Caltrans Proposal Response

SUBJECT: **Increase Tridem Group Allowable Weight**

DATE: **February 19, 2004**

POLICY: **CTPAC WG4 111203-002**

I. INDUSTRY PROPOSED REVISION - Authorize tridem maximum weight comparable to trunnion configurations.

Caltrans Response: *See response to II below.*

Tridem and trunnion axle groups distribute load differently. While these suspension types may be contrasted, the way they act under load prevents a direct comparison with respect to allowable weights. A tridem axle group has a longer load distribution area than a trunnion axle group. A vehicle, ten feet wide with eight tires per axle and using a trunnion axle group, has a wider load distribution area than a tridem. In general, a trunnion axle group distributes load far better than a tridem axle group.

For most bridges, the assumption that tridem axle groups may be allowed the same weight as trunnion axle groups is invalid. In fact, there is no evidence that supports this position. For the vast majority of cases, a tridem should only be allowed the same weight as an eight-foot wide tandem with four tires per axle.

Typically, it is correct to assume that Caltrans bases allowable group weights on the total axle spread of the group and not on the group's number of axles. In fact, with respect to bridge analysis, the number of axles in a group is insignificant except for a short span bridge. Evidence of this is that the majority of currently proposed legal weight formulas do not consider the number of axles.

California transportation permit policy considers the total width of axle groups, as well as number of tires per axle, to determine axle group allowable weight. An increase of 25% in allowable weight is authorized for an axle group with ten-foot wide axles and eight tires per axle. The reason for this is that the added tires and width spreads the load to more of the main load carrying bridge elements (girders and stringers), which reduces the stress on the individual members. Since load distribution is better, more weight is allowed on a trunnion axle group.

Recapping the comparison between a tridem and trunnion axle group, the two group types are not interchangeable with respect to allowable weight. Structurally, allowable weight is based on axle group spread, not the number of axles in the group. Since a tridem axle group is narrower with fewer tires, policy restricts its weight. On the other hand, a trunnion axle group does have a greater width and more tires, which, as mentioned earlier, distributes weight more structural members, allowing a greater maximum group weight.

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Transportation permit weight policy uniformity among States will never be achieved if the most liberal practices are compared with those of California. There are several reasons for this.

Very few States (including California) have structural bridge models defined in bridge analysis software. The reason for this is that bridge analysis software capable of evaluating the multitude of existing bridge types, has only recently become available. In addition, once the software is acquired, substantial investment is required to create the bridge models in the software. On the bright side, once these two obstacles are overcome, bridge analysis software can efficiently analyze a bridge using <u>any</u> vehicle configuration.

Some States transportation permit structural analysis consists only of comparing the design vehicle of a bridge to the applicant's vehicle. The results are then used to decide if the extra-legal load may use the structure. This form of analysis method is not accurate and is subject to individual, and varied, judgement. Human nature dictates that some engineers are more conservative in their assumptions and conclusions and vice versa.

While some States use a permit vehicle to design bridges, most do not. California is among the minority that uses a heavy permit vehicle to design bridges. Other States use the basic design vehicles (HS20) and increase its weight. Most States use no special vehicle of any kind to design their bridges. Because of the nonstandard design practices, bridge load capacity will vary from State to State anyway.

California transportation permit policy does not consider the number of axles in a group to determine axle group allowable weight. Instead, it uses axle group total width and total number of tires. This is a policy that has been extensively analyzed, justified and proven to work. Furthermore, extensive modeling of many, if not all, bridges in California would be required to determine the ones that could handle the more intensive tridem group load distribution. The resources necessary for this effort would be substantial and are unavailable at this time.

II. INDUSTRY PROPOSED REVISION - Authorize 60,000 pounds on a tridem axle group and for routine permit issuance.

<u>Caltrans Response</u>: *Permit writers will be trained in policy. A tridem axle group is allowed chart weight, pursuant to the first to last axle spread and when that axle*

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spread exceeds eight feet. Ensure Regional offices know and understand the policy allowances for, as well as policy differences between, a semi-trailer tandem and tridem axle group.

Use the workgroup agreed upon envelope vehicles (see accompaniments) as follows:

SC&RA- SASHTO – WASHTO, 6 -axle
SC&RA- SASHTO – WASHTO, 6 -axle –1
SC&RA- SASHTO – WASHTO, 7- axle
SC&RA-CA- SASHTO – WASHTO, 7 -axle –2
SC&RA-CA- SASHTO – WASHTO, 7-axle -3
SC&RA-CA- SASHTO – WASHTO, 8-axle-1
SC&RA-CA- SASHTO – WASHTO, 8-axle-2
SC&RA-CA- SASHTO – WASHTO, 13-axle

All of these envelope vehicles, except the SC&RA-CA- SASHTO – WASHTO 13-axle can potentially be allowed 60,000 pounds on the tridem axle group(s) with slight modifications under the following provisions:

1. *The dimensions on the final approved drawings shall be minimum dimensions.*
2. *The maximum allowable weight authorized on the tridem axle group will determined using a table, to be developed, similar to the second line of the tables found in Appendix 20 of the Transportation Permit Manual (**Note:** The spread on the tridem axle groups shown on all of the vehicles is not enough to authorize 60,000 pounds).*
3. *Approval of these vehicles is subject to all other transportation permit requirements (**Note:** Some of the proposed vehicles do not satisfy some of these provisions and will require further analysis and modification).*
4. *Routing will be based on the vehicle's total number of axles.*
5. *A list of bridges will be generated that these vehicles shall not cross (Caltrans does not anticipate this list to be very large).*

Rather than use envelope vehicles, policy may be developed to describe authorized vehicles.

A tridem group is authorized additional weight when compared to a tandem. Policy prohibits extra-legal weight on a semi-trailer tandem axle group that exceeds an 8-foot

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axle spread. On the other hand, a tridem axle group is authorized extra-legal weight when the first to last axle spread exceeds 8-feet.

This proposal appears to request 60,000 pounds on tridem axle groups for any vehicle that otherwise meets Caltrans permit policy. Structurally, this will not work. In addition, this was not what the workgroup agreed on.

Tridem axle groups may be authorized increased maximum weights pursuant to certain envelope vehicle parameters. Envelope vehicles are a solution to this proposal because this method allows efficient identification of all bridges adversely affected by a 60,000 pound tridem axle group.

During the workgroup conference call, envelope vehicles were agreed upon. Furthermore, the workgroup agreed that envelope vehicles would be used to determine tridem maximum allowable weights. It appears that, except for the XXX vehicle, tridem axle groups may be authorized 60,000 pounds, with slight modifications and pursuant to certain provisions.

Envelope vehicles were supposed to be included in this proposal. In fact, envelope vehicles were submitted separate from this proposal but are not referenced in this proposal. For the purpose of processing this proposal, Caltrans assumes that the workgroup agreed upon envelope vehicles are part of this proposal.