SHOCKTESTS OF MECHANICAL FASTENERS FOR SHOCK RESISTANT APPLICATIONS IN PROTECTIVE STRUCTURES

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All kind of equipment in Switzerland, installed in civil defense structures and military fortifications have to resist the severe ground loading to nuclear explosions. To guarantee the desired shock reliability, not
only the equipment itself but also its attachments in the shelter have to withstand the ground shock loading.

Since many equipments are fixed to the concrete walls of the shelter by means of mechanical fasteners, special investigations have been started at our laboratory to get more insight in the dynamic behavior of such fixing elements, with special emphasis on the behavior in cracked concrete and under ground shock loading. An appropriate shock testing machine, in principle a fall machine, is used for this purpose.
The normal force in the fastener screws and the slipping of the fastener itself are measured during each test.
During the last five years, several types of mechanical fasteners, expansion and adhesion systems, set in cracked concrete have been tested.

The test results confirm that metallic mechanical fasteners with automatic expansion by the controlled application of force (with follow-up expansion principle), set in cracked concrete (crack width up to 2.5 mm) can withstand a ground shock loading equivalent to its save working load, without slipping more than 5 mm.

In Switzerland, only mechanical fasteners which have resisted the ground shock test in cracked concrete are allow to be used as fasteners of shock resistant equipment in protective structures.