Technical Document

MOUNTING CALCULATIONS FOR 4000 PRODUCT FAMILY TRANSMISSIONS

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MOUNTING CALCULATIONS FOR 4000 PRODUCT FAMILY TRANSMISSIONS

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MOUNTING CALCULATIONS FOR 4000 PRODUCT FAMILY TRANSMISSIONS

1.0 INTRODUCTION

This document addresses two different mounting approaches that may be taken to support the installation of an engine and a 4000 Product Family transmission:

- **Three-Point Mount Using the Transmission Side Pads** (paragraph 3.0) – The powerpack is mounted at three points. One point is attached to the front of the engine. The remaining two mounting locations use the transmission converter housing side pads. The calculations evaluate the transmission side pad bending moments and bolt shear loads. Also included are calculations that determine the flywheel housing to transmission converter housing split line loading, and develop rear support loading if necessary.

- **Three-Point Mount Using a Cradle Subframe** (paragraph 4.0) – The powerpack is mounted at three points. One point is attached to the front of the engine. The other two mounting locations are attached to cradle subframes at each side of the powerpack. The subframes are attached to both the engine and the transmission. The calculations locate the cradle mount isolation point such that there is a zero bending moment at the flywheel housing to transmission converter housing split line.

For additional mounting requirements and recommendations, refer to the following documents:

- *Transmission Mounting – General Requirements*
- *Transmission Mounting Design – Transmission Overhung*
- *Transmission Mounting Design – Using the Transmission Side Pads*

2.0 REFERENCED DOCUMENTS

Unless otherwise noted, all documents referenced in this document may be found in the Extranet channel of the Allison Transmission website, *www.allisontransmission.com*. To locate the referenced documents, which are identified by *italic* font, look for Tech Data under the Engineering heading on the Extranet home page. Contact your Allison Transmission representative if you do not have access to the Allison Transmission Extranet. A list of all items referenced in this document can be found at the end of this document.

3.0 THREE-POINT MOUNT USING THE TRANSMISSION SIDE PADS

A typical power package mounting using the transmission converter housing side mounting pads and engine front trunnion mount is illustrated in Figure 2. The significant loads on the converter housing side pads include:

- powerpack weight
- the powerpack reaction torque
- inertial loading

The following calculations are made for each load condition:

- side pad bolt shear limits (paragraph 3.2)
- side pad bending moment limits (paragraph 3.3)

In addition, paragraph 3.4 contains calculations to evaluate the bending moment at the flywheel housing to converter housing split line.

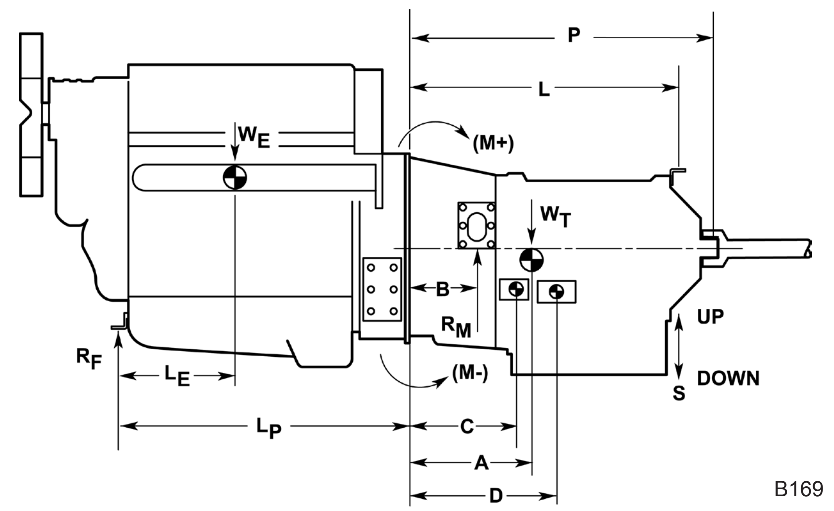

Figure 2: Typical powerpack mount using converter housing side pads

All load calculations assume the following:

- the centers of gravity are located on the powerpack vertical center-plane
- the front engine mount hardware is mirrored on the vertical center-plane of the powerpack
- the transmission side mount hardware is mirrored on the vertical center-plane of the powerpack

Load Condition I is at stall in first range and in reverse range. First determine the transmission output stall torque in first range and reverse. Then, estimate the transmission output torque required to give a tractive effort equal to 40 percent of the weight on the drive axles. Use whichever output torque is less for both first and reverse. Reaction loads due to the weight of the powerpack are included in the calculated pad loads.

Load Condition II is a combination of inertial loading and torque while the vehicle is in motion. For the combined case, peak engine torque is used. Inertial loads are based upon the static equilibrium of the powerpack weight resting on the isolation mounts. The powerpack weights and the locations of the centers of gravity must include all equipment mounted to the powerpack:

- engine, including oil
- transmission, including oil
- transmission cooler, including oil, if mounted on powerpack
- 50% of the front propshaft
- all PTOs mounted on the powerpack
- all hydraulic pumps mounted on the powerpack
- any other ancillary equipment mounted on the engine or the transmission

The equations calculate transmission side pad loads, for 1 +/- 5 g vertically at the rated engine torque. The calculated side pad loads are compared to experience-based limit factors and moments. For vehicles without suspensions, such as dock spotters, accelerations can be significantly higher. For those types of vehicles, the vehicle manufacturer must pay additional attention to powerpack mounting design.

3.1 DATA REQUIRED TO MAKE CALCULATIONS

TRANSMISSION DATA

W_T = Total weight of transmission and all transmission-mounted hardware__________(lbs. or kg)
(*4000 Product Family Transmission Data* for weight of transmission & Allison hardware)

A = Distance from flywheel housing rear face to transmission C.G. _________ (in. or mm)
(*4000 Product Family Transmission Data*)

B = Distance from flywheel housing rear face to transmission side pads ___________(in. or mm)
(4000 Basic Installation Drawings)

X = Lateral reach from face of transmission side pad out to center of side isolation mount (in. or mm)

Z = Rearward reach from transmission side pad to center of side isolation mount (in. or mm)

- Z = 0 if the isolator is directly out from the transmission side pad
- Z is positive if the isolator is rearward of the transmission side pad
- Z is negative if the isolator is forward of the transmission side pad

T_{RF} = Transmission gear ratio in first range (Gear ratio is positive)
T_{RR} = Transmission gear ratio in reverse (Gear ratio is positive. Ignore sign for reverse direction.)
(*4000 Product Family Transmission Data*)

L = Location of the transmission rear support (in. or mm)
(*Installation Drawing AS67-430, Rear Support Provision*)

Transmission static bending moment limit (lb-ft or N·m)
(*4000 Product Family Transmission Data*)

W_T and A must include all weight that is carried by the transmission. Including:

- transmission dry weight (*4000 Product Family Transmission Data*)
- transmission oil (*4000 Product Family Transmission Data* for oil volume)
- the mounting hardware that is located between the transmission and the isolators
- transmission-mounted PTOs
- transmission-mounted hydraulic pumps
- 50% of the front propshaft
- transmission cooler, including oil, if mounted to transmission (*4000 Product Family Transmission Data*)
- all other equipment mounted on the transmission

The total transmission weight and C.G. will affect isolation mount load sharing.

ENGINE DATA – Obtain from Engine Manufacturer

W_E = Total weight of engine and all engine-mounted hardware__________________(lbs. or kg)
L_E = Distance from front engine isolation mount to engine C.G. __________________(in. or mm)
L_P = Distance from front engine isolation mount to flywheel housing rear face _______(in. or mm)
T_P = Peak torque ____(lb-ft or N·m)

Flywheel housing bending moment limit (lb-ft or N·m)

W_E and L_E must include all weight that is carried by the engine. Including:

- engine dry weight
- engine oil
- the mounting hardware that is located between the engine and the isolator
- engine-mounted PTOs
- engine-mounted exhaust hardware
- all other equipment mounted on the engine

The total engine weight and C.G. will affect isolation mount load sharing.

VEHICLE DATA – Obtain from *iSCAAN* Analysis of Subject Vehicle

T_1 = Maximum transmission output torque at stall (forward) ________________ (lb-ft or N·m)
T_2 = Maximum transmission output torque at stall (reverse) (lb-ft or N·m)
(Torques are positive. Ignore sign based on forward or reverse direction.)
W_{DA} = Weight on drive axles (lbs. or kg)
R_R = Tire rolling radius ____ (in. or m)
A_R = Axle ratio

3.2 DETERMINE THE MOUNTING PAD CLAMPING COEFFICIENTS

The equations below calculate the required transmission side pad clamping coefficients for both Right Hand and Left Hand side pads, as viewed from the rear of the transmission, for two conditions:

- Load Condition I – vehicle stalled
- Load Condition II – vehicle in motion

Design practice allows slip in the most limiting condition in the most limiting load direction. Design practice does not allow slip for load in the opposite direction in that same condition. The lower calculated coefficient in the most limiting of Condition I or Condition II must not exceed 0.18 for either side pad. The calculations of the clamping loads are based on the following:

- the vertical isolation load
- the couple created by the vertical load when it is not centered on the side pad. Z is the couple arm.

Calculate Traction Limit Torque

$TTL = (0.0333) \times (W_{DA}) \times (R_R) \times (1/A_R) =$ lb-ft (3.01)

or

$TTL = (3.92266) \times (W_{DA}) \times (R_R) \times (1/A_R) =$ N·m

Determine Peak Torque in Both Forward and Reverse Ranges (Torques are positive. Ignore sign based on forward or reverse direction.)

T_3 = Forward Peak Torque = $(T_P) \times (T_{RF})$ = _____________ lb-ft or N·m (3.02)

T_4 = Reverse Peak Torque = $(T_P) \times (T_{RR})$ = _____________ lb-ft or N·m (3.03)

Calculate Gravitational Load at Each Transmission Side Pad

$R_G = \{(W_E \times L_E) + [W_T \times (L_p + A)]\} / \{2 \times (L_p + B + Z)\}$ = _____________ lbs (3.04)

$R_G = \{(W_E \times L_E) + [W_T \times (L_p + A)]\} / \{.20396 \times (L_p + B + Z)$ = __________ N (3.04)

Determine Torque Reaction Load on Each Transmission Side Pad

Forward Maximum: R_{FM} = [12/(2X + 20.5)] x (T_1 or TTL)* = lbs (3.05)
R_{FM} = [1000/(2X + 520.7)] x (T_1 or TTL)* = _______N

Forward Peak: R_{FP} = [12/(2X + 20.5)] x T_3 or TTL)* = lbs (3.06)
R_{FP} = [1000/(2X + 520.7)] x T_3 or TTL)* = ________N

Reverse Maximum: R_{RM} = [12/(2X + 20.5)] x (T_2 or TTL)* = lbs (3.07)
R_{RM} = [1000/(2X + 520.7)] x (T_2 or TTL)* = _______N

Reverse Peak: R_{RP} = [12/(2X + 20.5)] x (T_4 or TTL)* = lbs (3.08)
R_{RP} = [1000/(2X + 520.7)] x (T_4 or TTL)* = N

* Use maximum output torque (T_1, T_2, T_3, or T_4 as appropriate) or TTL, whichever is less.

TOTAL REACTION LOAD ON EACH TRANSMISSION SIDE PAD

(Refer to data from equations 3.04 through 3.08)

LOAD CONDITION I (VEHICLE STALLED)

Right Pad: Fwd: R_1 = + R_{FM} + R_G = + ( ) + ( ) = ____________lbs or N (3.09)

Rev: R_2 = – R_{RM} + R_G = – ( ) + ( ) = ____________lbs or N (3.10)

Left Pad: Fwd: R_3 = – R_{FM} + R_G = – ( ) + ( ) = ____________lbs or N (3.11)

Rev: R_4 = + R_{RM} + R_G = + ( ) + ( ) = ____________lbs or N (3.12)

LOAD CONDITION II (VEHICLE IN MOTION)

Right Pad: Fwd: R_5 = + R_{FP} + 6R_G = + ( ) + 6 ( ) = ___________lbs or N (3.13)

Rev: R_6 = – R_{RP} – 4R_G = – ( ) – 4 ( ) = ___________lbs or N (3.14)

Left Pad: Fwd: R_7 = – R_{FP} – 4R_G = – ( ) – 4 ( ) = ___________lbs or N (3.15)

Rev: R_8 = + R_{RP} + 6R_G = + ( ) + 6 ( ) = __________lbs or N (3.16)

REACTION PER BOLT AND CLAMPING COEFFICIENT REQUIRED WITH SIX M16 x 2.0 BOLTS (Refer to equations 3.09 through 3.16)

LOAD CONDITION I For R_{XB} = lbs, use C = 0.0000612
R_{XB} = N, use C = 0.0000138

Right Pad: Fwd: $R_{1B} = \{[(R_1 / 6)+(0.0577 \times R_1 \times Z)]^2 + (0.0825 \times R_1 \times Z)^2\}^{1/2}$ = lbs (3.17)

$R_{1B} = \{[(R_1 / 6)+(0.00227 \times R_1 \times Z)]^2 + (0.00325 \times R_1 \times Z)^2\}^{1/2} =$ N

$\mu_1 = (R_{1B}) \times C =$ (3.18)

Rev: $R_{2B} = \{[(R_2 / 6)+(0.0577 \times R_2 \times Z)]^2 + (0.0825 \times R_2 \times Z)^2\}^{1/2} =$ lbs (3.19)

$R_{2B} = \{[(R_2 / 6)+(0.00227 \times R_2 \times Z)]^2 + (0.00325 \times R_2 \times Z)^2\}^{1/2} =$ N

$\mu_2 = (R_{2B}) \times C =$ (3.20)

Left Pad: Fwd: $R_{3B} = \{[(R_3 / 6)+(0.0577 \times R_3 \times Z)]^2 + (0.0825 \times R_3 \times Z)^2\}^{1/2} =$ lbs (3.21)

$R_{3B} = \{[(R_3 / 6)+(0.00227 \times R_3 \times Z)]^2 + (0.00325 \times R_3 \times Z)^2\}^{1/2} =$ N

$\mu_3 = (R_{3B}) \times C =$ (3.22)

Rev: $R_{4B} = \{[(R_4 / 6)+(0.0577 \times R_4 \times Z)]^2 + (0.0825 \times R_4 \times Z)^2\}^{1/2} =$ lbs (3.23)

$R_{4B} = \{[(R_4 / 6)+(0.00227 \times R_4 \times Z)]^2 + (0.00325 \times R_4 \times Z)^2\}^{1/2} =$ N

$\mu_4 = (R_{4B}) \times C =$ (3.24)

LOAD CONDITION II

Right Pad: Fwd: $R_{5B} = \{[(R_5 / 6)+(0.0577 \times R_5 \times Z)]^2 + (0.0825 \times R_5 \times Z)^2\}^{1/2} =$ lbs (3.25)

$R_{5B} = \{[(R_5 / 6)+(0.00227 \times R_5 \times Z)]^2 + (0.00325 \times R_5 \times Z)^2\}^{1/2} =$ N

$\mu_5 = (R_{5B}) \times C =$ (3.26)

Rev: $R_{6B} = \{[(R_6 / 6)+(0.0577 \times R_6 \times Z)]^2 + (0.0825 \times R_6 \times Z)^2\}^{1/2} =$ lbs (3.27)

$R_{6B} = \{[(R_6 / 6)+(0.00227 \times R_6 \times Z)]^2 + (0.00325 \times R_6 \times Z)^2\}^{1/2} =$ N

$\mu_6 = (R_{6B}) \times C =$ (3.28)

Left Pad: Fwd: $R_{7B} = \{[(R_7 / 6)+(0.0577 \times R_7 \times Z)]^2 + (0.0825 \times R_7 \times Z)^2\}^{1/2} =$ lbs (3.29)

$R_{7B} = \{[(R_7 / 6)+(0.00227 \times R_7 \times Z)]^2 + (0.00325 \times R_7 \times Z)^2\}^{1/2} =$ N

$\mu_7 = (R_{7B}) \times C =$ (3.30)

Rev: $R_{8B} = \{[(R_8 / 6)+(0.0577 \times R_8 \times Z)]^2 + (0.0825 \times R_8 \times Z)^2\}^{1/2} =$ lbs (3.31)

$R_{8B} = \{[(R_8 / 6)+(0.00227 \times R_8 \times Z)]^2 + (0.00325 \times R_8 \times Z)^2\}^{1/2} =$ N

$\mu_8 = (R_{8B}) \times C =$ (3.32)

Maximum permissible coefficient (μ_x) is 0.18 in equations 3.18, 3.20, etc. through 3.32.

If less than six bolts per pad are used, review with Allison Transmission Application Engineering. In any case, the four holes at the corners of each pad must always be used.

3.3 DETERMINE THE BENDING MOMENTS AT THE MOUNTING PADS

The bending loads (M_P) at the side pads are based upon the side isolation mount loads multiplied by the lateral reach from the isolation mount to the transmission housing wall. The side isolation mount loads were calculated in paragraph 3.2 for the evaluation of the bolt shear loads at the side pads.

The lateral reach to the transmission housing wall is X, the distance from the isolation mount to the face of the side pad, plus an additional 1.5 inches (38 mm) from the side pad face to the housing wall. For commercial truck transmissions, Allison Transmission limits the bending moment at the side pads based on experience.

CALCULATE THE BENDING MOMENT AT EACH TRANSMISSION SIDE PAD

(Refer to equations 3.09 through 3.16)

Load Condition I

Right Pad:	Fwd:	$M_{1P} = R_1 \times (X + 1.5)/12 =$	lb-ft	(3.33)
		$M_{1P} = R_1 \times (X + 38)/1000 =$	N-m	
	Rev:	$M_{2P} = R_2 \times (X + 1.5)/12 =$	lb-ft	(3.34)
		$M_{2P} = R_2 \times (X + 38)/1000 =$	N-m	
Left Pad:	Fwd:	$M_{3P} = R_3 \times (X + 1.5)/12 =$	lb-ft	(3.35)
		$M_{3P} = R_3 \times (X + 38)/1000 =$	N-m	
	Rev:	$M_{4P} = R_4 \times (X + 1.5)/12 =$	lb-ft	(3.36)
		$M_{4P} = R_4 \times (X + 38)/1000 =$	N-m	

Load Condition II

Right Pad:	Fwd:	$M_{5P} = R_5 \times (X + 1.5)/12 =$	lb-ft	(3.37)
		$M_{5P} = R_5 \times (X + 38)/1000 =$	N-m	
	Rev:	$M_{6P} = R_6 \times (X + 1.5)/12 =$	lb-ft	(3.38)
		$M_{6P} = R_6 \times (X + 38)/1000 =$	N-m	
Left Pad:	Fwd:	$M_{7P} = R_7 \times (X + 1.5)/12 =$	lb-ft	(3.39)
		$M_{7P} = R_7 \times (X + 38)/1000 =$	N-m	
	Rev:	$M_{8P} = R_8 \times (X + 1.5)/12 =$	lb-ft	(3.40)
		$M_{8P} = R_8 \times (X + 38)/1000 =$	N-m	

For all eight load cases, 3.33 through 3.40, the moments must fall within the range below:

$$-5190 \text{ lb-ft} < M_P < +6770 \text{ lb-ft}$$

$$-7040 \text{ Nm} < M_P < +9180 \text{ Nm}$$

3.4 DETERMINE FLYWHEEL HOUSING TO CONVERTER HOUSING BENDING MOMENT WHEN THE CONVERTER HOUSING SIDE PADS ARE USED

A rear support is generally not required when the converter housing side pads are used for the powerpack side mounts. It is advisable to calculate the bending moment at flywheel housing to transmission converter housing split line in order to insure that neither the transmission static bending moment limit nor the engine bending moment limit is exceeded.

This paragraph contains the following calculations:

- engine flywheel housing to converter housing split line bending moment
- rear support force required to reduce the split line moment to zero, if required.

The flywheel housing to converter housing split line bending moment calculations and limit are based upon system weight. Load calculations assume the following:
- the centers of gravity are located on the powerpack vertical center-plane
- the side mount hardware is mirrored on the vertical center-plane of the powerpack
- the front engine mount hardware is mirrored on the vertical center-plane of the powerpack

Determine the load (R_M) carried by the converter housing side pads:

$R_M = (2) \times (R_G)$ (Refer to Eq. 3.04 for R_G)   (3.41)

Determine bending moment at the engine housing without a transmission rear support.

$M = \{(W_T \times A) – [R_M \times (B + Z)]\} / 12 =$ lb-ft   (3.42)

$M = \{(9.80665 \times W_T \times A) – [R_M \times (B + Z)]\} / 1000$ N•m

The powerpack mounting must be modified if the calculated bending moment, M, exceeds one of the following:
- the transmission static bending moment limit. Refer to *4000 Product Family Transmission Data*.
- the engine manufacturer's flywheel housing bending moment limit

If the most restrictive bending moment limit is exceeded by 15% or less, the addition of a transmission rear support may be considered. Design the rear support such that its upward vertical static spring force, S, results in a zero bending moment at the flywheel housing to converter housing split line:

$S = [(W_E\ L_E) + (W_T\ L_p) - (W_T A\ L_p)/(B+Z)] / [L_p - (L\ L_p)/(B+Z)]$ lbs   (3.43)

$S = [9.80665\ (W_E\ L_e) + W_T\ L_p - (W_T A\ L_p)/(B+Z)] / [L_p - (L\ L_p)/(B+Z)]$ N

This equation is derived from the bending moment equations:
- Moment at the front engine mount

  $\Sigma M = 0 = W_E\ L_e + W_T\ (L_p+A) - R_m(L_p+B+Z) - S(L_p+L)$ (3.44)

- Moment at the engine flywheel housing to converter housing split line

  $\Sigma M = 0 = W_T A = R_m(B+Z) + SL$ or $R_m = (W_T A - SL) / (B+Z)$ (3.45)

  positive (+) S value indicates upward support needed
  negative (–) S value indicates downward support needed

For additional requirements and recommendations for rear support designs and installations, refer to *Transmission Mounting Design – Transmission Overhung*.

If the transmission static bending moment limit is exceeded by more than 15%, an alternative mounting arrangement must be used. The following options may be considered:
- Use a cradle mount between the engine flywheel mounting pads and the transmission converter side pads. Refer to 4.0, Three-Point Mount Using a Cradle Subframe.
- Use a cradle mount between the flywheel housing mounting pads and the side pads at the rear of the seven-speed transmission. Refer to 4.0, Three-Point Mount Using a Cradle Subframe.

If the transmission limit is not exceeded, but the engine limit is exceeded by more than 15%, consult the engine manufacturer. The engine manufacturer may have concerns about the dynamic loading at the flywheel housing. The rear support discussed here only shifts the dynamic load range; it does not reduce the dynamic load range at the flywheel housing.

4.0 THREE-POINT MOUNT USING A CRADLE SUBFRAME

In this mounting arrangement, the powerpack is mounted at three points. One point is attached to the front of the engine, centered on the powerpack center-plane. The other two mounting locations are attached to cradle subframes at each side of the powerpack. Each subframe is attached to both the engine and the transmission. The typical attachment locations are the engine flywheel housing side mounting pads and the transmission converter housing side mounting pads. For 7-speed model transmissions, the side mounting pads at the rear of the transmission may be used. The isolation brackets and subframe hardware are assumed to be mirrored on the vertical center-plane of the transmission. Figure 3 illustrates a typical cradle mount.

The calculations develop the location of the cradle mount isolation point (L_X) that establishes a zero bending moment at the flywheel housing to converter housing split line.

The vehicle manufacturer is responsible for evaluating the following system loads:

- load at the cradle to engine side pad interface
- load at the cradle to transmission side pad interface

Evaluate the actual loads based upon the cradle and powerpack stiffnesses. Poor stiffness matching between the cradle and the powerpack can create very large forces at the cradle to flywheel housing and cradle to transmission housing interfaces. Such forces could be much greater than the estimated external and inertial loads on the powerpack. High loads at the cradle to housing interfaces may result in the following:

- slipping at the bolted joints
- breaking of the mounting pads on the flywheel housing
- breaking of the mounting pads on the transmission housing

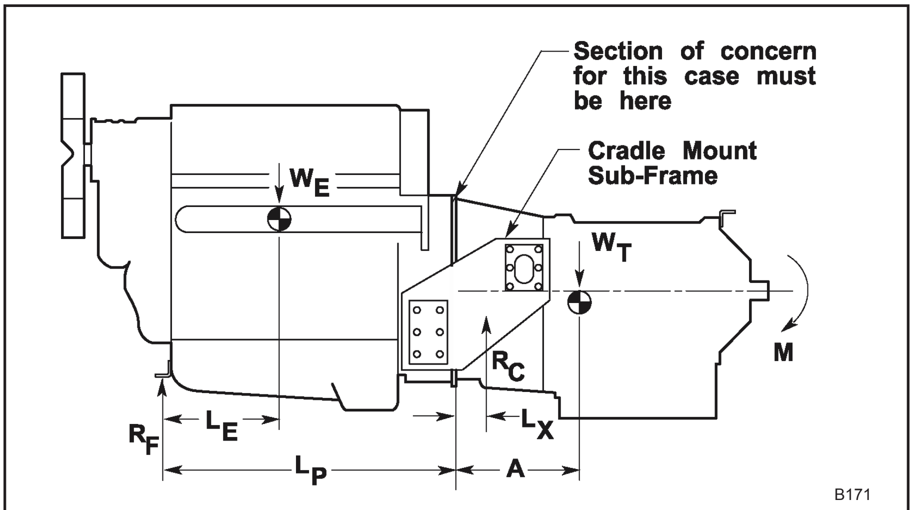

Figure 3: Typical cradle mount for engine and transmission

Equations 4.01 through 4.03 outline a procedure for determining the location of the main frame support (R_C).

DATA REQUIRED TO MAKE CALCULATIONS

• TRANSMISSION DATA

W_T = Total weight of transmission and all transmission-mounted hardware __________(lbs. or kg)
(Refer to 3.1, Data Required to Make Calculations and to *4000 Product Family Transmission Data* for weight of transmission & Allison hardware)

A = Distance from flywheel housing rear face to transmission C.G.________________(in. or mm)
(*4000 Product Family Transmission Data*)

• **ENGINE DATA** (Obtain from Engine Manufacturer)

W_E = Total weight of engine and all engine-mounted hardware ________________________(lbs. or kg)

(Refer to 3.1, Data Required to Make Calculations)

L_E = Distance from front engine isolation mount to engine C.G. ___________________(in. or mm)

L_P = Distance from front engine isolation mount to flywheel housing rear face ______(in. or mm)

DETERMINE LOCATION (L_X) of RESULANT (R_c):

$$L_X = (W_T A) / [(W_E L_E / L_p) + W_T] \quad \text{(in. or mm)} \qquad (4.01)$$

This equation is derived from the bending moment equations:

• Moment at the front engine mount:

$$\Sigma M = 0 = W_E L_E + W_T (L_P + A) - R_C (L_P + L_X) \qquad (4.02)$$

• Zero moment at the flywheel housing to converter housing split line:

$$\Sigma M = 0 = (W_T A) - (R_C L_X) \qquad (4.03)$$

LIST OF REFERENCED DOCUMENTS

- *4000 Product Family Transmission Data*
- *iSCAAN*, Allison's vehicle performance calculation program
- *Transmission Mounting – General Requirements*
- *Transmission Mounting Design – Transmission Overhung*
- *Transmission Mounting Design – Using the Transmission Side Pads*

4000 Product Family Installation Drawings

- *AS67-416, Basic 6-Speed*
- *AS67-417, Basic 7-Speed, Deep Sump*
- *AS67-418, Retarder Option*
- *AS67-430, Rear Mount Provision*

REVISION HISTORY

REVISION E – NOVEMBER 8, 2016

- Updated the document to reflect the new consolidated 4000 Installation Drawings; AS67-416, AS67-417, & AS67-418

REVISION D – MAY 19, 2008

- Updated references to new mounting documents
- Moved references for transmission data from Referenced Documents to 3.1, Data Required to Make Calculations
- Added 2.0, Referenced Documents, and List of Referenced Documents; changed Transmission *Specifications* to *Transmission Data*.

REVISION C – JUNE 13, 2006

- Corrected equations 2.13 through 2.16, Total Reaction Load on Transmission Side Pad for Condition II, Vehicle in Motion.

REVISION B – MAY 8, 2006

- Corrected metric units for tire rolling radius (R_R) from mm to m.

REVISION A – APRIL 5, 2005

- Major revision of document
- Moved bending moment calculation for overhung transmission to Installation Manual, Section B.
- Expanded descriptions of mounting systems
- Added assumptions and limitations for calculations
- Corrected calculations as required
- Added Z reach dimension for location of isolation mount with respect to converter side pads.

NEW TD – OCTOBER 19, 2004

- Created new Technical Document 179, Mounting Calculations for the 4000 Product Family. TD179 replaces EM44.
- New TD includes new note that side pad calculations assume that isolators are laterally in line with the transmission side pads.
- In new TD, required mounting pad coefficient (μ) changed from 0.10 to 0.18.