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The Use of Elastomeric Damping Layers in Safety Platforms of Mine Shafts

Cezary Dębek
Institute for Engineering of Polymer Materials and Dies
Marii Skłodowskiej-Curie 55 St., 87-100 Toruń, Poland
c.debek@ipgum.pl

Andrzej Wasilewicz
Sadex Sp. z o.o.
Sygnały 64 St, 44-251 Rybnik, Poland
andrzej.awan@interia.pl

Extended Abstract

Many years of coal mining resulted in the depletion of currently exploited deposits of raw materials. Therefore, the mines are forced to reach for ever lower surging coal seams. Consequently it becomes necessary to deepen existing shafts. To protect teams operating in the shaft, artificial bottom (safety platforms) are used.

Old solutions based on rigid steel construction with the top, several meters height, damping layer such as slag, can absorb the energy of drop an object with a mass of 5 Mg to a depth of 700 m. Currently, the requirements of mines assume collapse of weight 20 Mg at a depth of 1000 m! Compact safety platforms (about 3 m in height), consisting of carrier rings and networks of wire ropes (rope platforms) used in Poland by Sadex Ltd are able to take the energy of drop for the mass of 5 Mg and depth of 900 m. These platforms, together with the use of elastomeric layers, according to the FEM, are able to absorb the energy of drop according the new requirements.

Performed Finite Element Analysis (FEA) of multiple network security platform made according to the technology developed by Sadex Sp. z o.o. using the composite elastomer damping layers placed in the free spaces between networks designed under this work.

Developed a composite material based on rubber granules (cost optimization) with improved flame retardancy. Specified material models and their parameters were determined for the rapid deformation. Performed characteristics: steel rope with a diameter of 40 mm based on the curves of strength and literature data, steel plates, elements of support rings, bracing tees (steel S355J2, MAT15 JOHNSON_COOK), pins, screws (MAT100_SPOTWELD) and composite elastomer material (MAT_SIMPLIFIED_RUBBER, MAT 181). For selected models conditions of destruction were added. It was assumed appropriate boundary conditions, constraints, and contacts. FEM calculations were performed at MESco Tarnowskie Góry by dr. ing. Tomasz Czyż using LS-DYNA software.

The drawings 1-4 shows the visualization of calculations made for the safety rope platforms with and without damping elastomer layers depicting the impact of mining equipment weighing 20 Mg falling at a rate of 100 m/s

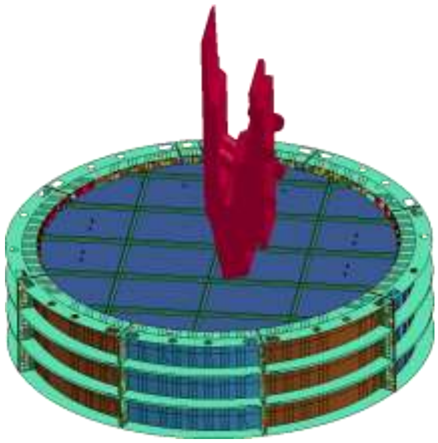

Fig. 1. Visualization of safety cable platforms at the moment of impact the housing section (20Mg, 100m/s).

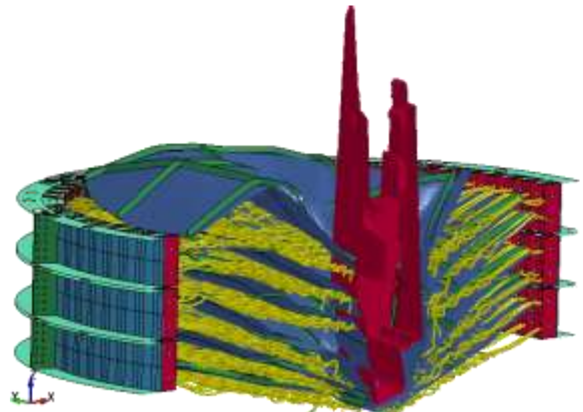

Fig. 2. Visualization of safety cable platforms at the time of 120 ms after the impact the housing section (20Mg, 100m/s).

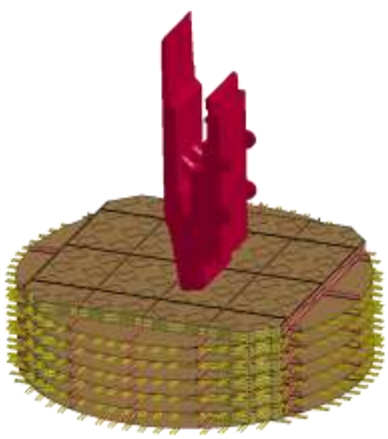

Fig. 3. Visualization of safety cable platforms with elastomeric damping layers at the moment of impact the housing section (20Mg, 100m/s).

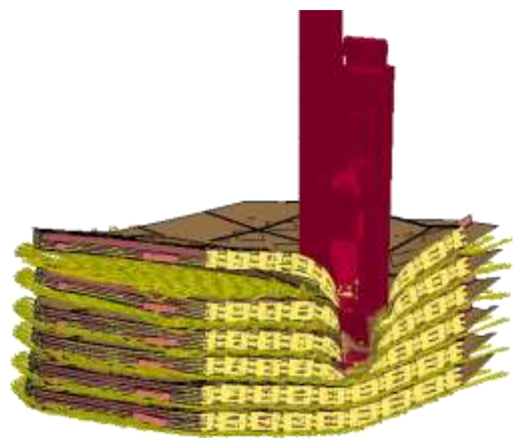

Fig. 4. Visualization of safety cable platforms with elastomeric damping layers at the time of 120 ms after the impact the housing section (20Mg, 100m/s).

FEM simulations confirm the possibility of the absorbtion of the energy resulting from a drop of 20 Mg at a depth of 1000 m (speed of about 100 m/s). The use of elastomeric damping layers clearly increases the energy consumption of the security platform without changes in dimension of the whole structure.

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