# SECTION 3

## *Data Collection and Analysis*

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# TASK 3 – DATA COLLECTION AND ANALYSIS

This section describes the information obtained from local Colorado companies transporting two or more precast concrete panels as nondivisible loads.

## PURPOSE

The purpose of this phase of the study is to collect data regarding local Colorado companies transporting two or more of the subject precast concrete panels as nondivisible loads in accordance with the provisions of TITLE 23-UNITED STATES CODE, Section 127. This provision states, “With respect to the State of Colorado, vehicles designed to carry 2 or more precast panels shall be considered a nondivisible load.” At the present time, divisible loads are only an issue if the transporting company were to request an Extra Legal Permit from the Colorado Department of Transportation or other Governmental Agency with jurisdiction on a public roadway system. At the direction of the Colorado Department of Transportation, Nondivisible Load Study Steering Committee, this study is to address only the effects of A-frame trailers on the State highway system.

## BACKGROUND

The Colorado Department of Transportation currently requires any loaded truck with a gross vehicle weight (GVW) in excess of 85,000 lbs. (42.5 ton), to obtain an Extra Legal Permit. These permits are available on an annual basis for those trucks routinely transporting non-divisible loads up to a GVW of 200,000 lbs (100 tons). They are only available on a "per trip" basis for those with GVW over 200,000 lbs.

A "precast concrete panel", for this study, is defined as a concrete product, fabricated in a facility specifically suited to produce thin (relative to the width or length) members. These panels are currently transported on flatbed semi trailers. Many different configurations of flatbed trailers have been observed. Precast panels are being transported:

1) On flat trailers with the panels lying flat on the bed of the trailer. This case would probably be limited to those precast panels narrow enough to not require an Extra Legal Permit for over-size.
2) On trailers fitted with single tilt frames. These trailers have a pivot near the bottom of the frame that is usually outside the width of the trailer bed. This is to allow gravity to pivot the frame. As the panel is lifted, from the top edge, it begins to hang more and more vertical. The more vertical it becomes, the center of gravity (CG) of the panel moves toward the "pivot" and increases the vertical load on the bottom of the frame. This causes the frame to pivot toward the vertical position. Trailers of this configuration have an inherent problem with balance of the load. The imbalance is caused by the fact that the center of gravity of the panel is seldom directly over the center of gravity of the trailer. This causes an eccentricity, and consequently the loads seen by the tires on either side of the trailer are seldom equal. A simple method utilized to balance the load is to insert a spacer block at the bottom of the frame to raise the precast panel. Depending on the angle of the frame to the bed of the trailer, the center of gravity of the precast panel can be moved toward the CG of trailer as a function of the Cosine of the angle times the width of the spacer. Because an infinite number of spacers are not available, the load is seldom centered on the trailer. A severe imbalance can result in potential handling problems for the driver of the transport vehicle.
3) On trailers fitted with a single slant frame. These trailers are similar to the tilt frame trailers, but the frames do not pivot and are fixed firmly to the trailer. The load balancing issues are similar, but usually are not as significant. This is because the bottom of the frame is usually on top of the trailer bed, which places the center of gravity of the panels closer to the center of the trailer.
4) On flat trailers with a removable A-frame. These are usually utilized for an even number of precast panels and transported in as near balanced loadings as possible. This type of trailer and removable A-frame, generally have a higher trailer bed level and therefore are limited to narrower panels.
5) On drop trailers with permanent frames. These trailers are generally longer and may be in either single tilt frame or A-frame configuration. The A-frame configuration could also have an unbalanced load, unless the two precast panels are identical, but it offers other advantages. The center of gravity of the load is always very near the

center of the trailer if the panel weights are nearly the same. Matching panel weights is easily done since the panel weights are always known for erection purposes.

a. The carrying surface of a single drop trailer is usually not quite as low as that of a double drop because the bed of the trailer is higher than the top of the rear wheels.
b. The double drop trailer bed is below the top of the rear wheels and this allows the widest panels to be transported, but the panel lengths are restricted.

Sketches of the above trailers are included in Appendix 3-A.

## TRAILER LENGTHS

Preliminary efforts to obtain data, from various sources, including the Internet, regarding truck trailer lengths, sizes, capacities and configurations, has not been especially fruitful. Trailer manufacturers all build their own unique "standard trailers", but they also fabricate "custom trailers" to the specifications of their various clients. The variations of the types of trailers fabricated are numerous. In order to specifically determine several standards of the type of trailers used for this study, visual observation of existing trailers used to haul precast panels was employed.

A visit to the local fabrication plant provided a selection of several different trailers dedicated to transporting precast concrete panels. Both trailers with tandem and tridem rear axle groups were observed. The axle spacing for these groups were consistently in the 4 to 4.2 foot range. The distance from the king pin to center of the axle groups varied.

The single drop A-frame trailers were generally shorter because the trailer length over the rear wheels was useable bed length. These trailers measured approximately 31 feet from king pin to the center of the axle group for both tandem and tridem axle groups.

The double drop A-frame trailers had a useable bed length of 30 feet because of the rear drop, the king pin to center of the axle group measured approximately 37 feet.

The dimensions taken from truck-trailer combinations owned by the fabricator and the local custom hauling contractor will be used for this Study.

## AXLE LOADING

A-frame trailers neatly fit all the AASHTO assumptions and definitions of live load applications to the bridges, especially, the assumption that both sides of the trailer are equally loaded.

## PRECAST PANEL DATA

The concrete panels being transported were of varying dimensional sizes and weights. Those observed for this study were each clearly marked with the weight on the end of each panel near the lifting loops. The two panels on each load were, with few exceptions, approximately of equal weight. The gross panel weights on the study trucks ranged from 38.5 kips (one load), to 72.4 kips (two loads). The average of the remaining 49 study panel pairs was 42.8 kips. For the final distribution of the panel loads between the tandem axle trailers and the tridem axle trailers, and the individual load weights, see Appendix 3-B.

The panel loads were assumed to be distributed 51 % to the trailer axles and 49 % to the fifth wheel. Appendix 3-C shows the actual axle weight distributions for loads transported during December 2000.

## TRANSPORTATION VEHICLES

The A-frame trailers used in this study are owned by the fabricator but are often supplemented with trailers from a local transportation company. All observed trailers were very similar in size, configuration and capacity. Two trailers were used due to their similarity, to represent the study trailers. The transportation company trailers were also similar. The trailer details can be seen in Appendix 3-A.

The observed towing tractors can be represented by one study tractor. The tractor details can be seen in Appendix 3-A.

The fabricator provided a detailed summary of the trip tickets for the two study months of June 1999 and February 2000. The summary included date, job location, load number, panel weights and the trailer type. Only the combined weight of the two concrete panels was recorded on the trip tickets. Without an actual scale weight ticket for the trailers, the distribution of the trailer self-weight, approximately 20,000 lb., was assumed to be 60 % on the rear axles and 40 % on the fifth wheel.

The observed towing tractors were all of similar configurations but of two gross weights. The smaller tractors weighing approximately 20,000 lb. were exclusively used on the smaller loads like the A-frame trailers and slant frame trailers. The larger tractors weighing 29,000 lb. were used for larger and heavier loads like bridge girders etc. Although the tractors were not weighed, the steering axle was assumed at 9,000 lb. and the remaining 11,000 lbs split equally between the tandem driving axles, and also assuming the driving axles were centered under the fifth wheel.

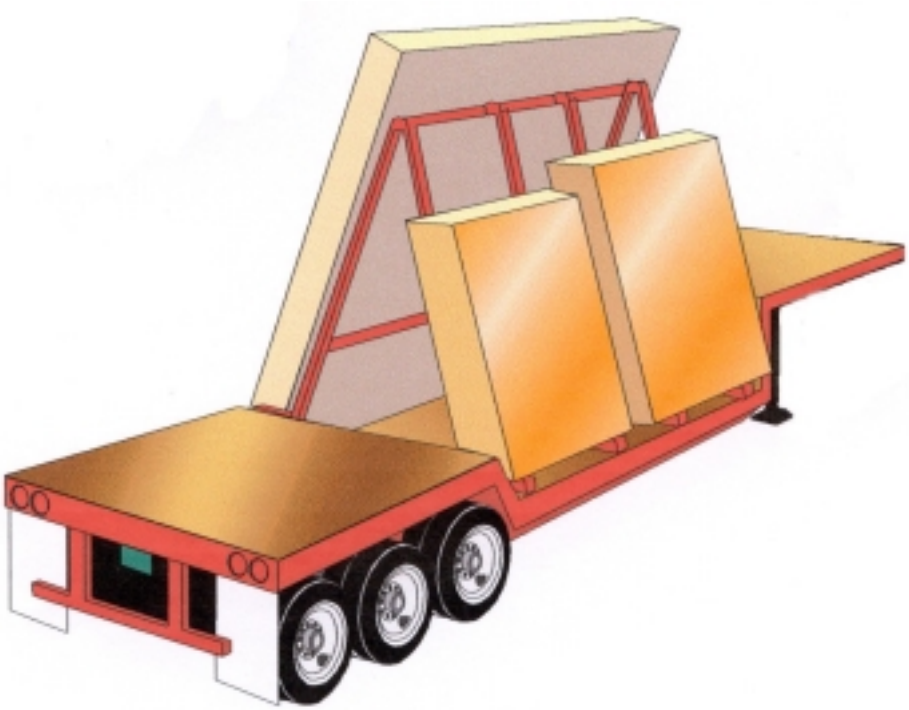
### Colorado companies transporting two or more of the subject precast concrete panels as nondivisible loads on subject vehicles:

Rocky Mountain Prestress

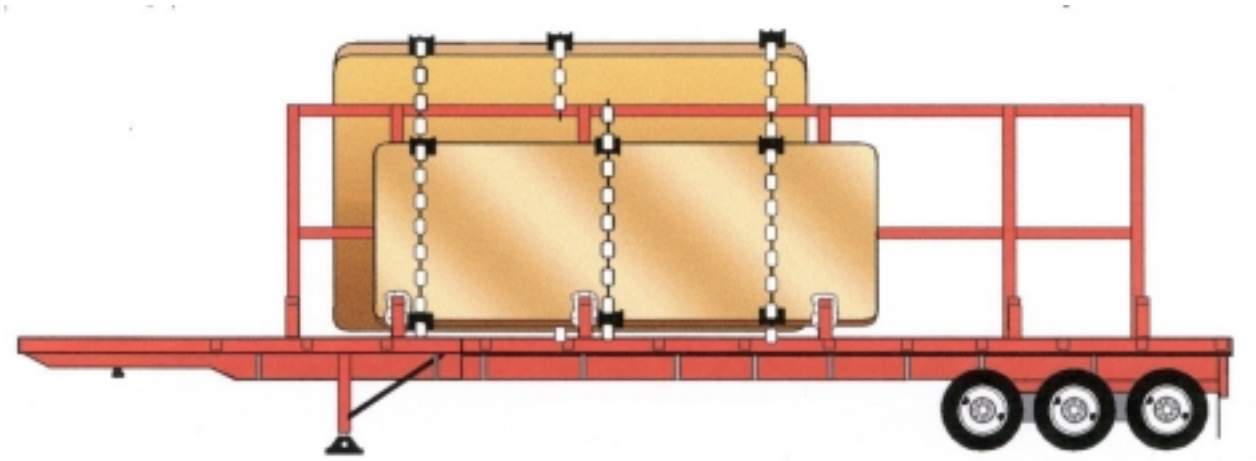
| | Average Trip Distances | Number of Loads per Year | Average GVW | Average axle weights | Maximum axle weights |
|---|---|---|---|---|---|
| Extra-legal weight subject vehicles<br><br>(June 1999 data) | 15.2 miles/trip (455.4 miles per month based on June data; 420 miles on interstates, 35.4 miles on other highways) | 360 loads per year (based on 30 loads/month for June data); 21.6% overweight A/F loads | 89,760 pounds per load (based on June data); 116,400 pounds max load | | |
| Extra-legal weight subject vehicles<br><br>(Feb. 2000 data) | 18.2 miles/trip (218.7 miles per month based on Feb. data; 206.6 miles on interstates, 12.1 miles on other highways) | 144 loads per year (based on 12 loads/month for Feb. data); 23% overweight A/F loads | 85, 460 pounds per load (based on Feb. data); 92,300 pounds max load | | |
| Legal weight subject vehicles | N/A | 15,516 loads per year (based on 1293 loads/month for June data); 6588 loads per year (based on 549 loads/month for Feb. data); 13413 total loads reported for 1999 | | | |

# APPENDIX 3-A

**LOADED, SINGLE DROP, TRIDEM AXLE, A-FRAME TRAILER**

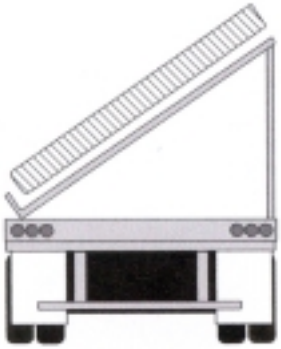


**LOADED, DOUBLE DROP, TRIDEM AXLE, A-FRAME TRAILER**

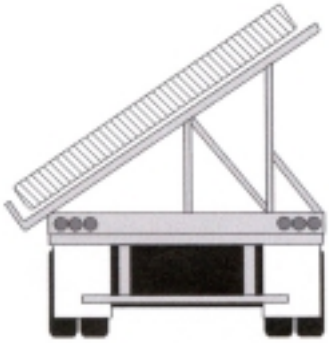


**LOADED FLAT BED TRAILER**

**TYPICAL TRACTOR**



**LOADED SLANT FRAME TRAILER**



**LOADED TILT FRAME TRAILER**

**LOADED A-FRAME TRAILER**

# APPENDIX 3B

## NET PANEL WEIGHTS BASED ON FABRICATORS TRIP RECORDS

CONCRETE PANEL FABRICTORS TRIP TICKETS FOR JUNE 1999 & FEB 2000

SHIPPED ON DOUBLE DROP TRAILERS - **TANDEM AXLES**

| JUNE ' 99 NET WT. KIP | FEB ' 00 NET WT. KIP |
|---|---|
| 46.80 | 41.60 |
| 46.80 | |
| 48.20 | |
| 46.80 | |
| 47.00 | |

AVG. = 46.20 FOR TWO MONTHS

**NET WEIGHT WILL BE DISTRIBUTED BETWEEN THE TRACTOR TANDEM AND THE TRAILER WHEELS AT A RATIO OF 50% TO TRAILER AXLES AND 50% TO TRACTOR TANDEM BUT NOT TO EXCEED 29 KIP ON TRACTOR TANDEM.**

SHIPPED ON SINGLE DROP TRAILERS - **TRIDEM AXLES**

| JUNE ' 99 NET WT. KIP | JUNE ' 99 NET WT. KIP | FEB ' 00 NET WT. KIP |
|---|---|---|
| 43.20 | 46.20 | 40.6 |
| 43.20 | 46.20 | 39.1 |
| 42.00 | 72.40 | 39.3 |
| 41.40 | 72.40 | 39.1 |
| 41.40 | 41.40 | 38.4 |
| 41.40 | 41.40 | 48.3 |
| 41.40 | 48.20 | 48.3 |
| 43.90 | 48.20 | 40.1 |
| 43.90 | 48.20 | 39.1 |
| 43.90 | 48.20 | 43.5 |
| 42.80 | 48.20 | |
| 42.80 | 45.80 | |
| 41.40 | 46.20 | |
| 41.40 | 43.80 | |
| 41.40 | 38.50 | |
| 41.40 | 46.50 | |
| 55.20 | 46.50 | |

AVG = 44.91 FOR TWO MONTHS

# Appendix 3-C New

## Truck Weights**Dec 2000

| LOADED TRUCKS | | | Lbs. | Lbs. | Lbs. | | | | Lbs. |
|---|---|---|---|---|---|---|---|---|---|
| TICKET # / LOAD # | DATE | TRAILER NO. | FRONT AXLE | DRIVER AXLES | TRAILER AXLES | % FRONT | % DRIVERS | % TRAILER | PRODUCT WEIGHT |
| 9037/037 | | 151 | 10,680 | 34,800 | 32,200 | 13.7 | 44.8 | 41.5 | 44,900 |
| 9037/067 | 12/5/00 | 151 | 10,780 | 26,520 | 28,880 | 16.3 | 40.1 | 43.6 | 34,500 |
| 9037/104 | 12/7/00 | 152 | 10,900 | 32,800 | 36,000 | 13.7 | 41.2 | 45.2 | 38,900 |
| 9037/031 | 12/5/00 | 173 | 12,400 | 31,400 | 29,140 | 17.0 | 43.0 | 40.0 | 40,300 |
| 9037/038 | | 177 | 10,600 | 33,120 | 27,480 | 14.9 | 46.5 | 38.6 | 39,300 |
| 9037/036 | 12/7/00 | 193 | 9,980 | 30,400 | 32,080 | 13.8 | 42.0 | 44.3 | 43,500 |
| 9037/034 | | 415-017 | 10,520 | 28,180 | 24,060 | 16.8 | 44.9 | 38.3 | 30,300 |
| 9037/068 | 12/6/00 | 415-030 | 10,440 | 32,060 | 27,600 | 14.9 | 45.7 | 39.4 | 40,400 |
| 9037/039 | | 415-037 | 10,640 | 34,400 | 28,340 | 14.5 | 46.9 | 38.6 | 41,000 |
| 9037/035 | 12/6/00 | 415-038 | 10,220 | 25,620 | 21,980 | 17.7 | 44.3 | 38.0 | 28,800 |
| 9037/106 | | 415-040 | 10,620 | 31,820 | 31,880 | 14.3 | 42.8 | 42.9 | 43,500 |
| 9037/042 | 12/8/00 | 415-043 | 10,480 | 29,000 | 26,900 | 15.8 | 43.7 | 40.5 | 36,700 |
| 9037/069 | | 415-043 | 10,520 | 26,620 | 22,340 | 17.7 | 44.8 | 37.6 | 28,900 |
| 9037/032 | 12/5/00 | 415-046 | 10,060 | 29,040 | 34,060 | 13.8 | 39.7 | 46.6 | 43,400 |
| 9037/033 | 12/5/00 | | 10,700 | 31,940 | 34,160 | 13.9 | 41.6 | 44.5 | 43,900 |
| | | | | | | | | | |
| AVERAGE | | | 10,636 | 30,515 | 29,140 | 15 | 43 | 41 | |
| | | | | | | | | | |
| STUDY TRUCKS | | | | | | | | | |
| TANDEM AXLE TRLR (ACTUAL) | | | 9,000 | 40,000 | 37,200 | 10.4 | 46.4 | 43.2 | 86,200 |
| TRIPLE AXLE TRLR (ACTUAL) | | | 9,000 | 40,000 | 33,600 | 10.9 | 48.4 | 40.7 | 82,600 |
| | | | | | | | | | |
| TANDEM AXLE TRLR (MAX) | | | 15,000 | 50,000 | 50,000 | 13.0 | 43.5 | 43.5 | 115,000 |
| TRIPLE AXLE TRLR (MAX) | | | 15,000 | 50,000 | 65,000 | 11.5 | 38.5 | 50.0 | 130,000 |