .     | 0%                             |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 29.5 in.                       |
| Track Width .....           | 72 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 38 in.                         |
| Auxiliary Roll Stiffness .. | 29000 in-lbs/deg               |
| Rollsteer Coefficient ...   | 0.175                          |

| Trailing Axle            |                  |
|--------------------------|------------------|
| Auxiliary Roll Stiffness | 46000 in-lbs/deg |
| Rollsteer Coefficient .. | 0.175            |

Suspension File

TRAILER TANDEM AIR SUSPENSION NEWAY AR 95-17, 24000 LBS/AXLE

FILE NAME = ST6T:SU.AR9517.24

Four Spring Tandem Rear Suspension

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| Lead Axle                    |                                |
|------------------------------|--------------------------------|
| Roll Moment of Inertia . .   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass . . . . .      | 1500 lbs.                      |
| Axle Separation . . . . .    | 48 in.                         |
| Static Load Distribution .   | 50 %                           |
| Dynamic Load Transfer .      | 0%                             |
| Center of Gravity Height     | 20 in.                         |
| Roll Center Height . . . .   | 29 in.                         |
| Track Width . . . . .        | 78 in.                         |
| Dual Tire Separation . . . . | 13 in.                         |
| Spring Spread . . . . .      | 44 in.                         |
| Auxiliary Roll Stiffness . . | 60000 in-lbs/deg               |
| Rollsteer Coefficient . . .  | 0.000                          |

---

Trailing Axle Data is identical to Lead Axle Data.

Suspension File

TRAILER TANDEM AIR SUSPENSION NEWAY AR 95-17, 16000 LBS/AXLE

FILE NAME = ST6T:SU.AR9517.16

Four Spring Tandem Rear Suspension

| Lead Axle                    |                              |
|------------------------------|------------------------------|
| Roll Moment of Inertia . .   | 4100 in-lbs-sec <sup>2</sup> |
| Unsprung Mass . . . . .      | 1500 lbs.                    |
| Axle Separation . . . . .    | 48 in.                       |
| Static Load Distribution .   | 50 %                         |
| Dynamic Load Transfer .      | 0%                           |
| Center of Gravity Height     | 20 in.                       |
| Roll Center Height . . . .   | 29 in.                       |
| Track Width . . . . .        | 78 in.                       |
| Dual Tire Separation . . .   | 13 in.                       |
| Spring Spread . . . . .      | 44 in.                       |
| Auxiliary Roll Stiffness . . | 83000 in-lbs/deg             |
| Rollsteer Coefficient . . .  | 0.000                        |

Trailing Axle Data is identical to Lead Axle Data.

Suspension File

TRAILER TANDEM AIR SUSPENSION NEWAY AR 95-17, 8000 LBS/AXLE

FILE NAME = ST6T:SU.AR9517.8

Four Spring Tandem Rear Suspension

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 1500 lbs.                      |
| Axle Separation .....       | 48 in.                         |
| Static Load Distribution .. | 50 %                           |
| Dynamic Load Transfer ..    | 0%                             |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 29 in.                         |
| Track Width .....           | 78 in.                         |
| Dual Tire Separation .....  | 13 in.                         |
| Spring Spread .....         | 44 in.                         |
| Auxiliary Roll Stiffness .. | 87000 in-lbs/deg               |
| Rollsteer Coefficient ...   | 0.000                          |

Trailing Axle Data is identical to Lead Axle Data.

Suspension File

Reyco 21B Single-Axle Trailer Suspension.  
Based on Ontario MTC tandem-axle semitrailer measurements.  
Overall tire width: 102." - extrapolated from measurements of 96."  
Filename = ST6T:Su.Rc21Bsngl

Single Rear Suspension

|                             |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 1500 lbs.                      |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 27 in.                         |
| Track Width .....           | 78 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 44 in.                         |
| Auxiliary Roll Stiffness .. | 9000 in-lbs/deg                |
| Rollsteer Coefficient ...   | 0.230                          |

**Suspension File**

Reyco 21B 4-Spring Trailer (48" axle spacing) Suspension.  
 Based on Ontario MTC semitrailer measurements.  
 Overall tire width: 102." - extrapolated from measurements of 96."  
 Filename = ST6T:Su.Rc21B48in

**Four Spring Tandem Rear Suspension**

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 1500 lbs.                      |
| Axle Separation .....       | 48 in.                         |
| Static Load Distribution .  | 50 %                           |
| Dynamic Load Transfer .     | -10%                           |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 27 in.                         |
| Track Width .....           | 78 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 44 in.                         |
| Auxiliary Roll Stiffness .. | 9000 in-lbs/deg                |
| Rollsteer Coefficient ...   | 0.230                          |

Trailing Axle Data is identical to Lead Axle Data.

**Suspension File**

Reyco 21B 4-Spring Trailer (60" axle spacing) Suspension.  
 Based on Ontario MTC semitrailer measurements.  
 Overall tire width: 102." - extrapolated from measurements of 96."  
 Filename = ST6T:Su.Rc21B60in

**Four Spring Tandem Rear Suspension**

| Lead Axle                    |                                |
|------------------------------|--------------------------------|
| Roll Moment of Inertia . .   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass . . . . .      | 1500 lbs.                      |
| Axle Separation . . . . .    | 60 in.                         |
| Static Load Distribution .   | 50 %                           |
| Dynamic Load Transfer .      | -10%                           |
| Center of Gravity Height     | 20 in.                         |
| Roll Center Height . . . . . | 27 in.                         |
| Track Width . . . . .        | 78 in.                         |
| Dual Tire Separation . . . . | 13 in.                         |
| Spring Spread . . . . .      | 44 in.                         |
| Auxiliary Roll Stiffness . . | 9000 in-lbs/deg                |
| Rollsteer Coefficient . . .  | 0.230                          |

Trailing Axle Data is identical to Lead Axle Data.



**Suspension File**

Reyco 21B 4-Spring Trailer (72" axle spacing) Suspension.  
 Based on Ontario MTC semitrailer measurements.  
 Overall tire width: 102." - extrapolated from measurements of 96."  
 Filename = ST6T:Su.Rc21B72in

**Four Spring Tandem Rear Suspension**

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia . .  | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass . . . . .     | 1500 lbs.                      |
| Axle Separation . . . . .   | 72 in.                         |
| Static Load Distribution .  | 50 %                           |
| Dynamic Load Transfer .     | -10%                           |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height . . . .  | 27 in.                         |
| Track Width . . . . .       | 78 in.                         |
| Dual Tire Separation . . .  | 13 in.                         |
| Spring Spread . . . . .     | 44 in.                         |
| Auxiliary Roll Stiffness .. | 9000 in-lbs/deg                |
| Rollsteer Coefficient . . . | 0.230                          |

Trailing Axle Data is identical to Lead Axle Data.

**Suspension File**

Reyco 21B 4-Spring Trailer (48" axle spacing) Suspension.  
 Original Ontario MTC semitrailer measurements.  
 Overall tire width: 96."  
 Filename = ST6T:Su.MTCReyco4

**Four Spring Tandem Rear Suspension**

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 1500 lbs.                      |
| Axle Separation .....       | 48 in.                         |
| Static Load Distribution .. | 50 %                           |
| Dynamic Load Transfer ..    | -10%                           |
| Center of Gravity Height    | 19.5 in.                       |
| Roll Center Height .....    | 28 in.                         |
| Track Width .....           | 72 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 38 in.                         |
| Auxiliary Roll Stiffness .. | 9000 in-lbs/deg                |
| Rollsteer Coefficient ...   | 0.230                          |

Trailing Axle Data is identical to Lead Axle Data.

**Suspension File**

Reyco 21B 4-Spring Trailer (96" axle spacing) Suspension.  
 Based on Ontario MTC semitrailer measurements.  
 Overall tire width: 102. " Created for conf. 1.1 var. 3.13  
 Filename = ST6T:Su.Rc21B96in

**Four Spring Tandem Rear Suspension**

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 1500 lbs.                      |
| Axle Separation .....       | 96 in.                         |
| Static Load Distribution .  | 50 %                           |
| Dynamic Load Transfer .     | -10%                           |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 27 in.                         |
| Track Width .....           | 78 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 44 in.                         |
| Auxiliary Roll Stiffness .. | 9000 in-lbs/deg                |
| Rollsteer Coefficient ...   | 0.230                          |

Trailing Axle Data is identical to Lead Axle Data.

**Suspension File**

Reyco 21B 4-Spring Trailer (108" axle spacing) Suspension.  
 Based on Ontario MTC semitrailer measurements.  
 Overall tire width: 102." Created for conf. 1.1 var. 3.14.  
 Filename = ST6T:Su.Rc21B108i

**Four Spring Tandem Rear Suspension**

| Lead Axle                   |                                |
|-----------------------------|--------------------------------|
| Roll Moment of Inertia ..   | 4100 in-lbs-sec <sup>2</sup> . |
| Unsprung Mass .....         | 1500 lbs.                      |
| Axle Separation .....       | 108 in.                        |
| Static Load Distribution .  | 50 %                           |
| Dynamic Load Transfer .     | -10%                           |
| Center of Gravity Height    | 20 in.                         |
| Roll Center Height .....    | 27 in.                         |
| Track Width .....           | 78 in.                         |
| Dual Tire Separation ....   | 13 in.                         |
| Spring Spread .....         | 44 in.                         |
| Auxiliary Roll Stiffness .. | 9000 in-lbs/deg                |
| Rollsteer Coefficient ...   | 0.230                          |

Trailing Axle Data is identical to Lead Axle Data.

## SPRING FILES

### LIST OF SPRINGS:

IH "reference" 12k tractor front (leaf)  
Hendrickson RTE 440 tractor tandem (walking beam, leaf)  
Hendrickson RTE 380 tractor tandem (walking beam, leaf)  
Mack "Camelback" SS38C tractor tandem (walking beam, leaf)  
Neway ARD 244 tractor tandem (4-spring, air), @ 16, 12 & 8 k/axle  
Neway AR 95-17 trailer tandem/single (4/2 spring, air), @ 24, 16 & 8 k/axle  
Reyco 21B trailer tandem/single (4/2 spring, leaf)

### PARAMETER TERMINOLOGY:

Compression / Extension Coefficients - Empirically-derived exponential coefficients in the equations defining the force-deflection relationship within inner hysteresis loops of the spring-envelope model used by the Phase-4 program.

Coulomb Friction - One half of the average width of the spring load-deflection envelope (along a line of constant deflection), applicable to linear and table representation (moot for envelope representation).

Spring File

FileName = ST6T:SpJHRef.Frt — IH REFERENCE FRONT SPRING  
 LASH APPROXIMATION: 0.0 INCHES  
 WHEEL CORRECTION USED (BETAS CALCULATED ANALYTICALLY)  
 OCTOBER/15/1985

Linear Rate = 885.7 lb/in.  
 Coulomb Friction = 475.0 lbs.

Spring Table

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -20550.0    | -15.000         |
| -1170.0     | -0.750          |
| -150.0      | 0.000           |
| 1250.0      | 1.000           |
| 2550.0      | 2.000           |
| 3825.0      | 3.000           |
| 7240.0      | 5.500           |
| 11127.5     | 8.500           |
| 20076.5     | 15.500          |

Spring Envelope

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -20400.0          | -15.000         | -20700.0        | -15.000         |
| -1020.0           | -0.750          | -1320.0         | -0.750          |
| 0.0               | 0.000           | -300.0          | 0.000           |
| 1550.0            | 1.000           | 950.0           | 1.000           |
| 2900.0            | 2.000           | 2200.0          | 2.000           |
| 4200.0            | 3.000           | 3450.0          | 3.000           |
| 7700.0            | 5.500           | 6780.0          | 5.500           |
| 11750.0           | 8.500           | 10505.0         | 8.500           |
| 21200.0           | 15.500          | 18953.0         | 15.500          |

Compression Coefficient = 0.170  
 Extension Coefficient = 0.150

Spring File

FILE NAME = ST6T:SP.HknRTE440 -- HENDRICKSON RTE440 (44k Wkg-Bm)  
 LASH MEASURED: 0.25 INCHES  
 WHEEL CORRECTION USED (BETAS CALCULATED ANALYTICALLY)  
 OCTOBER/15/1985

Linear Rate = 10600.0 lb/in.  
 Coulomb Friction = 1000.0 lbs.

Spring Table

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -8107.5     | -2.000          |
| -25.0       | -0.250          |
| 225.0       | 0.000           |
| 625.0       | 0.250           |
| 1355.0      | 0.500           |
| 2375.0      | 0.750           |
| 4475.0      | 1.000           |
| 19086.0     | 2.250           |
| 50753.5     | 5.000           |

Spring Envelope

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -7990.0           | -2.000          | -8225.0         | -2.000          |
| 100.0             | -0.250          | -150.0          | -0.250          |
| 450.0             | 0.000           | 0.0             | 0.000           |
| 900.0             | 0.250           | 350.0           | 0.250           |
| 1800.0            | 0.500           | 910.0           | 0.500           |
| 2950.0            | 0.750           | 1800.0          | 0.750           |
| 5500.0            | 1.000           | 3450.0          | 1.000           |
| 22375.0           | 2.250           | 15796.7         | 2.250           |
| 59500.0           | 5.000           | 42007.0         | 5.000           |

Compression Coefficient = 0.150  
 Extension Coefficient = 0.150

**Spring File**

FILE NAME = ST6T:SP.HknRTE380 — HENDRICKSON RTE380 (38k Wkg-Bm)  
 LASH MEASURED: 0.30 INCHES  
 WHEEL CORRECTION USED ( BETAS CALCULATED ANALYTICALLY)  
 OCTOBER/15/1985

Linear Rate = 7500.0 lb/in.  
 Coulomb Friction = 700.0 lbs.

**Spring Table**

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -7720.0     | -1.500          |
| -200.0      | -0.300          |
| 200.0       | 0.000           |
| 1435.0      | 0.500           |
| 2150.0      | 0.750           |
| 5570.0      | 1.500           |
| 40367.9     | 6.000           |

**Spring Envelope**

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -7520.0           | -1.500          | -7920.0         | -1.500          |
| -100.0            | -0.300          | -300.0          | -0.300          |
| 400.0             | 0.000           | 0.0             | 0.000           |
| 1700.0            | 0.500           | 1170.0          | 0.500           |
| 2450.0            | 0.750           | 1850.0          | 0.750           |
| 6200.0            | 1.500           | 4940.0          | 1.500           |
| 44630.0           | 6.000           | 36105.7         | 6.000           |

Compression Coefficient = 0.054  
 Extension Coefficient = 0.058



Spring File

FILE NAME = ST6T:SP.CAMELBACK — MACK CAMEL BACK SS38C 38K  
 LASH APPROXIMATION: 0.75 INCHES  
 WHEEL CORRECTION USED (BETAS CALCULATED ANALYTICALLY)  
 OCTOBER/15/1985

Linear Rate = 4500.0 lb/in.  
 Coulomb Friction = 960.0 lbs.

Spring Table

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -19933.0    | -10.000         |
| -100.0      | -0.750          |
| -50.0       | 0.000           |
| 1700.0      | 0.500           |
| 3910.0      | 1.000           |
| 7330.0      | 1.750           |
| 19197.9     | 4.500           |

Spring Envelope

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -19833.0          | -10.000         | -20033.0        | -10.000         |
| 0.0               | -0.750          | -200.0          | -0.750          |
| 100.0             | 0.000           | -200.0          | 0.000           |
| 2200.0            | 0.500           | 1200.0          | 0.500           |
| 4660.0            | 1.000           | 3160.0          | 1.000           |
| 8240.0            | 1.750           | 6420.0          | 1.750           |
| 20890.0           | 4.500           | 17505.8         | 4.500           |

Compression Coefficient = 0.089  
 Extension Coefficient = 0.072

Spring File

FILENAME = ST6T:SP.ARD244.16 — NEWAY ARD-244 AIR SPRING  
 (FOR TANDEM-DRIVE-AXLE SUSPENSION)  
 NOMINAL AXLE LOAD: 16000 LBS ; NOMINAL SUSPENSION LOAD: 32000 LBS  
 OCTOBER/15/1985

Linear Rate = 1475.0 lb/in.  
 Coulomb Friction = 275.0 lbs.

Spring Table

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -38775.0    | -3.000          |
| 5100.0      | -1.250          |
| 6012.5      | -0.500          |
| 6725.0      | 0.000           |
| 7537.5      | 0.500           |
| 8537.5      | 1.000           |
| 34387.5     | 3.000           |

Spring Envelope

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -38650.0          | -3.000          | -38900.0        | -3.000          |
| 5300.0            | -1.250          | 4900.0          | -1.250          |
| 6300.0            | -0.500          | 5725.0          | -0.500          |
| 7025.0            | 0.000           | 6425.0          | 0.000           |
| 7850.0            | 0.500           | 7225.0          | 0.500           |
| 8725.0            | 1.000           | 8350.0          | 1.000           |
| 34512.5           | 3.000           | 34262.5         | 3.000           |

Compression Coefficient = 0.075  
 Extension Coefficient = 0.080

**Spring File**

FILENAME = ST6T:SP.ARD244.12 — NEWAY ARD-244 AIR SPRING  
 (FOR TANDEM-DRIVE-AXLE SUSPENSION)  
 NOMINAL AXLE LOAD: 12000 LBS ; NOMINAL SUSPENSION LOAD: 24000 LBS  
 OCTOBER/15/1985

Linear Rate = 1218.7 lb/in.  
 Coulomb Friction = 312.5 lbs.

**Spring Table**

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -43600.0    | -4.000          |
| 3037.5      | -1.175          |
| 3837.5      | -0.750          |
| 4725.0      | 0.000           |
| 5712.5      | 0.750           |
| 7200.0      | 1.750           |
| 32050.0     | 4.000           |

**Spring Envelope**

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -43500.0          | -4.000          | -43700.0        | -4.000          |
| 3225.0            | -1.750          | 2850.0          | -1.750          |
| 4275.0            | -0.750          | 3400.0          | -0.750          |
| 5100.0            | 0.000           | 4350.0          | 0.000           |
| 6100.0            | 0.750           | 5325.0          | 0.750           |
| 7500.0            | 1.750           | 6900.0          | 1.750           |
| 32162.5           | 4.000           | 31937.5         | 4.000           |

Compression Coefficient = 0.073  
 Extension Coefficient = 0.075

Spring File

FILENAME = ST6T:SP.ARD244.8 — NEWAY ARD-244 AIR SPRING  
 (FOR TANDEM-DRIVE-AXLE SUSPENSION)  
 NOMINAL AXLE LOAD: 8000 LBS ; NOMINAL SUSPENSION LOAD: 16000 LBS  
 OCTOBER/15/1985

Linear Rate = 812.5 lb/in.  
 Coulomb Friction = 350.0 lbs.

Spring Table

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -18062.2    | -4.000          |
| 1112.5      | -2.500          |
| 2087.5      | -1.000          |
| 2850.0      | 0.000           |
| 3900.0      | 1.000           |
| 5075.0      | 2.000           |
| 21356.2     | 4.000           |

Spring Envelope

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -17912.5          | -4.000          | -18212.5        | -4.000          |
| 1300.0            | -2.500          | 925.0           | -2.500          |
| 2400.0            | -1.000          | 1775.0          | -1.000          |
| 3200.0            | 0.000           | 2500.0          | 0.000           |
| 4375.0            | 1.000           | 3425.0          | 1.000           |
| 5300.0            | 2.000           | 4850.0          | 2.000           |
| 21443.7           | 4.000           | 21268.7         | 4.000           |

Compression Coefficient = 0.150  
 Extension Coefficient = 0.125

Spring File

FILENAME = ST6T:SP.AR9517.24 — NEWAY AR 95-17 AIR SPRING  
 (FOR TRAILER SINGLE-AXLE AIR SUSPENSION)  
 NOMINAL AXLE & SUSPENSION LOAD: 24000 LBS  
 OCTOBER/15/1985

Linear Rate = 2250.0 lb/in.  
 Coulomb Friction = 362.0 lbs.

Spring Table

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -41675.0    | -2.000          |
| 9300.0      | -0.750          |
| 10600.0     | -0.250          |
| 11137.5     | 0.000           |
| 11662.5     | 0.250           |
| 12775.0     | 0.750           |
| 13387.5     | 1.000           |
| 43406.2     | 2.500           |

Spring Envelope

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -41475.0          | -2.000          | -41875.0        | -2.000          |
| 9600.0            | -0.750          | 9000.0          | -0.750          |
| 10950.0           | -0.250          | 10250.0         | -0.250          |
| 11525.0           | 0.000           | 10750.0         | 0.000           |
| 12075.0           | 0.250           | 11250.0         | 0.250           |
| 13175.0           | 0.750           | 12375.0         | 0.750           |
| 13700.0           | 1.000           | 13075.0         | 1.000           |
| 43531.2           | 2.500           | 43281.2         | 2.500           |

Compression Coefficient = 0.037  
 Extension Coefficient = 0.030

**Spring File**

FILENAME = ST6T:SPAR9517.16 — NEWAY AR 95-17 AIR SPRING  
 (FOR TRAILER SINGLE-AXLE AIR SUSPENSION)  
 NOMINAL AXLE & SUSPENSION LOAD: 16000 LBS  
 OCTOBER/15/1985

Linear Rate = 1375.0 lb/in.  
 Coulomb Friction = 380.0 lbs.

**Spring Table**

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -20750.0    | -2.500          |
| 5100.0      | -1.375          |
| 6400.0      | -0.500          |
| 7000.0      | 0.000           |
| 7737.5      | 0.500           |
| 9437.5      | 1.500           |
| 28268.7     | 3.000           |

**Spring Envelope**

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -20625.0          | -2.500          | -20875.0        | -2.500          |
| 5375.0            | -1.375          | 4825.0          | -1.375          |
| 6750.0            | -0.500          | 6050.0          | -0.500          |
| 7375.0            | 0.000           | 6625.0          | 0.000           |
| 8150.0            | 0.500           | 7325.0          | 0.500           |
| 9750.0            | 1.500           | 9125.0          | 1.500           |
| 28356.2           | 3.000           | 28181.2         | 3.000           |

Compression Coefficient = 0.056  
 Extension Coefficient = 0.056

Spring File

FILENAME = ST6T:SP.AR9517.8 — NEWAY AR 95-17 AIR SPRING  
 (FOR TRAILER SINGLE-AXLE AIR SUSPENSION)  
 NOMINAL AXLE & SUSPENSION LOAD: 8000 LBS  
 OCTOBER/15/1985

Linear Rate = 787.5 lb/in.  
 Coulomb Friction = 250.0 lbs.

Spring Table

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -38412.5    | -3.500          |
| 2562.5      | -0.875          |
| 3025.0      | -0.250          |
| 3237.5      | 0.000           |
| 3525.0      | 0.375           |
| 3900.0      | 0.750           |
| 27731.2     | 4.000           |

Spring Envelope

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -38337.5          | -3.500          | -38487.5        | -3.500          |
| 2750.0            | -0.875          | 2375.0          | -0.875          |
| 3300.0            | -0.250          | 2750.0          | -0.250          |
| 3525.0            | 0.000           | 2950.0          | 0.000           |
| 3800.0            | 0.375           | 3250.0          | 0.375           |
| 4150.0            | 0.750           | 3650.0          | 0.750           |
| 27806.2           | 4.000           | 27656.2         | 4.000           |

Compression Coefficient = 0.030  
 Extension Coefficient = 0.053

Spring File

FILE NAME = ST6T:SP.MTC.REYCO — MTC TRAILER-REYCO  
 LASH APPROXIMATION: 1.5 INCHES  
 WHEEL CORRECTION USED  
 OCTOBER/15/1985

Linear Rate = 8500.0 lb/in.  
 Coulomb Friction = 975.0 lbs.

Spring Table

| Force [lbs] | Deflection [in] |
|-------------|-----------------|
| -26660.1    | -10.000         |
| -97.6       | -1.500          |
| -50.0       | 0.000           |
| 1150.0      | 0.250           |
| 3000.0      | 0.500           |
| 5375.0      | 0.750           |
| 39542.8     | 4.500           |

Spring Envelope

| Compression Table |                 | Extension Table |                 |
|-------------------|-----------------|-----------------|-----------------|
| Force [lbs]       | Deflection [in] | Force [lbs]     | Deflection [in] |
| -26562.5          | -10.000         | -26757.8        | -10.000         |
| 0.0               | -1.500          | -195.3          | -1.500          |
| 0.0               | 0.000           | -100.0          | 0.000           |
| 1600.0            | 0.250           | 700.0           | 0.250           |
| 4000.0            | 0.500           | 2000.0          | 0.500           |
| 6750.0            | 0.750           | 4000.0          | 0.750           |
| 48000.0           | 4.500           | 31085.7         | 4.500           |

Compression Coefficient = 0.150  
 Extension Coefficient = 0.150



## TIRE FILES

### LIST OF TIRES:

Michelin XZA 11.00R22.5G, @ full, 1/2 & 1/3 remaining tread depth

Michelin X "Pilote" 11.00/80R22.5G

Firestone "Transport 100" 10.00-20F (bias-ply, parameters extrapolated to represent "G" rating)

### PARAMETER TERMINOLOGY:

(Note, that all single-number entries appearing next to the following labels represent approximate, linearized values @ rated load, and do not necessarily equal actual values extracted from the more comprehensive tables or semi-empirical model representation forms.)

Lateral Stiffness - Lateral (cornering) force causing one unit of pure lateral deflection of the tire along its spin axis, with all angular degrees of freedom removed.

Vertical Stiffness - Vertical force causing one unit of pure vertical deflection of the tire.

Camber Stiffness - Lateral (cornering) force resulting from one degree of camber (axle roll).

Overtuning Stiffness - Moment applied to the tire about the x-axis causing one degree of camber.

Longitudinal Stiffness - [Longitudinal (braking or drive-thrust) force at contact-patch causing 1.% longitudinal slip] X 100.

Peak Cornering Friction Coefficient - Used for tire side-force saturation in the Yaw/Roll model.

Mu-Y - Cornering Force / Vertical Load.

Mu-X - Longitudinal Force / Vertical Load.

Roll-Off Tables - Coefficients multiplying (reducing) the cornering force at the presence of longitudinal force, and vice versa ("Friction Ellipse" effects).

**Tire File**

ST6T:Ti.XZA11R225, Michelin XZA 11:00R22.50 Radial DRY; Data Sources:  
 Muy-a: RTAC Tire tests; Mux-s, Align Tor. & Rolloff Table: tire model;  
 Model param: DOT noise & traction report; STIFFYZ, CAMBER, ALIGN, CLONGL &  
 Al. Tor. coeffs: rule-of-thumb estimates. See end of file for more info.

Tire Radius = 20.0 in.  
 Polar Moment of Inertia = 103.0 in-lbs-sec<sup>2</sup>.  
 Lateral Stiffness = 5000.0 lb/in.  
 Vertical Stiffness = 4500.0 lb/in.  
 Camber Stiffness = 0.0 lb/deg.  
 Overturning Stiffness = 352.2 in-lb/deg.  
 Aligning Torque Stiffness = 1320.8 in-lb/deg.  
 Longitudinal Stiffness = 50452.0 lb/slip.  
 Cornering Stiffness = 880.6 lb/deg.  
 Peak Cornering Friction Coefficient = 0.8

**Mu-y vs. Slip Angle Tables**

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.18 |
| 2.00             | 0.32 |
| 4.00             | 0.54 |
| 8.00             | 0.77 |
| 12.00            | 0.91 |

Velocity = 58.7 ft/sec.  
 Load = 1983.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.14 |
| 2.00             | 0.27 |
| 4.00             | 0.47 |
| 8.00             | 0.66 |
| 12.00            | 0.73 |

Velocity = 58.7 ft/sec.  
 Load = 5967.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.10 |
| 2.00             | 0.19 |
| 4.00             | 0.36 |
| 8.00             | 0.55 |
| 12.00            | 0.61 |

Velocity = 58.7 ft/sec.  
 Load = 9441.0 lbs.

Lateral Roll-Off Table

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 0.87 | 0.40 | 0.38 | 0.17 | 0.06 |
| 1.00  | 1.00 | 1.00 | 0.83 | 0.40 | 0.38 | 0.17 | 0.06 |
| 2.00  | 1.00 | 1.00 | 0.81 | 0.39 | 0.38 | 0.17 | 0.06 |
| 4.00  | 1.00 | 0.97 | 0.75 | 0.39 | 0.38 | 0.17 | 0.06 |
| 6.00  | 1.00 | 0.96 | 0.79 | 0.45 | 0.44 | 0.21 | 0.07 |
| 8.00  | 1.00 | 0.97 | 0.84 | 0.52 | 0.50 | 0.25 | 0.09 |
| 12.00 | 1.00 | 0.97 | 0.89 | 0.63 | 0.62 | 0.33 | 0.12 |
| 16.00 | 1.00 | 0.98 | 0.92 | 0.71 | 0.70 | 0.40 | 0.15 |

Mu-x vs. Slip Tables

| Slip | Mu-x |
|------|------|
| 0.04 | 0.58 |
| 0.10 | 0.81 |
| 0.21 | 0.86 |
| 0.25 | 0.86 |
| 0.50 | 0.79 |
| 1.00 | 0.62 |

Velocity = 29.3 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.51 |
| 0.10 | 0.79 |
| 0.21 | 0.85 |
| 0.25 | 0.85 |
| 0.50 | 0.77 |
| 1.00 | 0.56 |

Velocity = 58.7 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.46 |
| 0.10 | 0.78 |
| 0.21 | 0.84 |
| 0.25 | 0.84 |
| 0.50 | 0.76 |
| 1.00 | 0.52 |

Velocity = 80.7 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.37 |
| 0.10 | 0.71 |
| 0.24 | 0.80 |
| 0.25 | 0.80 |
| 0.50 | 0.74 |
| 1.00 | 0.54 |

Velocity = 29.3 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.33 |
| 0.10 | 0.69 |
| 0.24 | 0.79 |
| 0.25 | 0.79 |
| 0.50 | 0.72 |
| 1.00 | 0.48 |

Velocity = 58.7 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.30 |
| 0.10 | 0.67 |
| 0.24 | 0.79 |
| 0.25 | 0.78 |
| 0.50 | 0.70 |
| 1.00 | 0.44 |

Velocity = 80.7 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.24 |
| 0.10 | 0.59 |
| 0.24 | 0.74 |
| 0.25 | 0.74 |
| 0.50 | 0.69 |
| 1.00 | 0.46 |

Velocity = 29.3 ft/sec.  
Load = 9060.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.22 |
| 0.10 | 0.55 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.67 |
| 1.00 | 0.41 |

Velocity = 58.7 ft/sec.  
Load = 9060.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.20 |
| 0.10 | 0.52 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.65 |
| 1.00 | 0.36 |

Velocity = 80.7 ft/sec.  
Load = 9060.0 lbs.

#### Longitudinal Roll-off Table

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1.00  | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2.00  | 1.00 | 1.00 | 0.96 | 0.99 | 0.99 | 1.00 | 1.00 |
| 4.00  | 1.00 | 0.93 | 0.87 | 0.96 | 0.97 | 0.99 | 1.00 |
| 6.00  | 0.79 | 0.78 | 0.77 | 0.92 | 0.93 | 0.98 | 0.99 |
| 8.00  | 0.64 | 0.65 | 0.67 | 0.87 | 0.88 | 0.96 | 0.99 |
| 12.00 | 0.44 | 0.47 | 0.52 | 0.77 | 0.78 | 0.92 | 0.98 |
| 16.00 | 0.34 | 0.37 | 0.41 | 0.66 | 0.68 | 0.87 | 0.96 |

#### Semi-Empirical Tire Model Parameters

| Variable                         | Initial Value | D(var)/Dload | D(var)/Dvelocity |
|----------------------------------|---------------|--------------|------------------|
| Nominal Cornering Stiff-lb/deg   | 880.56        | 0.065        | 0                |
| Peak Friction Value .....        | 0.79          | -1.95E-05    | -4.29E-04        |
| Locked Wheel Friction Value ..   | 0.48          | -2.55E-05    | -2.86E-03        |
| Slip Value at Peak Friction-% .. | 0.24          | 1E-05        | 0                |
| Nominal Pneumatic Trail-in ...   | 2.10          | 1.25E-04     | 0                |
| Nominal Vertical Load-lbs ....   | 6040.000      | N/A          | N/A              |
| Nominal Velocity-ft/sec .....    | 58.700        | N/A          | N/A              |

$$D^2(\text{Calfa})/D\text{load}^2 - (\text{lb-deg})^{-1} = -1.387\text{E-}05$$

Tire File

ST6T:T1.XZAWORN, Michelin XZA 11:00R22.50 Radial DRY 1/3 TREAD; Data Srces  
 Muy-a: RTAC Tire tests; Mux-s, Align Tor. & Rolloff Table: tire model;  
 Model param: DOT noise & traction report; STIFFYZ, CAMBER, ALIGN, CLONGL &  
 Al. Tor. coeffs: rule-of-thumb estimates. See end of file for more info.

Tire Radius = 20.0 in.  
 Polar Moment of Inertia = 103.0 in-lbs-sec<sup>2</sup>.  
 Lateral Stiffness = 5000.0 lb/in.  
 Vertical Stiffness = 4993.0 lb/in.  
 Camber Stiffness = 0.0 lb/deg.  
 Overturning Stiffness = 449.6 in-lb/deg.  
 Aligning Torque Stiffness = 1686.0 in-lb/deg.  
 Longitudinal Stiffness = 64400.0 lb/slip.  
 Cornering Stiffness = 1124.0 lb/deg.  
 Peak Cornering Friction Coefficient = 0.8

Mu-y vs. Slip Angle Tables

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.27 |
| 2.00             | 0.47 |
| 4.00             | 0.71 |
| 8.00             | 0.87 |
| 12.00            | 0.93 |

Velocity = 58.7 ft/sec.  
 Load = 1984.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.18 |
| 2.00             | 0.35 |
| 4.00             | 0.59 |
| 8.00             | 0.78 |
| 12.00            | 0.86 |

Velocity = 58.7 ft/sec.  
 Load = 5964.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.11 |
| 2.00             | 0.22 |
| 4.00             | 0.42 |
| 8.00             | 0.65 |
| 12.00            | 0.73 |

Velocity = 58.7 ft/sec.  
 Load = 9435.0 lbs.

Lateral Roll-Off Table

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 0.75 | 0.32 | 0.32 | 0.14 | 0.05 |
| 1.00  | 1.00 | 1.00 | 0.72 | 0.32 | 0.31 | 0.14 | 0.05 |
| 2.00  | 1.00 | 1.00 | 0.69 | 0.32 | 0.30 | 0.14 | 0.05 |
| 4.00  | 1.00 | 0.93 | 0.69 | 0.35 | 0.33 | 0.15 | 0.05 |
| 6.00  | 1.00 | 0.95 | 0.76 | 0.43 | 0.41 | 0.19 | 0.06 |
| 8.00  | 1.00 | 0.96 | 0.82 | 0.50 | 0.49 | 0.24 | 0.08 |
| 12.00 | 1.00 | 0.97 | 0.88 | 0.62 | 0.61 | 0.32 | 0.11 |
| 16.00 | 1.00 | 0.98 | 0.91 | 0.70 | 0.69 | 0.40 | 0.15 |

Mu-x vs. Slip Tables

| Slip | Mu-x |
|------|------|
| 0.04 | 0.58 |
| 0.10 | 0.81 |
| 0.21 | 0.86 |
| 0.25 | 0.86 |
| 0.50 | 0.79 |
| 1.00 | 0.62 |

Velocity = 29.3 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.51 |
| 0.10 | 0.79 |
| 0.21 | 0.85 |
| 0.25 | 0.85 |
| 0.50 | 0.77 |
| 1.00 | 0.56 |

Velocity = 58.7 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.46 |
| 0.10 | 0.78 |
| 0.21 | 0.84 |
| 0.25 | 0.84 |
| 0.50 | 0.76 |
| 1.00 | 0.52 |

Velocity = 80.7 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.37 |
| 0.10 | 0.71 |
| 0.24 | 0.80 |
| 0.25 | 0.80 |
| 0.50 | 0.74 |
| 1.00 | 0.54 |

Velocity = 29.3 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.33 |
| 0.10 | 0.69 |
| 0.24 | 0.79 |
| 0.25 | 0.79 |
| 0.50 | 0.72 |
| 1.00 | 0.48 |

Velocity = 58.7 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.30 |
| 0.10 | 0.67 |
| 0.24 | 0.79 |
| 0.25 | 0.78 |
| 0.50 | 0.70 |
| 1.00 | 0.44 |

Velocity = 80.7 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.24 |
| 0.10 | 0.59 |
| 0.24 | 0.74 |
| 0.25 | 0.74 |
| 0.50 | 0.69 |
| 1.00 | 0.46 |

Velocity = 29.3 ft/sec.  
Load = 9060.0 lbs.



| Slip | Mu-x |
|------|------|
| 0.04 | 0.22 |
| 0.10 | 0.55 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.67 |
| 1.00 | 0.41 |

Velocity = 58.7 ft/sec.  
Load = 9060.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.20 |
| 0.10 | 0.52 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.65 |
| 1.00 | 0.36 |

Velocity = 80.7 ft/sec.  
Load = 9060.0 lbs.

**Longitudinal Roll-off Table**

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1.00  | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2.00  | 1.00 | 1.00 | 0.96 | 0.96 | 0.99 | 1.00 | 1.00 |
| 4.00  | 1.00 | 0.96 | 0.88 | 0.95 | 0.97 | 0.99 | 1.00 |
| 6.00  | 0.82 | 0.80 | 0.77 | 0.92 | 0.93 | 0.98 | 0.99 |
| 8.00  | 0.65 | 0.66 | 0.68 | 0.87 | 0.88 | 0.96 | 0.99 |
| 12.00 | 0.45 | 0.48 | 0.52 | 0.77 | 0.78 | 0.92 | 0.98 |
| 16.00 | 0.34 | 0.37 | 0.41 | 0.67 | 0.68 | 0.87 | 0.96 |

**Semi-Empirical Tire Model Parameters**

| Variable                         | Initial Value | D(var)/Dload | D(var)/Dvelocity |
|----------------------------------|---------------|--------------|------------------|
| Nominal Cornering Stiff-lb/deg   | 1124.00       | 4.22E-02     | 0                |
| Peak Friction Value .....        | 0.79          | -1.95E-05    | -4.29E-04        |
| Locked Wheel Friction Value ..   | 0.48          | -2.55E-05    | -2.86E-03        |
| Slip Value at Peak Friction-% .. | 0.24          | 1E-05        | 0                |
| Nominal Pneumatic Trail-in ...   | 2.10          | 1.25E-04     | 0                |
| Nominal Vertical Load-lbs ....   | 6040.000      | N/A          | N/A              |
| Nominal Velocity-ft/sec .....    | 58.700        | N/A          | N/A              |

$$D^2(\text{Calfa})/Dload^2 - (\text{lb-deg})^{-1} = -2.1522E-05$$

Tire File

ST6T:T1.XZA5WORN, Michelin XZA 11:00R22.50 Radial DRY 1/2 TREAD;Data Srces  
 Mux-a: RTAC Tire tests; Mux-s, Align Tor. & Rolloff Table: tire model;  
 Model param: DOT noise & traction report; STIFFYZ, CAMBER, ALIGN, CLONGL &  
 Al. Tor. coeffs: rule-of-thumb estimates. See end of file for more info.

Tire Radius = 20.0 in.  
 Polar Moment of Inertia = 103.0 in-lbs-sec<sup>2</sup>.  
 Lateral Stiffness = 5000.0 lb/in.  
 Vertical Stiffness = 4935.0 lb/in.  
 Camber Stiffness = 21.1 lb/deg.  
 Overturning Stiffness = 422.6 in-lb/deg.  
 Aligning Torque Stiffness = 1584.4 in-lb/deg.  
 Longitudinal Stiffness = 60521.5 lb/slip.  
 Cornering Stiffness = 1056.3 lb/deg.  
 Peak Cornering Friction Coefficient = 0.8

Mu-y vs. Slip Angle Tables

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.22 |
| 2.00             | 0.38 |
| 4.00             | 0.58 |
| 8.00             | 0.73 |
| 12.00            | 0.86 |

Velocity = 58.7 ft/sec.  
 Load = 1986.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.16 |
| 2.00             | 0.31 |
| 4.00             | 0.52 |
| 8.00             | 0.71 |
| 12.00            | 0.82 |

Velocity = 58.7 ft/sec.  
 Load = 5970.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.10 |
| 2.00             | 0.21 |
| 4.00             | 0.39 |
| 8.00             | 0.60 |
| 12.00            | 0.69 |

Velocity = 58.7 ft/sec.  
 Load = 9445.0 lbs.

Lateral Roll-Off Table

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 0.76 | 0.35 | 0.32 | 0.14 | 0.05 |
| 1.00  | 1.00 | 1.00 | 0.74 | 0.34 | 0.32 | 0.14 | 0.05 |
| 2.00  | 1.00 | 1.00 | 0.72 | 0.33 | 0.32 | 0.14 | 0.05 |
| 4.00  | 1.00 | 0.94 | 0.70 | 0.36 | 0.34 | 0.16 | 0.05 |
| 6.00  | 1.00 | 0.95 | 0.77 | 0.43 | 0.42 | 0.20 | 0.06 |
| 8.00  | 1.00 | 0.96 | 0.82 | 0.51 | 0.49 | 0.24 | 0.08 |
| 12.00 | 1.00 | 0.97 | 0.88 | 0.62 | 0.61 | 0.32 | 0.11 |
| 16.00 | 1.00 | 0.98 | 0.91 | 0.70 | 0.69 | 0.40 | 0.15 |

Mu-x vs. Slip Tables

| Slip | Mu-x |
|------|------|
| 0.04 | 0.58 |
| 0.10 | 0.81 |
| 0.21 | 0.86 |
| 0.25 | 0.86 |
| 0.50 | 0.79 |
| 1.00 | 0.62 |

Velocity = 29.3 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.51 |
| 0.10 | 0.79 |
| 0.21 | 0.85 |
| 0.25 | 0.85 |
| 0.50 | 0.77 |
| 1.00 | 0.56 |

Velocity = 58.7 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.46 |
| 0.10 | 0.78 |
| 0.21 | 0.84 |
| 0.25 | 0.84 |
| 0.50 | 0.76 |
| 1.00 | 0.52 |

Velocity = 80.7 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.37 |
| 0.10 | 0.71 |
| 0.24 | 0.80 |
| 0.25 | 0.80 |
| 0.50 | 0.74 |
| 1.00 | 0.54 |

Velocity = 29.3 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.33 |
| 0.10 | 0.69 |
| 0.24 | 0.79 |
| 0.25 | 0.79 |
| 0.50 | 0.72 |
| 1.00 | 0.48 |

Velocity = 58.7 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.30 |
| 0.10 | 0.67 |
| 0.24 | 0.79 |
| 0.25 | 0.78 |
| 0.50 | 0.70 |
| 1.00 | 0.44 |

Velocity = 80.7 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.24 |
| 0.10 | 0.59 |
| 0.24 | 0.74 |
| 0.25 | 0.74 |
| 0.50 | 0.69 |
| 1.00 | 0.46 |

Velocity = 29.3 ft/sec.  
Load = 9060.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.22 |
| 0.10 | 0.55 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.67 |
| 1.00 | 0.41 |

Velocity = 58.7 ft/sec.  
Load = 9060.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.20 |
| 0.10 | 0.52 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.65 |
| 1.00 | 0.36 |

Velocity = 80.7 ft/sec.  
Load = 9060.0 lbs.

#### Longitudinal Roll-off Table

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1.00  | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2.00  | 1.00 | 1.00 | 0.96 | 0.99 | 0.99 | 1.00 | 1.00 |
| 4.00  | 1.00 | 0.95 | 0.88 | 0.96 | 0.97 | 0.99 | 1.00 |
| 6.00  | 0.82 | 0.79 | 0.77 | 0.92 | 0.93 | 0.98 | 0.99 |
| 8.00  | 0.65 | 0.66 | 0.67 | 0.87 | 0.88 | 0.96 | 0.99 |
| 12.00 | 0.45 | 0.48 | 0.52 | 0.77 | 0.78 | 0.92 | 0.98 |
| 16.00 | 0.34 | 0.37 | 0.41 | 0.66 | 0.68 | 0.87 | 0.96 |

#### Semi-Empirical Tire Model Parameters

| Variable                         | Initial Value | D(var)/Dload | D(var)/Dvelocity |
|----------------------------------|---------------|--------------|------------------|
| Nominal Cornering Stiff-lb/deg   | 1056.30       | 5.46E-02     | 0                |
| Peak Friction Value .....        | 0.79          | -1.95E-05    | -4.29E-04        |
| Locked Wheel Friction Value ..   | 0.48          | -2.55E-05    | -2.86E-03        |
| Slip Value at Peak Friction-% .. | 0.24          | 1E-05        | 0                |
| Nominal Pneumatic Trail-in ...   | 2.10          | 1.25E-04     | 0                |
| Nominal Vertical Load-lbs ....   | 6040.000      | N/A          | N/A              |
| Nominal Velocity-ft/sec .....    | 58.700        | N/A          | N/A              |

$$D^2(\text{Calfa})/Dload^2 - (\text{lb-deg})^{-1} = -1.9565E-05$$

**Tire File**

ST6T:T1.XZAPILOTE, Michelin XZA PILOTE 11/80R22.50 Radial DRY; Data Srcs:  
 Mux-a: RTAC Tire tests; Mux-s, Align Tor. & Rolloff Table: tire model;  
 Model param: DOT noise & traction report; STIFFYZ, CAMBER, ALIGN, CLONGL &  
 Al. Tor. coeffs: rule-of-thumb estimates. See end of file for more info.

Tire Radius = 18.5 in.

Polar Moment of Inertia = 88.1 in-lbs-sec<sup>2</sup>.

Lateral Stiffness = 5000.0 lb/in.

Vertical Stiffness = 4614.0 lb/in.

Camber Stiffness = 17.6 lb/deg.

Overtuning Stiffness = 326.2 in-lb/deg.

Aligning Torque Stiffness = 1322.5 in-lb/deg.

Longitudinal Stiffness = 50516.0 lb/slip.

Cornering Stiffness = 881.7 lb/deg.

Peak Cornering Friction Coefficient = 0.8

**Mu-y vs. Slip Angle Tables**

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.17 |
| 2.00             | 0.30 |
| 4.00             | 0.52 |
| 8.00             | 0.77 |
| 12.00            | 0.86 |

Velocity = 58.7 ft/sec.

Load = 1987.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.14 |
| 2.00             | 0.27 |
| 4.00             | 0.47 |
| 8.00             | 0.66 |
| 12.00            | 0.71 |

Velocity = 58.7 ft/sec.

Load = 5966.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.00             | 0.10 |
| 2.00             | 0.20 |
| 4.00             | 0.37 |
| 8.00             | 0.55 |
| 12.00            | 0.60 |

Velocity = 58.7 ft/sec.

Load = 9444.0 lbs.

**Lateral Roll-Off Table**

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 0.87 | 0.40 | 0.38 | 0.17 | 0.06 |
| 1.00  | 1.00 | 1.00 | 0.83 | 0.40 | 0.38 | 0.17 | 0.06 |
| 2.00  | 1.00 | 1.00 | 0.81 | 0.39 | 0.38 | 0.17 | 0.06 |
| 4.00  | 1.00 | 0.96 | 0.75 | 0.39 | 0.38 | 0.17 | 0.06 |
| 6.00  | 1.00 | 0.96 | 0.79 | 0.45 | 0.44 | 0.21 | 0.07 |
| 8.00  | 1.00 | 0.97 | 0.84 | 0.52 | 0.50 | 0.25 | 0.09 |
| 12.00 | 1.00 | 0.97 | 0.89 | 0.63 | 0.62 | 0.33 | 0.12 |
| 16.00 | 1.00 | 0.98 | 0.92 | 0.71 | 0.70 | 0.40 | 0.15 |

**Mu-x vs. Slip Tables**

| Slip | Mu-x |
|------|------|
| 0.04 | 0.58 |
| 0.10 | 0.81 |
| 0.21 | 0.86 |
| 0.25 | 0.86 |
| 0.50 | 0.79 |
| 1.00 | 0.62 |

Velocity = 29.3 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.51 |
| 0.10 | 0.79 |
| 0.21 | 0.85 |
| 0.25 | 0.85 |
| 0.50 | 0.77 |
| 1.00 | 0.56 |

Velocity = 58.7 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.46 |
| 0.10 | 0.78 |
| 0.21 | 0.84 |
| 0.25 | 0.84 |
| 0.50 | 0.76 |
| 1.00 | 0.52 |

Velocity = 80.7 ft/sec.  
Load = 3020.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.37 |
| 0.10 | 0.71 |
| 0.24 | 0.80 |
| 0.25 | 0.80 |
| 0.50 | 0.74 |
| 1.00 | 0.54 |

Velocity = 29.3 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.33 |
| 0.10 | 0.69 |
| 0.24 | 0.79 |
| 0.25 | 0.79 |
| 0.50 | 0.72 |
| 1.00 | 0.48 |

Velocity = 58.7 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.30 |
| 0.10 | 0.67 |
| 0.24 | 0.79 |
| 0.25 | 0.78 |
| 0.50 | 0.70 |
| 1.00 | 0.44 |

Velocity = 80.7 ft/sec.  
Load = 6040.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.24 |
| 0.10 | 0.59 |
| 0.24 | 0.74 |
| 0.25 | 0.74 |
| 0.50 | 0.69 |
| 1.00 | 0.46 |

Velocity = 29.3 ft/sec.  
Load = 9060.0 lbs.



| Slip | Mu-x |
|------|------|
| 0.04 | 0.22 |
| 0.10 | 0.55 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.67 |
| 1.00 | 0.41 |

Velocity = 58.7 ft/sec.  
Load = 9060.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.04 | 0.20 |
| 0.10 | 0.52 |
| 0.24 | 0.73 |
| 0.25 | 0.73 |
| 0.50 | 0.65 |
| 1.00 | 0.36 |

Velocity = 80.7 ft/sec.  
Load = 9060.0 lbs.

#### Longitudinal Roll-off Table

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.24 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1.00  | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2.00  | 1.00 | 1.00 | 0.96 | 0.99 | 0.99 | 1.00 | 1.00 |
| 4.00  | 1.00 | 0.93 | 0.87 | 0.96 | 0.97 | 0.99 | 1.00 |
| 6.00  | 0.79 | 0.78 | 0.77 | 0.92 | 0.93 | 0.98 | 0.99 |
| 8.00  | 0.64 | 0.65 | 0.67 | 0.87 | 0.88 | 0.96 | 0.99 |
| 12.00 | 0.44 | 0.47 | 0.52 | 0.77 | 0.78 | 0.92 | 0.98 |
| 16.00 | 0.34 | 0.37 | 0.41 | 0.66 | 0.68 | 0.87 | 0.96 |

#### Semi-Empirical Tire Model Parameters

| Variable                         | Initial Value | D(var)/Dload | D(var)/Dvelocity |
|----------------------------------|---------------|--------------|------------------|
| Nominal Cornering Stiff-lb/deg   | 881.67        | 0.0697       | 0                |
| Peak Friction Value .....        | 0.79          | -1.95E-05    | -4.29E-04        |
| Locked Wheel Friction Value ..   | 0.48          | -2.55E-05    | -2.86E-03        |
| Slip Value at Peak Friction-% .. | 0.24          | 1E-05        | 0                |
| Nominal Pneumatic Trail-in ...   | 2.10          | 1.25E-04     | 0                |
| Nominal Vertical Load-lbs ....   | 6040.000      | N/A          | N/A              |
| Nominal Velocity-ft/sec .....    | 58.700        | N/A          | N/A              |

$$D^2(\text{Calfa})/D\text{load}^2 - (\text{lb-deg})^{-1} = -1.4107\text{E-}05$$

Tire File

ST6T:T1.TP110F20D, Firestone Transport 1 10:00F20.00 Biasply DRY;  
 Data Sources: Mux-a, Mux-s & model para: DOT Noise & Traction Report;  
 Align Moment & Rolloff Tables: tire model; STIFFYZ, CAMBER, ALIGN, CLONGL,  
 & Align coeffs: rule of thumb estimates. See end of file for further info.

Tire Radius = 20.0 in.  
 Polar Moment of Inertia = 103.0 in-lbs-sec<sup>2</sup>.  
 Lateral Stiffness = 5000.0 lb/in.  
 Vertical Stiffness = 4500.0 lb/in.  
 Camber Stiffness = 56.4 lb/deg.  
 Overturning Stiffness = 1128.6 in-lb/deg.  
 Aligning Torque Stiffness = 846.5 in-lb/deg.  
 Longitudinal Stiffness = 32332.0 lb/slip.  
 Cornering Stiffness = 564.3 lb/deg.  
 Peak Cornering Friction Coefficient = 0.8

Mu-y vs. Slip Angle Tables

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.08             | 0.14 |
| 2.06             | 0.27 |
| 3.73             | 0.50 |
| 5.69             | 0.67 |
| 11.86            | 0.93 |
| 20.00            | 0.97 |

Velocity = 58.7 ft/sec.  
 Load = 2839.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 1.08             | 0.09 |
| 2.06             | 0.18 |
| 3.73             | 0.36 |
| 5.69             | 0.52 |
| 11.86            | 0.76 |
| 20.00            | 0.85 |

Velocity = 58.7 ft/sec.  
 Load = 5515.0 lbs.

| Slip Angle [deg] | Mu-y |
|------------------|------|
| 0.49             | 0.04 |
| 1.47             | 0.11 |
| 3.14             | 0.27 |
| 5.10             | 0.42 |
| 11.28            | 0.68 |
| 19.41            | 0.78 |

Velocity = 58.7 ft/sec.  
 Load = 8109.0 lbs.

Lateral Roll-Off Table

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.23 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 1.00 | 0.56 | 0.51 | 0.25 | 0.09 |
| 1.00  | 1.00 | 1.00 | 1.00 | 0.56 | 0.53 | 0.25 | 0.09 |
| 2.00  | 1.00 | 1.00 | 1.00 | 0.56 | 0.52 | 0.25 | 0.09 |
| 4.00  | 1.00 | 1.00 | 0.94 | 0.54 | 0.51 | 0.24 | 0.09 |
| 6.00  | 1.00 | 0.99 | 0.87 | 0.54 | 0.51 | 0.25 | 0.09 |
| 8.00  | 1.00 | 0.98 | 0.88 | 0.59 | 0.56 | 0.29 | 0.11 |
| 12.00 | 1.00 | 0.98 | 0.91 | 0.68 | 0.65 | 0.36 | 0.14 |
| 16.00 | 1.00 | 0.98 | 0.93 | 0.75 | 0.72 | 0.43 | 0.17 |

Mu-x vs. Slip Tables

| Slip | Mu-x |
|------|------|
| 0.02 | 0.13 |
| 0.06 | 0.39 |
| 0.10 | 0.57 |
| 0.14 | 0.67 |
| 0.18 | 0.73 |
| 0.25 | 0.76 |
| 0.40 | 0.79 |
| 0.60 | 0.76 |
| 0.80 | 0.69 |
| 1.00 | 0.63 |

Velocity = 29.3 ft/sec.  
Load = 5325.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.02 | 0.16 |
| 0.06 | 0.45 |
| 0.10 | 0.65 |
| 0.14 | 0.76 |
| 0.18 | 0.81 |
| 0.25 | 0.83 |
| 0.40 | 0.81 |
| 0.60 | 0.74 |
| 0.80 | 0.66 |
| 1.00 | 0.56 |

Velocity = 58.7 ft/sec.  
Load = 5325.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.02 | 0.17 |
| 0.06 | 0.45 |
| 0.10 | 0.63 |
| 0.14 | 0.73 |
| 0.18 | 0.78 |
| 0.25 | 0.81 |
| 0.40 | 0.80 |
| 0.60 | 0.72 |
| 0.80 | 0.63 |
| 1.00 | 0.53 |

Velocity = 80.7 ft/sec.  
Load = 5325.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.02 | 0.12 |
| 0.06 | 0.33 |
| 0.10 | 0.51 |
| 0.14 | 0.63 |
| 0.18 | 0.70 |
| 0.25 | 0.75 |
| 0.40 | 0.75 |
| 0.60 | 0.71 |
| 0.80 | 0.63 |
| 1.00 | 0.58 |

Velocity = 29.3 ft/sec.  
Load = 8140.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.02 | 0.14 |
| 0.06 | 0.39 |
| 0.10 | 0.58 |
| 0.14 | 0.69 |
| 0.18 | 0.75 |
| 0.25 | 0.76 |
| 0.40 | 0.73 |
| 0.60 | 0.65 |
| 0.80 | 0.57 |
| 1.00 | 0.53 |

Velocity = 58.7 ft/sec.  
Load = 8140.0 lbs.

| Slip | Mu-x |
|------|------|
| 0.02 | 0.13 |
| 0.06 | 0.39 |
| 0.10 | 0.58 |
| 0.14 | 0.69 |
| 0.18 | 0.75 |
| 0.25 | 0.76 |
| 0.40 | 0.72 |
| 0.60 | 0.64 |
| 0.80 | 0.55 |
| 1.00 | 0.45 |

Velocity = 80.7 ft/sec.  
Load = 8140.0 lbs.

**Longitudinal Roll-off Table**

| Alpha | Slip |      |      |      |      |      |      |
|-------|------|------|------|------|------|------|------|
|       | 0.00 | 0.04 | 0.10 | 0.23 | 0.25 | 0.50 | 1.00 |
| 0.00  | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| 1.00  | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 | 1.00 |
| 2.00  | 1.00 | 1.00 | 0.96 | 0.99 | 0.99 | 1.00 | 1.00 |
| 4.00  | 0.93 | 0.91 | 0.87 | 0.96 | 0.97 | 0.99 | 1.00 |
| 6.00  | 0.73 | 0.74 | 0.76 | 0.92 | 0.93 | 0.98 | 0.99 |
| 8.00  | 0.56 | 0.60 | 0.66 | 0.87 | 0.88 | 0.96 | 0.99 |
| 12.00 | 0.38 | 0.43 | 0.51 | 0.76 | 0.78 | 0.92 | 0.98 |
| 16.00 | 0.28 | 0.33 | 0.40 | 0.65 | 0.68 | 0.87 | 0.96 |

**Semi-Empirical Tire Model Parameters**

| Variable                         | Initial Value | D(var)/Dload | D(var)/Dvelocity |
|----------------------------------|---------------|--------------|------------------|
| Nominal Cornering Stiff-lb/deg   | 564.30        | 2.35E-02     | 0                |
| Peak Friction Value .....        | 0.81          | -1.88E-05    | 1.71E-03         |
| Locked Wheel Friction Value ..   | 0.52          | -1.84E-05    | -2.69E-03        |
| Slip Value at Peak Friction-% .. | 0.23          | 1E-05        | 0                |
| Nominal Pneumatic Trail-in ...   | 2.30          | 1.25E-04     | 0                |
| Nominal Vertical Load-lbs ....   | 5430.000      | N/A          | N/A              |
| Nominal Velocity-ft/sec .....    | 58.700        | N/A          | N/A              |

$$D^2(C\alpha)/Dload^2 - (lb-deg)^{-1} = -1.14E-05$$

## SELF-STEER AXLE FILES

### LIST OF SELF-STEER AXLES:

CESCHI

KGI

ASTL

High & low aligning stiffness (CESCHI-based) simulated variants

High & low aligning friction (CESCHI-based) simulated variants

Low total aligning torque (CESCHI-based) simulated variant

### PARAMETER TERMINOLOGY:

(Note, that entries appearing next to the following labels represent approximate, linearized values about the straight-ahead position.)

Coulomb Friction - Net steer-resisting moment about steering pivots due to friction at rated load, per axle.

Aligning Stiffness - Net steering moment about steering pivots required to steer the wheels an average amount of one degree. More comprehensive, non-linear data for this parameter is provided in the Torque Steer Table.

Steer Damping - Net steer-damping moment about steering pivots generated by an average steer velocity of one degree/sec. Actual values are not known - the low ones selected serve strictly to assure numerical stability.

Primary Aligning Stiffness - Net steering moment about steering pivots required to steer the whole axle by one degree, when the steering function is blocked (same as aligning-torque compliance steer for a conventional axle).

### Self Steer File

FileName = ST6T:SS.CESCHI      Last Update - 31/03/86  
Self-Steer file for CESCHI B-dolly or belly axle.  
Steering pivot location (ARMXY) per John Pearson 12/2/85  
Dynamic values per pit-measurements at 16000 lbs., 75 psi.

Coulomb Friction = 15000.0 in-lbs.  
Aligning Stiffness = 4500.0 in-lbs/deg.  
Steer Damping = 50.0 in-lb-sec/deg.  
Mechanical Trail = 6.0 in.  
Lateral Kingpin Offset = 14.4 in.

### Torque Steer Table

| Steer Angle [deg] | Aligning Torque [in-lbs] |
|-------------------|--------------------------|
| -30.0             | -56700.0                 |
| -1.0              | -13200.0                 |
| -0.5              | -400.0                   |
| 0.0               | 0.0                      |
| 0.5               | 400.0                    |
| 1.0               | 13200.0                  |
| 30.0              | 56700.0                  |

Primary Aligning Stiffness = 400000.0 in-lbs.

### Self Steer File

FileName = ST6T:SS.KGI      Last Update - 31/03/86  
Self-Steer file for KGI B-dolly or belly axle.  
Pivot Moment Arm dimensions estimated from sales leaflet.  
Dynamic values per pit-measurements at 16000 lbs., 75 psi.

Coulomb Friction = 14400.0 in-lbs.  
Aligning Stiffness = 3680.0 in-lbs/deg.  
Steer Damping = 50.0 in-lb-sec/deg.  
Mechanical Trail = 6.0 in.  
Lateral Kingpin Offset = 14.0 in.

### Torque Steer Table

| Steer Angle [deg] | Aligning Torque [in-lbs] |
|-------------------|--------------------------|
| -30.1             | -73430.0                 |
| -1.1              | -7600.0                  |
| -0.5              | -800.0                   |
| 0.0               | 0.0                      |
| 0.5               | 800.0                    |
| 1.1               | 7600.0                   |
| 30.1              | 73430.0                  |

Primary Aligning Stiffness = 400000.0 in-lbs.



### Self Steer File

FileName = ST6T:SS.ASTL      Last Update - 31/03/86  
Self-Steer file for ASTL B-dolly axle.  
Pivot Moment Arm dimensions per ASTL drawing 28-C021 of 1/17/80  
Dynamic values per pit-measurements at 20000 lbs., 70 psi.

Coulomb Friction = 28200.0 in-lbs.  
Aligning Stiffness = 4600.0 in-lbs/deg.  
Steer Damping = 50.0 in-lb-sec/deg.  
Mechanical Trail = 6.0 in.  
Lateral Kingpin Offset = 17.0 in.

### Torque Steer Table

| Steer Angle [deg] | Aligning Torque [in-lbs] |
|-------------------|--------------------------|
| -30.3             | -119700.0                |
| -0.3              | -4200.0                  |
| 0.0               | 0.0                      |
| 0.3               | 4200.0                   |
| 30.3              | 119700.0                 |

Primary Aligning Stiffness = 400000.0 in-lbs.

Self Steer File

FileName = ST6T:SS.HiFrict      Last Update - 31/03/86  
Self-Steer file derived from CESCHI B-dolly or belly axle.  
Steering pivot location (ARMXY) per John Pearson 12/2/85  
High Friction variation

Coulomb Friction = 45000.0 in-lbs.  
Aligning Stiffness = 4500.0 in-lbs/deg.  
Steer Damping = 50.0 in-lb-sec/deg.  
Mechanical Trail = 6.0 in.  
Lateral Kingpin Offset = 14.4 in.

Torque Steer Table

| Steer Angle [deg] | Aligning Torque [in-lbs] |
|-------------------|--------------------------|
| -30.0             | -56700.0                 |
| -1.0              | -13200.0                 |
| -0.5              | -400.0                   |
| 0.0               | 0.0                      |
| 0.5               | 400.0                    |
| 1.0               | 13200.0                  |
| 30.0              | 56700.0                  |

Primary Aligning Stiffness = 400000.0 in-lbs.

### Self Steer File

FileName = ST6T:SS.LoStiff      Last Update - 31/03/86  
Self-Steer file derived from CESCHI B-dolly or belly axle.  
Steering pivot location (ARMXY) per John Pearson 12/2/85  
Low Stiffness variation

Coulomb Friction = 15000.0 in-lbs.  
Aligning Stiffness = 500.0 in-lbs/deg.  
Steer Damping = 50.0 in-lb-sec/deg.  
Mechanical Trail = 6.0 in.  
Lateral Kingpin Offset = 14.4 in.

### Torque Steer Table

| Steer Angle [deg] | Aligning Torque [in-lbs] |
|-------------------|--------------------------|
| -30.0             | -15000.0                 |
| 0.0               | 0.0                      |
| 30.0              | 15000.0                  |

Primary Aligning Stiffness = 400000.0 in-lbs.

### Self Steer File

FileName = ST6T:SS.HiStiff      Last Update - 31/03/86  
Self-Steer file derived from CESCHI B-dolly or belly axle.  
Steering pivot location (ARMXY) per John Pearson 12/2/85  
High Stiffness variation

Coulomb Friction = 15000.0 in-lbs.  
Aligning Stiffness = 26000.0 in-lbs/deg.  
Steer Damping = 50.0 in-lb-sec/deg.  
Mechanical Trail = 6.0 in.  
Lateral Kingpin Offset = 14.4 in.

### Torque Steer Table

| Steer Angle [deg] | Aligning Torque [in-lbs] |
|-------------------|--------------------------|
| -30.0             | -780000.0                |
| 0.0               | 0.0                      |
| 30.0              | 780000.0                 |

Primary Aligning Stiffness = 400000.0 in-lbs.

### Self Steer File

FileName = ST6T:SS.LoFrict      Last Update - 31/03/86  
Self-Steer file derived from CESCHI B-dolly or belly axle.  
Steering pivot location (ARMXY) per John Pearson 12/2/85  
Low Friction variation

Coulomb Friction = 5000.0 in-lbs.  
Aligning Stiffness = 4500.0 in-lbs/deg.  
Steer Damping = 50.0 in-lb-sec/deg.  
Mechanical Trail = 6.0 in.  
Lateral Kingpin Offset = 14.4 in.

#### Torque Steer Table

| Steer Angle [deg] | Aligning Torque [in-lbs] |
|-------------------|--------------------------|
| -30.0             | -56700.0                 |
| -1.0              | -13200.0                 |
| -0.5              | -400.0                   |
| 0.0               | 0.0                      |
| 0.5               | 400.0                    |
| 1.0               | 13200.0                  |
| 30.0              | 56700.0                  |

Primary Aligning Stiffness = 400000.0 in-lbs.

### Self Steer File

FileName = ST6T:SS.Low.All      Last Update - 4/25/86  
Self-Steer file derived from CESCHI B-dolly or belly axle.  
Steering pivot location (ARMXY) per John Pearson 12/2/85  
Free Castering variation

Coulomb Friction = 0.0 in-lbs.  
Aligning Stiffness = 100.0 in-lbs/deg.  
Steer Damping = 50.0 in-lb-sec/deg.  
Mechanical Trail = 6.0 in.  
Lateral Kingpin Offset = 14.4 in.

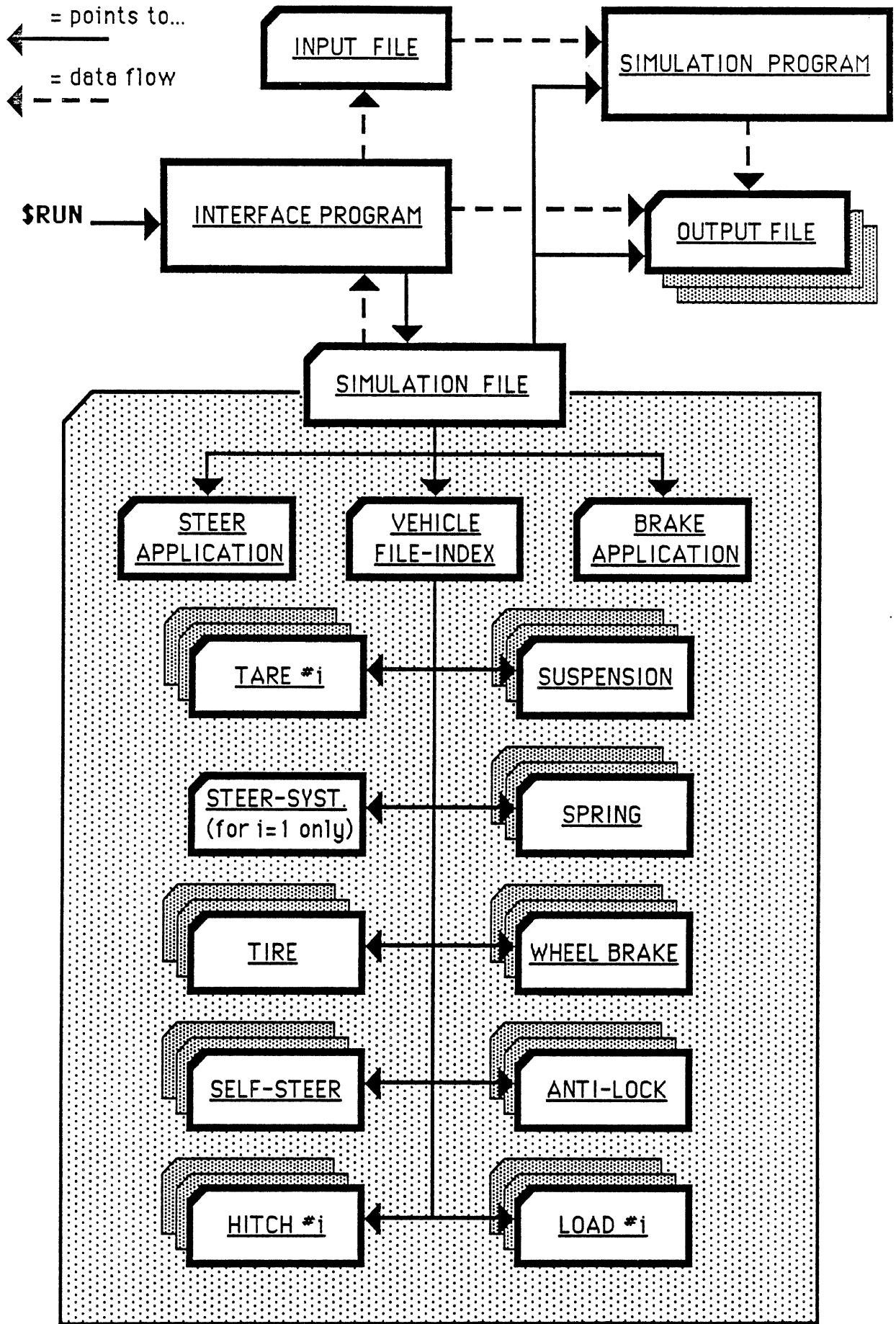
### Torque Steer Table

| Steer Angle [deg] | Aligning Torque [in-lbs] |
|-------------------|--------------------------|
| -30.0             | -3000.0                  |
| 0.0               | 0.0                      |
| 30.0              | 3000.0                   |

Primary Aligning Stiffness = 400000.0 in-lbs.

APPENDIX B.4

UMTRI SIMULATION INTERFACE SYSTEM  
(PRE-PROCESSOR & EXECUTIVE)





## 1.0 INTRODUCTION AND GENERAL INFORMATION

### 1.1 INTRODUCTION

The UMTRI Simulation Interface is a system that allows different computer simulations to be run on the same vehicle. Each simulation requires an input file that describes the vehicle being simulated and data about the desired path of the vehicle. This information is required in different forms by each of the simulations. The interface program accepts input which designates the components of the vehicle to be simulated. Regardless of the simulation model to be used, the interface extracts data from the same vehicle component files and uses the same type of calculations to construct each simulation input file. Thus, each simulation is essentially acting upon the same vehicle, producing results that can be compared directly. The simulations that are currently available on the UMTRI Simulation Interface are the PhaseIV Model, Yaw Roll Model, Simplified Braking Model, Static Roll Model and the Linear Yaw Plane models.

### 1.2 ENGINEERING UNITS AND COMPUTER REQUIREMENTS

Throughout the Simulation Interface, the English system of units is used. With the exceptions listed in the vehicle component files, all input data are given in units of pounds, inches, degrees, and seconds. Masses and weights are in units of pounds with a gravitational constant of 386 in/sec/sec assumed. (For specific information see the general notes about vehicle component files in section 3.3.)

The simulations accessed by the interface can be used on any large scale computer system. (Please see the appropriate simulation's user's manual for specifics on computer requirements.) The Simulation Interface as a whole was designed to take advantage of certain system specific properties of the Michigan Terminal System. It has not yet been tested on any other type of computer system.

This system was designed to facilitate the study of the influence of weights and dimensions on vehicle stability and control in the RTAC Canadian Truck study. Information about this system may be obtained by contacting the Engineering Research Division at the Transportation Research Institute, University of Michigan, 2901 Baxter Road, Ann Arbor, Michigan, 48109.

## 2.0 USE OF THE SIMULATION INTERFACE

### 2.1 GETTING STARTED - RUNSIM

All of the files and programs needed to run the simulation interface are stored on the computer account ST6T on the MTS computer system. In order to run this system, the user must create a SIMULATION file as specified in section 3.3, which indicates to the system which vehicle is to be simulated, and which simulation is to be performed.

If the simulation interface is to be run from a computer account other than ST6T, the following commands must be included in that account's sigfile:

```
$set macros=on  
$>set var maclib(1)="st6t:runsim.mac"
```

in that order. Also, that account must have read access for all of the files in the account ST6T.

#### 2.1.1 Input

The entire simulation interface can be run by using the macro RUNSIM. This macro allows all the programs and file operations to be accomplished with the user issuing only one command.

```
$RUNSIM Simulation_file
```

#### 2.1.2 Output

The main output from the simulation interface is stored in two files, a print file, and an ERD file. These files are named according to the naming conventions discussed in section 3.3. The print file contains output from the simulation itself, plus a page of output from the Post Processing program, which makes a short analysis of the simulation output (as discussed in section 4.4). This print file is automatically sent to the printer and delivered to UMTRI. The ERD file contains binary representation of the simulation run in a specialized format, that is discussed in Mike Sayers' Memos "ERD Files : Format and Layout" and "ERD File Outputs from the Vehicle Simulations".

#### 2.1.3 Possible Problems and Solutions

- Program not found or access not allowed - When this type of error is encountered, you must immediately abort the macro by hitting the control and the E keys at the same time, a couple of times, until the # sign appears. If access was not allowed, then sign on to the account where the file is stored and permit it to your account. If the program was not found, then sign onto the account ST6T and \*RESTORE that file. (See the MTS manual on Public Files for information about \*RESTORE.)
- Component file not found - When this type of error occurs you have two choices. Either enter the correct file name at the ? prompt after the error, or Control E out of the macro. Once out of the macro you can check your simulation file for file name misspellings, or if the file has been destroyed, you can \*RESTORE it.

- Access not allowed to Component file - To correct this problem, control E out of the macro, sign on to the account where that file is stored, and permit it to your account.
- Program fails - When a program within the macro fails, you must control E out of the macro immediately, and check your component files for valid data. You may use the debug file from the interface program to check your data. (§3.2.7)
- Program exceeds local time limit - If there is a local time limit specified in the sigfile, you may want to increase it. If the time limit is sufficient for the run of the program, then you may be stuck in a loop in the simulation program. In that case it is best to look at the print file to see what has happened in the simulation. Note : If the time limit is exceeded, the print file will not be printed automatically, you must copy it to the printer yourself.
- Run out of money in your account - When this error occurs, simply type RETURN to continue when prompted, to finish the interface run. If you are on a master account DO NOT sign off until you put more money in the account using the ACC Manager.

## 2.2 USE OF EACH PROGRAM SEPARATELY

Within the Simulation Interface System, there are three types of programs, the Interface program, the Simulations, and the Post Processor. These programs can be run individually, without using the RUNSIM macro. The sections below describe how to run each of these programs, the input required, and the output files produced.

### 2.2.1 Interface Program

The Interface Program may be run by issuing the command:

```
$Run VS.OBJ SCARDS=simulation_file SPRINT=*dummy* t=5
```

This command will run the interface program with simulation\_file as its input. SPRINT=\*dummy\* prevents the numerous program messages from being printed on the screen, and t=5 is the CPU time limit on the program.

**Input :** This program takes as input a simulation\_file that is described in detail in section 3.3. It is submitted on the logical I/O unit SCARDS, and indicates which vehicle is going to be simulated, and which simulation input file to prepare.

**Output :** There are three major output files created by this program, destination, debug.out, disp.out. The destination file contains the simulation input file that the program creates. The debug.out file contains a listing of steps the program goes through, variable assignments, and component files read. The disp.out file is a list of read and calculated vehicle parameters, and a record of component file assignments.

**Problems and Solutions :** Most problems that can arise in this program have to do with the component files used. If a component file is not found by the program, or if access to that file is not allowed, then follow the steps outlined in section 2.1.3. If the problem is a destination file that is not correct, then an inspection of the debug.out and the disp.out files is in order. The disp.out file is used as a debugging and engineering tool, and displays the static properties of the vehicle in both the empty and loaded conditions.

The debug.out file is a useful debugging device because it records the last steps taken by the program before aborting, if the program fails. This information can provide some clue as to where the program went wrong.

### 2.2.2 Simulation Programs

There are four computer simulations that are supported by the UMTRI Simulation Interface System:

Phase IV Model  
Yaw Roll Model  
Simplified Braking Model  
Static Roll Model  
Linear Yaw Plane Models

Detailed information about each of these models may be obtained by referring to the appropriate user's manual. A general description of each model may be found in section 3.4.

Input : Each of these models take as input the output file from the interface program, destination. The correct simulation input file is created by indicating which simulation is to be performed in the simulation file. Each input file is created according to the format described in the appropriate user's manual.

Output : Each of these models creates as output two main files, the print file and the ERD file. The print file contains an echo of the output to the simulation, as well as a record of the simulation. This file is a text file and may be copied to the printer. The ERD file is a binary record of the simulation and cannot be viewed on the screen or copied of the printer. It is used as input to the post processor program, and for plotting purposes. See Mike Sayers' memo "Plot : A Plotting Subroutine for Engineering Applications" for more information about plotting simulation data.

How to run each Simulation : Each of the simulations has one input file, destination, and at least two output files, printfile and ERD file. Note: The ERD file has not yet been implemented in the Static Roll Model. There are some output units that are not necessary for our purposes, these units are assign to \*dummy\*. The scientific subroutines packages naas:eispack and naas:nal are used by three of the simulations and must be added to the run command. The run commands are listed below.

> Phase 4 Model

```
$Run ST6T:Ph4.RTAC.O+naas:eispack+naas:nal 2=ERD_file 5=destination  
6=printfile t=60
```

> Yaw Roll Model

```
$Run ST6T:Yaw.RTAC.O+naas:eispack+naas:nal 2=ERD_file 5=destination  
6=printfile t=60
```

> Simplified Braking Model

```
$Run ST6T:Brake.RTAC.O+naas:eispack+naas:nal 2=ERD_file 5=destination  
6=printfile t=5
```

## >Static Roll Model

```
$Run ST6T:SRoll.RTAC.O 5=destination 6=printfile 7=*dummy* t=20
```

### 2.2.3 Post Processor Program

The Post Processor program analyzes the ERD file created by a simulation program. This analysis may consist of a combination of up to eight different vehicle performance measures. These measures include: A1-static rollover threshold, A2-yaw stability, A3-high speed offtracking, B-response to rapid steering reversals, C1-low speed offtracking, C2-tight turn jackknife conditions, D-braking in a turn, E-braking efficiency. For a more detailed description of these measures, refer to section 5.4.

Input : The Post Processor takes as input two files, the ERD file and the file RUNFILE. The ERD file is the output from a computer simulation run attached to the logical I/O unit 2. The RUNFILE is a file created by the user to indicate to the Post Processor program which performance measures are to be calculated. This file must be named RUNFILE, and appear in the account from which the program is being run. It is a text file that contains the letter codes of each measure desired, separated by commas. For example, the line A1,A2 would instruct the program to calculate the static rollover threshold and the yaw stability of the vehicle. Note: Entering the letter A alone, specifies that measures A1, A2, and A3 are to be calculated, and similarly, C=C1+C2. This program can be executed by issuing the command :

```
$Run ST6T:Post.obj scards=ERD_file t=30
```

Output : The output from this program appears in the file measures.out. This is a text file that contains the results of the performance measure analysis that was calculated. When the Simulation Interface System is run using the macro RUNSIM, this file is attached to the print file and copied to the printer. When the programs are run separately, this file, measures.out, must be copied to the printer manually. This is accomplished by issuing the command : \$copy measures.out \*print\*.

### 2.2.4 RTAC Database

The RTAC database is a file that stores the results of all the vehicle performance measures calculated by the Post Processor program. The database is arranged according to the vehicle configurations and variations outlined in the simulation matrix. Each vehicle record contains information that describes the vehicle, and the results of all the vehicle performance measures calculated for that vehicle. The information is stored in binary records. When a new performance measure is calculated by the Post Processor program, the Post Processor creates a file named measure.temp with this new information in it. This information is incorporated into the RTAC database by running the Database Updating program. This program can be run by issuing the command:

```
$Run meas.updat.o t=10
```

The Database Updating program adds the new performance measures to the appropriate vehicle record in the database file, RTAC.Data.

Examination of the RTAC Database is accomplished using the Microsoft Excel program on an Apple Macintosh computer. Since the database file is in the form of binary

records, it needs to be translated to a text format before it can be examined. To do this, run the program:

```
$run Excel.obj t=10
```

Once the database is converted to text, it has to be converted to "Excel" format, in order to allow it to be read by the program Excel. To do this, edit the file RTAC.Data, and replace every occurrence of @| with a tab. The Database is now ready to be downloaded to an Apple Macintosh and examined using Excel.

### 3.0 COMPONENTS OF SIMULATION INTERFACE

In this section, each part of the simulation interface system will be briefly described. In particular, how each segment works, how each is set up, and what each segment's purpose is in the system will be discussed.

#### 3.1 RUNSIM MACRO

The macro Runsim can be used to run the entire Simulation Interface System. A macro is a special set of MTS system programs that act as an interface between the user and MTS. It is essentially a file of MTS commands and command extensions that can be run. A macro is quite similar to a source file, but is much more powerful due to the command extensions allowed. More information on the use and structure of macros is available in the Computing Center's manual on "Command Extensions and Macros".

In section 2.2, the use of each component in the Simulation Interface was discussed. The purpose of the Runsim macro is to link these programs together by allowing communication among the files through text files, and it also automatically processes the output files as specified by the user in the simulation file. Thus, the sequence of steps necessary to generate simulation output are automated, and reduced to one command.

#### 3.2 INTERFACE PROGRAM

The Interface program was designed to create input data files for the vehicle simulation programs included in the system (Phase IV, Yaw Roll, Static Roll, Simplified Braking, and the Linear Yaw Plane models). It creates the input file according to the type of simulation indicated and the vehicle selected in the Simulation file, which is the input file to the Interface program. The program extracts data about the vehicle from the vehicle component files specified in the description of the vehicle in the Index file. All of the component files are stored in the Vehicle Component Library on the MTS computer account ST6T. These files are available to any account that is authorized to use the UMTRI Simulation Interface System.

### 3.3 VEHICLE COMPONENT FILES

#### GENERAL NOTES ON PARAMETER-FILE SYNTAX, STRUCTURE AND CONVENTIONS :

1. KEYWORDS (syntax literals) are shown, and must be input, in UPPER CASE.
2. The following characters [ ] { } // ( ) are used below merely for syntax specification, and are not part of the actual parameter-file syntax :
  - a. [Brackets] enclose optional input (not mandatory to enter).
  - b. {Braces} enclose notes or comments, which are not part of file structure.
  - c. /Slashes/ are used to indicate mutually exclusive input alternatives:
    - (i) Between / KEYWORDS - to separate between alternate literals of one mandatory input keyword on the line.
    - (ii) / Leading & trailing / on line(s) - to delimit alternate line formats.
3. Actual order of lines is insignificant, except for the following:
  - a. First 4 lines (a title line and 3 comment lines) are merely echoed, and otherwise ignored (except for b.).
  - b. The title line of the Vehicle-Index file is stored as the Run-Title.
  - c. A few specific line-order restrictions are indicated where applicable.
4. Parsed column range is 1 - 80, and file lines may be indented as desired.
5. All entries of each line are input sequentially in free format, adjacent entries being separated by any number and sequence of blanks and/or commas (" 2, ,1 " will cause the second entry to be read as 1 !).
6. Internal notes or comments in actual parameter file (in addition to 3.a.):
  - a. To be echoed: May appear on any line in the file, to the right of the rightmost entry on the line.
  - b. Not echoed : Any additional lines below the specified last input line.
7. A full trailer is considered as two Units (a dolly and a semitrailer).
8. All x (length) dimensions are with reference to each unit's front articulation point (front axle CL for unit #1), positive rearwards.
9. Hitch-File defines 5th-wheel/turntable/pintle-hook/s between current Unit# and Unit#+1 (HITCH line for last unit is ignored, if entered).



10. Specific issues for the Vehicle-Index file :
- a. VEHICLE line must be fifth, and TRKTR sixth. A single STRSTM line and a single FSUSP line must precede the first RSUSP line in the file.
  - b. Any RSUSP, HITCH & LOAD lines refer to the last preceding "tare" line (TRKTR/SEMI/DOLLY).
  - c. Any SLFSTR, SPRING, TIRE, WHLBRK & ALOCK lines refer to the last preceding FSUSP or RSUSP line.
  - d. Any RHS line modifies the indicated parameter (on the vehicle right handside only) for the last preceding FSUSP or RSUSP.
  - e. Any RHS and/or DEFAULT keywords must precede the component keyword (SPRING, TIRE, etc.) of the line.
  - f. A DEFAULT directive will cause the assignment of the data from that line also to all other occurrences of the same type (RSUSP, SPRING, etc.), which were not explicitly specified by separate lines.
  - g. Any RHS line with a DEFAULT directive will work as described above, but on the vehicle right-hand-side only (RHS & DEFAULT positions on the line may be swapped, provided that rule d. is observed).
  - h. All MTS file-names specified in the Vehicle-Index-File must feature their CCID: prefix, regardless of the CCID used for the simulation.
11. Physical Units : Unless otherwise specified in the prototype component files, English Engineering Units are assumed, as below:

| <u>Data Type</u>                   | <u>Unit</u>             |
|------------------------------------|-------------------------|
| Vehicle and component dimensions   | inches                  |
| Component translational deflection | inches                  |
| Yaw, Roll, Angular deflection      | degrees                 |
| Trajectory path (X-Y)              | feet                    |
| Velocity                           | ft/sec                  |
| Time                               | seconds                 |
| Weight, Load, Force                | lbs.                    |
| Torque, Moment                     | in_lbs.                 |
| Moment of Inertia                  | in_lbs_sec <sup>2</sup> |
| Translational stiffness            | lbs./in                 |
| Angular stiffness                  | (in_lbs.)/deg           |
| Pressure                           | psi                     |

## {PROTOTYPE SIMULATION FILE}

Title  
{3 comment lines (text or blank)}  
VEHICLE, Vehicle-Index-File  
PROGRAM, NS / LY / SR / YR / P4 / SB, = / - / Program-Input-File  
[MEASURE, [[A] / [[A1,] [A2,] [A3,]]] [B,] [[C] / [[C1,] [C2,]]] [D,] [E]] {Note  
1.}  
[STRAPL, PATH / ANGLE / LRANGLE, Steer-Applic-File] {this +/- or next line}  
[BRKAPL, [BHYST,] [BPROP,] [ALOCK,] Brake-Application-File]  
VELTIM, Velocity, Simulation-Time  
[ / ROAD, PLANAR, Long-Slope, Side-Slope /  
 / ROAD, USER, Road-File /] {either ROAD line - for P4 only}  
[CPUTIME, CPU-Time-Limit] {default is set to 200 sec}  
[DROLL, Roll-Increment] {for programs SR, YR only}  
[PRINT, [DISP,] [VELO,] [ACCE,] [TIREX,] [BRAKES,] [TIREY,]...  
 { on one line } ...[UNSPRGM,] [BTEMP,] = / - / Print-File, Time-incr]  
[ERDFILE, [DISP,] [VELO,] [ACCE,] [TIREX,] [BRAKES,] [TIREY,]...  
 { on one line } ...[UNSPRGM,] [BTEMP,] = / - / ERD-Plot-File, Time-incr]  
END

- {
1. See RTAC Simulation Plan, section 2.0, for explanation of performance measures. "A" stands for "A1"+"A2"+"A3", and similarly, "C"="C1"+"C2".
  2. All MTS file-names specified in the Simulation-File must feature their CCID: prefix, regardless of the CCID used for the simulation.
  3. An equal sign (=) entered instead of a full MTS file-name on either a PRINT, or ERDFILE line causes the relevant output to be written to an automatically-created permanent file, whose name is formed by the respective prefix 'PR.', or 'ER.', followed by characters # 4 thru 12 of the simulation-file name. An equal sign on a PROGRAM line will cause the assignment of the specified program code ('YR', 'P4', etc.) as the prefix in the name of the Program-Input-File, followed by characters #4 through 12 of the simulation-file name. For example, a simulation file ST6T:SI.TRSEMI.WT with the lines  
PROGRAM, YR, =  
ERDFILE, =  
will create a permanent Yaw/Roll input-file YR.TRSEMI.WT, and later will direct the ERD-format simulation output data to a permanent file ER.TRSEMI.WT of the active CCID, from which the run was invoked.
  4. A minus sign (-) entered instead of a full MTS file-name on either a PROGRAM, PRINT, or ERDFILE line causes the relevant output to be written to a temporary file (a leading -), whose name is formed by the same prefix as defined in 3, followed by characters # 4 thru 8 of the simulation-file name. For example, a simulation file ST6T:SI.TRSEMI.P4 with a line PROGRAM, P4, - will direct the Phase IV input data to a temporary file -P4.TRSEM .
  5. On PRINT line, optional output selection directives are effective only when running Phase 4 (ignored by other programs), and the absence of all optional output directives will invoke full output for all eight variable groups. }

## {PROTOTYPE VEHICLE-INDEX FILE}

Title  
{3 comment lines (text or blank)}  
VEHICLE, Num-Of-Units { < 8 }  
TRKTR, Tare-File {predefined as Unit#1}  
STRSTM, Steering-System-File  
FSUSP, Front-Suspension-File  
[SLFSTR, Selfsteer-File]  
[RHS,] [DEFAULT,] SPRING, LINEAR / TABLE / ENVLP, Spring-File]  
[[RHS,] [DEFAULT,] TIRE, LINEAR / TABLE / MODEL, Tire-File]  
[[RHS,] [DEFAULT,] WHLBRK, LINEAR / TABLE / MODEL, Whlbrake-File]  
[[RHS,] [DEFAULT,] ALOCK, Antilock-File]  
[DEFAULT,] RSUSP, Rear-Susp #, Suspension-File  
[SLFSTR, Selfsteer-File] {identical properties assigned on tandems}  
[[REAR,] [RHS,] [DEFAULT,] SPRING, LINEAR / TABLE / ENVLP, Spring-File]  
[[REAR,] [RHS,] [DEFAULT,] TIRE, LINEAR / TABLE / MODEL, Tire-File]  
[[REAR,] [RHS,] [DEFAULT,] WHLBRK, LINEAR / TABLE / MODEL, Whlbrake-File]  
[[REAR,] [RHS,] [DEFAULT,] ALOCK, Antilock-File]  
[HITCH, Hitch-File]  
[LOAD, Load-File]  
[SEMI, Unit#, Tare-File] {up to 3 SEMI lines allowed}  
{---> here need list only those suspension, spring, tire, brake and antilock files which are different than any indicated "DEFAULT"s. See note}  
[SLFSTR, Selfsteer-File] {RSUSP line must precede, if more than 1 RSUSP}  
[HITCH, Hitch-File]  
[LOAD, Load-File]  
[DOLLY, Unit#, Tare-File] {up to 3 DOLLY lines allowed}  
{---> here need list only those suspension, spring, tire, brake and antilock files which are different than any indicated "DEFAULT"s. See note}  
[SLFSTR, Selfsteer-File] {RSUSP line must precede, if more than 1 RSUSP}  
[HITCH, Hitch-File]  
[LOAD, Load-File]  
END

{Note : Must enter a null component file, when DEFAULT is in effect but a component has to be omitted (such as no brakes on an axle, while DEFAULT WHLBRK is specified elsewhere in the index file)}

{PROTOTYPE SPRING FILE}

Title  
{3 comment lines (text or blank)}  
SPRING  
[LINEAR, Rate]  
[FRICT, Coulomb-Friction]  
[TABLE, Table-Lines  
Force, Deflection]                    {Table-Lines}  
[ENVLP, One-Way-Lines  
JOUNCE, Jounce-Beta  
Force, Deflection                    {One-Way-Lines}  
REBOUND, Rebound-Beta  
Force, Deflection]                    {One-Way-Lines}  
END

{ Note: For a walking-beam tandem-suspension spring, the Force values are entered  
"per wheel", not "per side" !! }

{PROTOTYPE SUSPENSION FILE}

```
Title
{3 comment lines (text or blank)}
/ FSUSP /
/ RSUSP, Susp-Key /
INERT, Unsprung-Mass, Ixx                { per axle ! }
[LONGL, Axle-Sep, Static-Load-Dist, Dynamic-Load-Trans] {for Susp-Key>0}
VERT, Axle-CG-Height, Roll-Center-Height
TRACK, Track, Duals-Sep, Spring-Spread
ROLL, Aux-Roll-Stiffness, Rollsteer-Coef
[VISC, Lhs-Damping-Coef, Rhs-Damping-Coef]
[REAR, INERT, Unsprung-Mass, Ixx]        { per axle ! }
[REAR, VERT, Axle-CG-Height, Roll-Center-Height]
[REAR, TRACK, Track, Duals-Sep, Spring-Spread]
[REAR, ROLL, Aux-Roll-Stiffness, Rollsteer-Coef]
[REAR, VISC, Lhs-Damping-Coef, Rhs-Damping-Coef]
END
```

{ Note: Susp-Keys: 0 - Single ; 1 - Four Spring Tandem ; 2 - Walking Beam Tandem.  
REAR directive valid only for Susp-Key > 0, and redundant for identical  
leading and trailing axle data. }

{PROTOTYPE HITCH FILE}

Title  
{3 comment lines (text or blank)}  
HITCH, Hitch-Type {1 - 5th Wheel, 2 - Inverted 5th wheel,  
3 - Compensating 5th wheel, 4 - Turntable, 5 - 'A' dolly, 6 - 'B' dolly}  
[HROLL, Roll-Center-Height] {above 5th wheel plane - for type 3 only}  
[SEPAR, Sep-Moment, Sep-Angle] {used by static roll model only}  
[KINEM, Hitch-GLA, Hitch-KLA] {used by CW yaw roll model, for type 6  
only}  
[LINEAR, Yaw-Stiffness, Roll-Stiffness] {only for special YR runs, or type 6}  
[LASH, Yaw-Lash-Angle, Roll-Lash-Angle] {from here down - for type 6 only}  
[VISC, Yaw-Damping, Roll-Damping]  
[TABLE { not yet implemented !! }  
[YAW, Yaw-Stiff-Lines  
Z-Moment, Z-Angle] {Yaw-Stiff-Lines}  
[ROLL, Roll-Stiff-Lines  
X-Moment, X-Angle] {Roll-Stiff-Lines}  
END

## {PROTOTYPE TARE FILE}

Title  
{3 comment lines (text or blank)}  
/ DOLLY, Sprung-Mass /  
/ TRKTR, Sprung-Mass  
TFRAME, Torsional-Stiffness, Torsional-Friction, Torsion-Axis-Height /  
/ SEMI, Sprung-Mass  
KINGPIN, KP-Setting /  
[BEDXYZ, Bed-Length, Bed-Width, Bed-Floor-Height] {for truck & semi only}  
RSUSP, Num-Of-Rear-Susps  
Suspension-Num, Wheelbase-to {Num-Of-Rear-Susps lines ; Note 1}  
CGXYZ, Sprung-CG-Dist, Sprung-CG-Offset, Sprung-CG-Height  
INERT, Sprung-Ixx, Sprung-Iyy, Sprung-Izz  
HITCH, X-Location, Y-Location, Z-Location {Notes 1, 2}  
END

### { Notes:

1. "Wheelbase-to", and HITCH "x-Location" are, respectively, the longitudinal distances of the suspension's C.L. and the rear hitch C.L. measured from front axle on tractors/trucks, from front articulation point on dollies and semitrailers.
2. HITCH locations refer to 5th-wheel/turntable/pintle-hook/s on given Unit# (HITCH line for last unit is redundant - ignored if entered).}

{PROTOTYPE WHEEL BRAKE FILE}

Title  
{3 comment lines (text or blank)}  
WHLBRK, Time-Lag, Rise-Time  
[LINEAR, Torque-Coeff]  
[TABLE, Table1-Length  
  Pressure, Torque]       {Table1-Length lines}  
[MODEL  
  Chamber-Area, Drum-Diamtr, Wedge-Angle/Arm-Length, Pushout-Pressure  
  Bfo, Cv, Ct, Cf         {brake factor coefficients in eq. I.2.3, p.321, Ph IV  
  manual}  
  BTEMP, Table2-Length  
  Init-Temp, Temp-Coeff {Table2-Length lines}  
  Drum-Rub-Area, Drum-Thickness, Drum-Convect-Coeff  
  Drum-Temp, Ambient-Temp  
  Lining-Area, Lining-Thickness, Lining-Convect-Coeff, Lining-Temp]  
  {.....}  
  [BHYST, Hy             {if Hy = 0. then next line redundant (ignored if entered)}  
  [Hy2, Resbrk, Resid, Hy1]]  
  [BPROP, Ipro [,Spring0 {for Ipro = 2 only}]   {see pp.56, 351, Ph IV manual}  
  TREADLE, Table3-Length  
  Press-Treadle, Press-Out {Table3-Length lines}  
  VALVE, Table4-Length  
  V-Ipro, K]             {Table4-Length lines - see p. 348, Ph IV manual}  
END





## {PROTOTYPE TIRE FILE}

```
Title
{3 comment lines (text or blank)}
TIRE, Radius, Iyy
STIFFYZ, Lateral-Stiffness, Vertical-Stiffness
CAMBER, Camber-Stiffness, Overturning-Stiffness
[ALIGN, Aligning-Torque-Stiffness]           {not required by Model}
[CLONGL, Longitudinal-Stiffness]             {not required by Model or Table}
[CALFA, Cornering-Stiffness]                 {not required by Model or Table}
[PEAKMU, Peak-Cornering-Friction-Coefficient] {required by YR only}
{
[TABLE                                     { Sequence of lines within TABLE part is fixed !! }
CALFA, Num-Vert-Loads, Num-Velocities
Vert-Load1 [, Vert-Load2] [, Vert-Load3]
Velocity1 [, Velocity2] [, Velocity3]
{-----
one [---] block for each Calfa load-velocity combination}
Load#, Velocity#, Length1
Alfa, Mu-Y                                {Length1 lines; increasing, positive Alfa !
-----}
ROLLOFF, M-Slip-Points [, N-Alfa-Points
                                         {M-Slip-Points = 0 indicates no roll-off}
Long-Slip1 [, Long-Slip2]...[, Long-SlipM]
Alfa1 [, Alfa2]...[, AlfaN]
Rolly11 [, Rolly12]...[, Rolly1M]
{ : : : - N x M matrix}
RollyN1 [, RollyN2]...[, RollyNM]]
CLONGL, Num-Vert-Loads, Num-Velocities
Vert-Load1 [, Vert-Load2] [, Vert-Load3]
Velocity1 [, Velocity2] [, Velocity3]
{-----
one [---] block for each Clong load-velocity combination}
Load#, Velocity#, Length2
Slip, Mu-X                                {Length2 lines; increasing, positive Slip !
-----}
ROLLOFF, M-Slip-Points [, N-Alfa-Points
                                         {M-Slip-Points = 0 indicates no roll-off}
Long-Slip1 [, Long-Slip2]...[, Long-SlipM]
Alfa1 [, Alfa2]...[, AlfaN]
Rollx11 [, Rollx12]...[, Rollx1M]
{ : : : - N x M matrix}
RollxN1 [, RollxN2]...[, RollxNM]]
}
[MODEL
CALFA, Calfa, DCa/DFz, DCa/DV, D2Ca/DFz2
PEAKMU, Peak-Mu, DMup/DFz, DMup/DV
SLIDEMU, Slide-Mu, DMuS/DFz, DMuS/DV
PKSLIP, Peak-Slip, DSp/DFz, DSp/DV
TRAIL, Pneumtc-Trail, DXp/DFz, DXp/DV
LATRL, Lateral-Stiff, DCy/DFz, DCy/DV
NOMINAL, Fzo, Vo]
}
```

```

[ALIGN
[P4, Align-Coeff1, Align-Coeff2, Align-Coeff3, Align-Coeff4]
[YR, M Vert_Loads+1, N Alfas+1
0.0, Alfa1, ... AlfaN {Row #1 of (M+1) x (N+1) matrix; 0.0 < Alfa1 < AlfaN ! }
Vert-Load1, Align-Torque11, Align-Torque12, ... Align-Torque1N
{      :      :      :      :      - (M+1) x (N+1) matrix
}
Vert-LoadM, Align-TorqueM1, Align-TorqueM2, ... Align-TorqueMN]]
END

```

{PROTOTYPE SELF-STEER FILE}

Title  
{3 comment lines (text or blank)}  
SLFSTR  
ARMXY, Mechanical-Trail, Lateral-Kingpin-Offset  
FRICT, Coulomb-Friction {torque/axle}  
[LINEAR, Aligning-Stiffness, Steer-Damping] {Phase IV input}  
[TABLE, Primary-Aligning-Stiffness, Table-Length {Yaw/Roll input}  
Steer-Angle, Aligning-Torque] {Table-Length Lines}  
[FORCED, { not finalized yet ! }]  
END

{ Note: All stiffness and damping values are angular (torque-based), per axle. }

**{PROTOTYPE STEERING SYSTEM FILE}**

Title

{3 comment lines (text or blank)}

STRSTM

KINEM, Steering-Ratio, Mechanical-Trail, Lateral-Offset

STIFF, Steering-Stiffness, Tie-Rod-Stiffness, Wrap-Up-Stiffness

END

{PROTOTYPE ANTILOCK FILE}

Title

{3 comment lines (text or blank)}

ALOCK

{A parameter list according to specifications in pp. 257-267, Ph IV manual, beginning with OPTION1 (p. 257) and terminating with TSMPLE (p. 266)}

## {PROTOTYPE STEER-APPLICATION FILE}

Title  
{3 comment lines (text or blank)}  
/ ANGLE, Table1-Length  
Time, Steer-Angle / {Table1-Length lines}  
/ LRANGLE, Table2-Length  
Time, Left-Wheel-Angle, Right-Wheel-Angle / {Table2-Length lines}  
/ PATH, Table3-Length  
X-Path, Y-Path {Table3-Length lines}  
DRIVER, Driver-Lag, Preview-Interval  
[SWITCH, Closed-Loop-TimeOut, Ramp-Steer-Rate] / {see note}  
END

{ Note:

SWITCH line may figure only immediately after a DRIVER line. If no SWITCH line is present, a continuous closed-loop operation is assumed.

Ramp-Steer-Rate is required in *deg/sec*, and is interpreted as an average front-wheel steer-rate if no steering system (ratio) is specified, or as a steering-wheel turning rate if a steering system (ratio) is specified. A negative Ramp-Steer-Rate implies steering to the left direction from the last steer angle where the driver model has left-off.}

{PROTOTYPE BRAKE-APPLICATION FILE}

Title  
{3 comment lines (text or blank)}  
BRKAPL, Table-Length  
Time, Pressure            {Table-Length lines}  
END



### 3.3.1 File Naming Conventions

#### Naming Conventions for RTAC Simulations Input and Output Files on MTS

All MTS permanent files generated by or for RTAC simulation runs should include in their names basic information (within the unfortunate 12 character constraint) indicating the type of file and its general contents. This is done by making each file name to consist of two distinct, concatenated parts: A **Prefix** (first 2 characters followed by a period) identifying the file type, and a **Body** (characters #4 up to #12) specifying its contents. As there is a discrete number of valid file types, there will be the same discrete number of corresponding valid prefixes which should always be used.

The following **Prefixes** have been defined so far:

| <u>File Type</u>                | <u>Prefix (characters 1-3)</u> |
|---------------------------------|--------------------------------|
| Simulation-File                 | Si.                            |
| Vehicle-Index                   | In.                            |
| Steer- or Brake-<br>Application | Ap.                            |
| Tare-Files:                     |                                |
| Tractor or Truck                | Tr.                            |
| Semi                            | Se.                            |
| Dolly                           | Do.                            |
| Load-Files:                     |                                |
| Suspension-Load                 | SL.                            |
| Payload                         | PL.                            |
| Hitch                           | Hi.                            |
| Steering-System                 | St.                            |
| Suspension                      | Su.                            |
| Spring                          | Sp.                            |
| Wheel-Brake                     | Br.                            |
| Tire                            | Ti.                            |
| Anti-Lock                       | AL.                            |
| Self-Steer                      | SS.                            |
| ERD output                      | ER.                            |
| Printout                        | Pr.                            |

## 3.4 SIMULATIONS

### 3.4.1 Phase IV

The Phase IV program is a braking and directional response time-domain mathematical simulation of a truck/tractor, a semitrailer, and up to two full trailers. The vehicles are represented by differential equations derived from Newtonian mechanics that are solved for successive time increments by digital integration. The program is written in a generalized fashion to allow simulation of a large number of vehicle configurations.

### 3.4.2 Yaw Roll

The Constant Velocity Yaw/Roll Model simulates the turning and rolling behavior of motor vehicles in constant speed maneuvers. The model's particular features are tailored to simulation of trucks and tractor-trailer, accommodating up to four vehicle units. The simulation is particularly versatile in representation of multiple-axle configurations and different types of hitching mechanisms between the vehicle units. It generates time-based output indicating motions of each vehicle and the controlling forces internal to the vehicles.

### 3.4.3 Static Roll

The Static Roll Model is useful for calculating the rollover threshold of articulated vehicles during steady turning maneuvers. The roll response in a steady turn is computed by repeatedly solving, for small increments of roll angle, a set of equations which describe the static equilibrium of the vehicle in the roll plane.

### 3.4.4 Simplified Braking

The Simplified Braking Model determines the braking performance of an articulated vehicle assuming that it is making a constant deceleration stop. The simulation will accommodate a vehicle composed of a truck/trailer, a semi-trailer, and up to two full-trailers. The response to the applied braking forces is described in terms of the longitudinal deceleration and the vertical loads carried by each axle.

## 3.5 POST PROCESSING PROGRAMS

The Post Processor program is the final step in calculating results in the Simulation Interface. It takes as input the ERD\_file created by the run of the computer simulation, and condenses the data into a few values that indicate the important features of the simulation. The program calculates the measures that are indicated in the file runfile, as described in section 2.2.3.

The RTAC Database is a database containing the results of all the simulation runs made, as specified in the simulation matrix. The Database Updating program adds the new vehicle performance measures calculated by the Post Processor program to the RTAC Database. This database can later be transferred to a spreadsheet package to examine the results of the vehicle simulations.

## 4.0 INTERACTION OF INTERFACE COMPONENTS

This section discusses how the various components of the simulation interface interact to produce the final results of a simulation.

### 4.1 RUNSIM MACRO

The macro Runsim is essentially a manager of the programs in the simulation interface. It channels the information flow between programs, and directs the flow of the interface.

Runsim is executed by issuing the command Runsim, and supplying the simulation file to be used. Runsim first creates (or empties if they already exist) all the files that will be used by the programs in the Simulation Interface. It also issues some commands to suppress the output to the screen, so the user is not bombarded by messages that are not necessary.

It then runs the interface program, ST6T:vs.obj, with the simulation file supplied in the Runsim command. The output files from this program are saved in either permanent or temporary files, and named as indicated in the simulation file. Runsim then checks to make sure that the interface program ran correctly, by checking the file inputok. If the program did not run successfully, then Runsim writes a message to this effect on the printfile and immediately exits the macro (skipping the simulation and post processor). It also saves the debug file as a permanent file (according to the naming convention) for later inspection.

The next step in the Simulation Interface is the running of the specified simulation. Runsim branches to the simulation specified in the Simulation file and issues the appropriate command to run that simulation. In this run command, Runsim assigns the output from the interface program as input to the simulation program. It also channels the output from the simulation to the appropriately named printfile and ERDfile.

The final program in the Simulation Interface, the Post Processor, is then run. It takes as input the ERDfile output from the simulation run. The output from this program is stored in the file measures.out, and is appended to the beginning of the printfile by Runsim.

Finally, Runsim performs some cleanup operations. It copies the printfile to the printer, and destroys or empties the files that contain data that are no longer needed. The last task that Runsim performs is the issuing of the commands to re-assign the output to the screen.

### 4.2 INTERFACE PROGRAM

The Interface program takes as input the Simulation file, which indicates the simulation to be run, the vehicle to be examined, and the vehicle performance measures to be calculated, in addition to other parameters related to the running of the simulation. The output from this program is contained in four files, Destination, Disp.out, Debug.out, and Runfile. All of these files were discussed earlier in section 2.2.1, except for Runfile. Runfile, an input file for the Post Processor, contains one line which indicates the vehicle performance measures that are to be calculated in the Post Processor program.

### 4.3 SIMULATION PROGRAMS

The simulation programs (Phase IV, Yaw Roll, Simplified Braking, Static Roll, and the Linear Yaw Plane models) interact with the rest of the Simulation Interface in a very simple way. The interaction occurs through three files, Destination file, Printfile, and ERDfile. Everything the simulation needs as input is contained in the file Destination. The Printfile is not used by the rest of the Simulation Interface, but is used as a means of communicating the results of this process with the user. The ERDfile is used by the Post Processor program to compute the measures that are indicated in the file Runfile (created by the interface program).

### 4.4 POST PROCESSOR PROGRAM

The Post Processor program takes as input the ERDfile created by the vehicle simulation run. The ERDfile contains a binary record of the output of the simulation run. The Runfile created by the Interface program is also an input file to the Post Processor, it indicates which measures are to be calculated for the simulation run being examined. The output from this program appears in two file, Measures.out and Measure.temp. Measures.out is a text file displaying the results of the vehicle performance measures, Measure.temp is a binary record of these same results, used as input to the Database Updating program.

### 4.5 DATABASE UPDATING PROGRAM

The Database Updating program takes as input the file Measure.temp, created by the Post Processor program. This program uses the information in this file to update the vehicle performance measures stored in the RTAC Database file. This program is run after each vehicle simulation is completed, maintaining the RTAC Database as a completely up to date record of the results of every simulation run completed in the simulation matrix.