Summarized Report on the Research Work

"Protective Device for Columns against Fork Lift Impact"
Institut für Bautechnik, Berlin, IV/1-5-316/82

Fork lifts hitting columns within a building can generate very high impact loads on columns, so that the latter may fail. This is mainly due to the fork lifts' counterbalance masses which usually consist of solid steel, so that they hardly deform at the state of collapse.

Therefore in the above mentioned research work a special protective device was investigated, which consists of a sheet metall cylinder around the lower end of the column and filled with sand. As already in a preceding basic research work impact tests and computational investigations on unprotected steel-, timber- and reinforced concrete columns were done, in the case at hand the experimental studies could be limited to steel columns, where a computational verification of the test results is much easier to achieve.

After experimental and theoretical clarification of the scaling problem with regard to the impact loading installation the protective device itself was tested at scale of 1:1.
The impact was applied by a special vertically orientated "shooting equipment", in which a heavy mass was accelerated by air pressure.

The column to be impacted was horizontally arranged to make also use of the gravitational force. The mass to simulate the load at top of the column was horizontally prestressed against the column abutment by a force $F = m \cdot g$.

As the mass of the shooting equipment was limited to 1 t, while a fork lift can be of 5 t or more, the mass was accelerated to a velocity corresponding to the kinetic energy of a realistic fork lift. Scale investigations had shown, that this should give correct results for the purpose of interest.

Extensive numerical verification allowed to reconstruct the recorded column reactions satisfactorily and to explain the mechanical interrelations consistently.

Finally it may be stated, that the tested protective device is satisfactory to hinder column failure. A special design of the column against impact is not necessary, if this device is arranged.