
A vaulted multi-storey concrete floor system without external ties, a structural analysis

Frank Omloo*

*Catena Beton BV
aan de Fremme 62B, 6269BE Margraten, NL
frank.omloo@catenabeton.nl

Abstract

Vaulted structures are characterised by their high structural efficiency. On the downside, however, they produce a horizontal thrust, which either calls for tension ties or otherwise calls for buttresses. For a basement construction this doesn't pose much of a problem, but for a multi-storey building either solution could be undesirable. This paper examines if there is a third solution to the horizontal thrust problem and apply it to a multi-storey office building. The design is composed of bending stiff columns in combination with a thin concrete slab on top of the vault, which functions as a passable office floor and also contains the tie rods which support the columns (Figure 1). Tension ties underneath the vault can be avoided that way, which is more aesthetic and practical. We will investigate this conceptual design through the elaboration of a square groin vault with a ground plan of 7m. Of special interest is the junction of column, vault and concrete slab, which sits on top of the vault. A preliminary calculation of this design shows that a vault, supported on four bending stiff columns, is a stable and a safe structural building assembly.



Figure 1: Design of a vaulted floor system without ties underneath the vault.