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## Prototyping and testing of the transportation strategy for a high-energy physics detector

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The “Anode Plane Assemblies”(APAs) for the high energy physics project “Deep Underground Neutrino Experiment”(DUNE), must be transported more than 6000 km by road and sea. A series of activities were carried out for the assessment and validation of the DUNE APAs and their transportation structures. The APA shipping frame (ASF) assembly supports and protects the APAs for the entire trip while facilitating their handling. The ASF is installed on wire rope absorbers (damping devices) at the base, which help to limit the transfer of dynamic inputs to the detectors. Keeping in mind the APAs’ cost, fragility and importance to the DUNE project, a prototyping and testing campaign was estimated necessary to check and validate the transportation strategy and the finite element (FE) models. Preliminary FE analyses were used to assess the dynamic behaviour of the structure-absorber system, select adequate absorbers, and establish optimal positioning of the measuring equipment. The first tests highlighted a stiffer than expected response of the absorbers. The cause was identified to be the dependency of the absorber’s response with the energy input. Once this behaviour identified and accounted for, very good agreement was obtained between the numerical and measured data. Finally, the information obtained from the shipment to the US has confirmed the system behaviour for a longer and less controlled trip. Thus, using a more detailed FE model the results of the dynamic analyses were validated and the transportation system was demonstrated compliant with the USA and EU regulations.

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