



Image courtesy Terex

With a maximum payload capacity of 28 metric tons, the new Terex TA30 articulated dump truck is equipped with a Timoney independent suspension for increased comfort and safety.

# Taking the Shakes Out of Construction Trucks

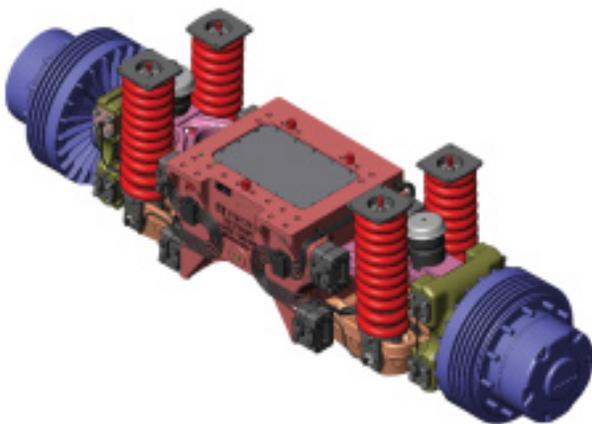
Timoney Technology designs independent suspensions that allow construction vehicles to travel faster on rough terrain without exceeding vibration regulations.

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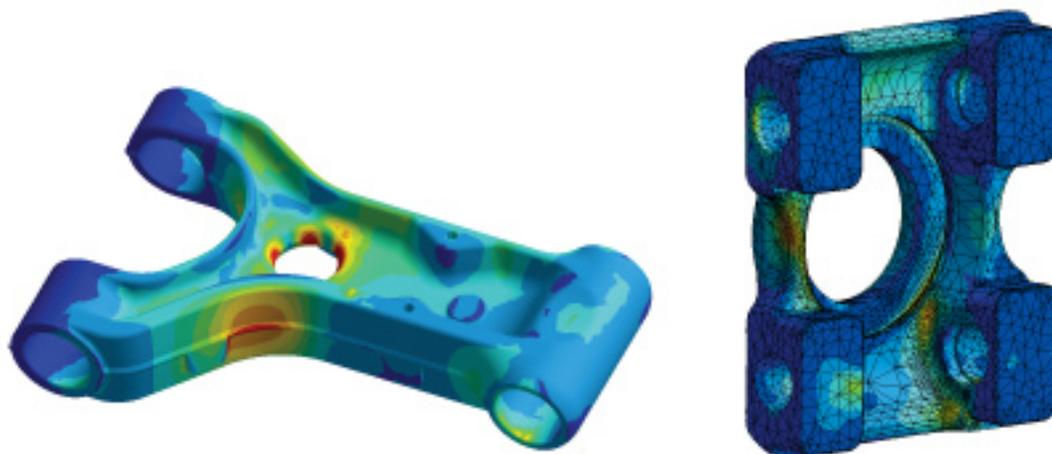
To maximize productivity on construction sites, operators want to drive off-road hauler trucks up to maximum possible speeds. But traveling over rugged terrain at higher speeds can result in excessive whole body vibration (WBV): lateral and vertical forces that jostle drivers as the vehicle bounces over rocks, holes, bumps, ruts and other surface irregularities.

WBV is uncomfortable and can cause serious health problems, such as spinal degeneration. Also, accident risks are greater with elevated vibration levels, since drivers lack full control of vehicles as they are bounced around. For these reasons, a correlation between operator comfort and vibration magnitudes is provided in ISO 2631, and the European Community Human Vibration Directive 2002/44/EC establishes single-action limits for driver acceleration, as well as an overall daily vibration limit for operators.

Timoney Technology addressed the issue of WBV with a patented double-wishbone independent suspension that decouples asymmetrical wheel loads, thus reducing lateral and vertical acceleration. As a result, the smoother-riding trucks can safely travel over rough terrain at speeds greater than those with conventional straight beam-axle suspension



CAD geometry of a Timoney suspension system designed for trucks that see high vibration



Stress contours are shown on the upper wishbone (left) and suspension knuckle (right), in which Timoney engineers used sphere-of-influence element sizing to increase mesh densities for studying areas of high stress in greater detail.

systems, thus increasing job-site hauling productivity and construction company profitability. Timoney has gained widespread recognition in the transportation industry designing and manufacturing such independent suspensions for off-highway vehicles — especially articulated dump trucks (ADTs), a relatively new class of hauler that is hinged with a universal joint between the cab and dump box for greater maneuverability on extremely uneven terrain.

Because of the structural complexities of ADTs compared to rigid-frame haulers, most of Timoney's independent suspensions are exhaustively custom-designed for each vehicle model. Engineers must tune suspensions by developing assemblies of parts to isolate severe loading on each wheel. Parts must be fatigue-resistant in withstanding these loads, yet cannot be over-designed with excess material because of cost and size considerations. Packaging is a particular focus because the suspension must fit within the overall vehicle width of 2.9 meters and between wider tires used to increase vehicle mobility. Moreover, designs must be completed efficiently, in order to meet tight OEM request-for-quotes and product delivery schedules.

Timoney engineers analyze stresses on all major parts of suspensions using ANSYS Mechanical software. Typically in an iterative process in which CAD geometry from SolidWorks® is imported into ANSYS Mechanical software, FEA meshes are generated, analyses performed and appropriate changes made to the CAD geometry to reinforce areas with high stress concentrations while removing material from regions with relatively low stress. The cycle is repeated until an optimal design is found — one that meets required performance specifications without excess material.

Automated modeling and analysis features of ANSYS Mechanical software, as well as tight integration with CAD, allow simulation iterations to be performed quickly in optimizing designs for performance and reliability together with size and weight savings. Native geometry for SolidWorks parts and assemblies was imported directly into the ANSYS Mechanical product. Analysis of major subsystems, such as the gearbox, was performed using features for modeling assemblies of parts that allow for representation of the relationships between the individual mating components.

Bonded contact element features were used to automatically detect

joined surfaces instead of requiring the regions to be defined manually. Sphere-of-influence element sizing was used to increase mesh densities in localized regions for studying stress in greater detail. Sequences of solutions were performed automatically using a single FEA model for various load cases encountered on the suspension as the vehicle turns, brakes and traverses various types of terrain.

In one recent project, ANSYS Mechanical technology was instrumental in reducing the overall weight of a Timoney product from 4.3 to 2.6 metric tons — nearly a 40 percent weight saving that reduced manufacturing costs and increased the payload capacity of the hauler truck. This effective simulation process is essential in meeting OEM design requirements and deadlines for a wide range of vehicles.

Timoney has used software from ANSYS, Inc. for years as an essential tool, enabling engineering teams to develop suspension systems for some of the most complex off-road vehicles in the world — most especially ADTs now found on just about all major construction jobsites. An efficient iterative process between design and simulation is key to making rigorous trade-off decisions quickly in the development of custom-designed suspensions. ■