Motor Mount Design Examples

Galloway, K. C., G. Clark Haynes, Deniz Ilhan, & Koditschek, D. (2010, November 4). *X-RHex: A Highly Mobile Hexapedal Robot for Sensorimotor Tasks*. ResearchGate; unknown. https://www.researchgate.net/publication/49128188_X-RHex_A_Highly_Mobile_Hexapedal_Robot_for_Sensorimotor_Tasks/figures?lo=1

Information extracted (referred pages; pg. 7-10):
(1) Spring loaded quick-release latches.
(2) Gearing offsets (opt.).
(3) Motor shaft extension.
(4) Overall motor mount design that consists of the assembly of a back plate & front plate.

Conceptual design of automobile engine rubber mounting composite using TRIZ-Morphological chart-analytic network process technique. (2018). *Defence Technology*, *14*(4), 268–277. https://doi.org/10.1016/j.dt.2018.05.009

Information extracted (referred pages; pg. 266-270, pg. 273-275):
(1) Need for the usage (purpose) of rubber mounting – vibration dampening.
(2) Considerations when selecting material.
(3) Considerations when selecting mounting; This includes whether: (a) if a mounting is necessary,
(b) if ***YES***, what are the relevant design/selection criteria (i.e., performance, weight, cost & etc)
(4) Criteria for weighing conceptual design (opt.)

Design and Construction of Motor Mounts. (2008). https://roblab.org/theses/2008-REV-Motor-Tan.pdf

Information extracted (referred pages; pg. 5-7, pg. 17-20. pg. 21-36):
(1) Further discussion on rubber mounting. *This report discusses the general integration of rubber mounts for an engines & motors* – To Dampen any resultant (BLDC) motor vibration and isolate these vibrations from the chassis.
(2) Assembly of ***rear support mounts, front support mounts & coupling.***
(2.1) Depending on the motor, select a suitable mount design (i.e., middle-style, plate mounts)
(2.2) Motor front mounting plate/adapter design process + CNC machined, for precision using Al_{13}.
(2.3) Coupling – ***TAPER LOCK HUBS (favoured)*** due to *coupling security* + *ease of maintenance*.
Look here for in-market options: https://www.ptparts.com.au/products/category/JADNKLMX-special-hubs/N100-TL-J-HUB--taper-lock-hubs
(3) Design options + ideation + finalisation of design (pg.)

Khan, A., Razlee, A., Zainal Nazri, Razak, A., & Ahmad, M. N. (2022). Topology Optimization of an Engine Mounting Bracket Using Finite Elements. *Advanced Structured Materials*, 243–254. https://doi.org/10.1007/978-3-030-93250-3_21

Information extracted (referred *"Introduction"*; pg. 1)

(1) FEA vs EMA
(2) Topology Optimization
(3) *"x"* Mount to be able to withstand, *"x"* load, *"x"* vibration/frequency.

Whitney, C. (2005, October 25). Sliding Motor Mount. FineWoodworking; Fine Woodworking. https://www.finewoodworking.com/2005/10/25/sliding-motor-mount

Supporting documentation for developing a ***Sliding Motor Mount***.

(Custom) Motor Mount Design Flow

1. Ideation of mounting system

2. Ideation of subsystem(s) + subsystem breakdown

2.1 Force distribution considerations (system suited to handle lateral and vertical loads)

2.1.1 Calculations/justifications for 2.1 – TBD

2.2 Decision to use tilted + angled ***Mount_Legs*** to distribute load(s) over a wider area.

2.2.1 Angle of 70 degrees, between ***Motor_Base_Plate*** & ***Mount_Legs*** (for optimal load distribution)

2.2.2 Calculations/justifications for 2.2.1 – TBD

2.2.3 FIND; Angle of '*x*' for tilt – TBD

2.3 ALL req. dimensions for ***Motor_Base_Plate*** & ***Mount_Legs*** – TBD

2.3.1 ***Motor_Base_Plate*** "material selection" (6061, Al) – TDB; shy 2

2.3.1.1 ***Motor_Base_Plate*** spec. re-evaluation

2.3.2 ***Mount_Legs*** "material selection"

2.3.2.1 ***Mount_Legs*** spec. re-evaluation

2.4 Decision to design the ***Motor_Base_Plate*** separately + mount to ***Mount _Legs*** (for ease of handling)

2.4.1 Mounting ***Motor_Base_Plate*** to ***Mount _Legs***

Using: ***External_Slotted_Flange*** + *Bolts + *Lock nuts + *Washers (*Nord-Lock*)

2.4.2 ***External_Slotted_Flange*** to be supported with ***Gusset_Plate(s)***

2.4.3 ***External_Slotted_Flange*** with "vertical/horizontal slot" + "slot dimensions" – TBD

2.4.5 ***External_Slotted_Flange*** dimensions – TDB

2.4.4 ***External_Slotted_Flange*** "material selection" (100% infill, PLA) – TDB; shy 2

2.4.4.1 ***External_Slotted_Flange*** spec. re-evaluation

2.4.5 ***Gusset_Plate(s)*** dimensions – TDB

2.4.6 ***Gusset_Plate(s)*** "material selection" (100% infill, PLA) – TDB; shy 2

2.4.6.1 ***Gusset_Plate(s)*** spec. re-evaluation

2.4.7 *Bolts selection (for fastening ***Motor_Base_Plate*** to ***External_Slotted_Flange***) – TBD

2.4.8 *Bolts; quantity + dimensions – TBD

2.4.9 *Lock nuts; quantity + dimensions – TBD

2.4.10 *Washers; quantity + dimensions – TBD

2.4.11 Calculations/justifications for 2.4.7 + 2.4.8 + 2.4.9 + 2.4.10 – TBD

Component List (Not complete):

Motor_Base_Plate, Mount_Legs, Motor_Base_Plate, External_Slotted_Flange, Gusset_Plate(s), *Bolts;

MotorToBase_Plate_Bolt, Base_PlateToMount_Leg_Bolt, Mount_LegToFloor_Bolt *Lock nuts, *Washers

Motor_Shaft & ***Steering_Shaft*** – Assembly

<u>**Stamp 1:** Steps 1. – 5. Finding *Belt Length* (Distance between ***Motor_Shaft*** & ***Steering_Shaft***)</u>

1. Find Rated Motor torque

2. Find Req. Steering (Rack & Pinion) torque

3. Calculate "optimum pulley ratio"

4. Find Req. "***Motor_Shaft_Pulley*** pitch + diameter" using 3.

4.1 Find Req. "***Steering_Shaft_Pulley*** pitch + diameter" Using 3.

4.1.2 Hence; Req. "***Motor_Shaft_Pulley*** teeth quantity". Using 3.

4.1.3 Hence; Req. "***Steering_Shaft_Pulley*** teeth quanitity". Using 3.

5. Find the belt length. Therefore; "viable ***Motor – Steering_Shaft*** distance" using <u>belt length formula</u>

<u>**Stamp 2:** Finding *Optimum Belt Parameters & Dimensions*</u>

6. Find suitable belt specifications using information in 5.

6.1 Find "belt width" – TBD

6.2 Find quanitity of "belt teeth" – TBD

6.3 Finalise belt selection – TBD

<u>**Stamp 3:** Confirming ***Motor_Base_Plate* + *Mount_Legs*** *Assembly & Positioning*</u>

7. Decide ***Mount_Legs*** "mounting position" on vehicle floor. Using 5. – TBD

8. Find Req. "motor mounting position" on ***Motor_Base_Plate*** – TBD

9. Find Req. ***Motor_Base_Plate*** "mounting position"between the ***Mount_Legs***

10. Model motor mount + Perform FEA + CAD for Motor mount.

11. Confirm **ALL** "motor mounting positions"

Tensioner Specifications – *Brief*

<u>**Stamp 1:** Finding *Tensioner Specifications*, *Design & Requirements*</u>

1. Find Req. "tensioning position" (position along the belt that needs tensioning) along pulley belt

2. Tensioner specifications (temporary, Req. ***Tensioner_Pulley*** parameters). Consider info from 7.

2.1 (Justify) **IS** Tensioner mounted on "*car_floor/motor_mount*" – TBD

2.1.1 Confirms Req. ***Tensioner_Pulley*** placement along belt – TBD

2.2 Confirms Req.***Tensioner_Pulley*** parameters – TBD

2.2.1 ***Tensioner_Pulley*** dimensions + "material selection" – TBD

2.3 Tensioner "*adjustable/spring-loaded*" – TBD

<u>**Stamp 2:** ***Tensioner_Mount*** *Design – Brief overview*</u>

2.4 ***Tensioner_Pulley*** to ***Tensioner_ Mount*** force distribution – TBD

2.5 ***Tensioner_ Mount*** "mounting position" on (+ using) <u>outcome of 2.1 & 2.1.1</u>

Next stages – Brief overview:

Motor_Shaft req. dimensions.

Motor to ***Motor_Shaft*** *coupling

Calculations for forces acting on ***Motor_Shaft***

(opt.) ***Motor_Shaft*** dimension + spec. re-evaluation

Motor_Shaft_InFloor_Bearing spec

Shape: rectangular

Dimension (approx.): 120 × 120mm

Thickness (approx.):

Pulley Design

Distance between ***Motor_Shaft*** & ***Steering_Shaft:*** https://sudenga.com/resources/figuring-belt-lengths-and-distance-between-pulleys/

Pulley & Belt calculator https://www.blocklayer.com/pulley-belt

Pulley ratio & RPM calculator: https://calculator.academy/pulley-size-calculator/

Pulley Design: https://assets-global.website-files.com/6321faa31729834cada9ee26/6321faa317298319abaa1420_B107%20Pulley%20Design%20Guidelines%2C%20Material%20and%20Finishes.pdf

Ideation Process for Motor Mounting Mechanisms (Most preferred iteration – See below; circled in ***RED***)