Lecture 2

Steel Hall Buildings – Part 1: Metal skeleton of frame industrial buildings

Acknowledgement

I express my gratitude to doctor Dawid Mądry for creating this work and for professor Antoni Biegus for making available to me the materials incorporated in his book "Stalowe budynki halowe" (Steel industrial buildings), which were mainly used at drawing this work up

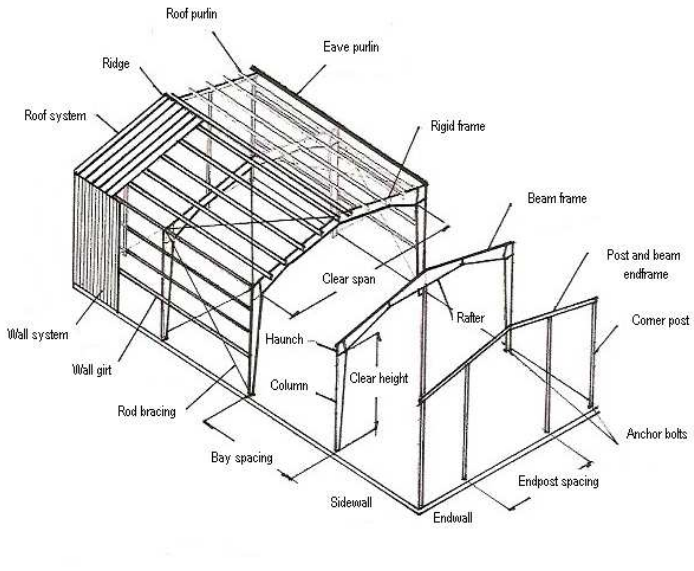


Fig.1.1 Typical components of a metal building system

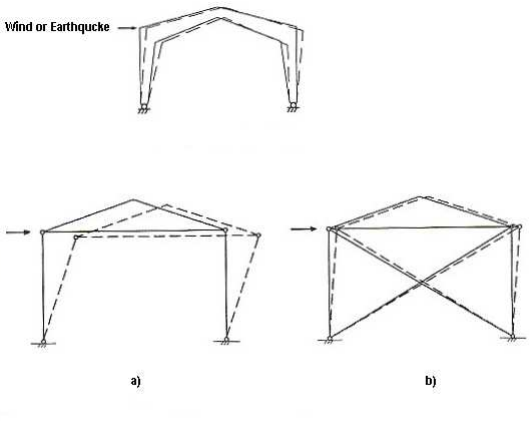


Fig.1.2 Post - and - beam frames: a) unbraced (unstable), b) braced (stable)

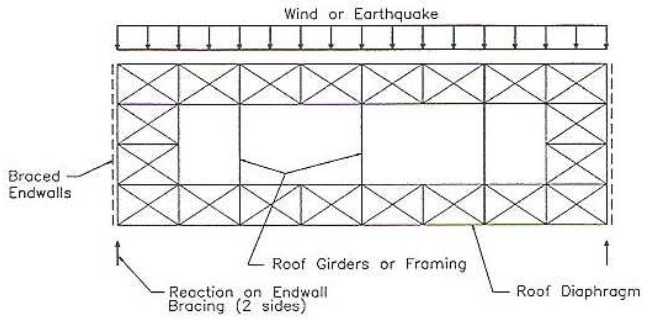


Fig.1.3 Roof diaphragm distributes lateral loads to braced endwall

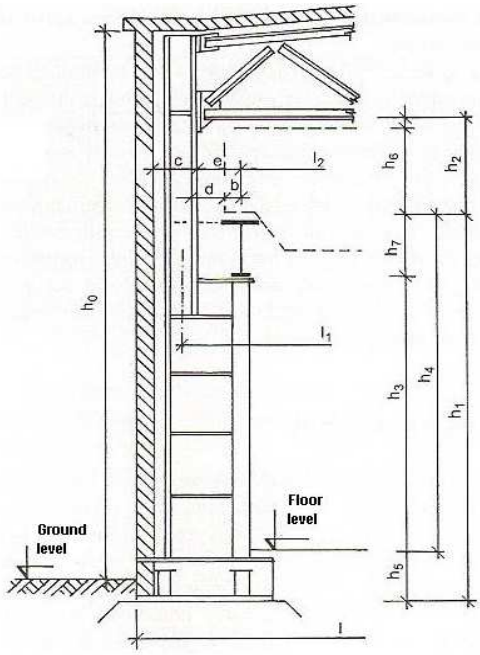


Fig.1.4 Basic dimensions of a industrial frame structure

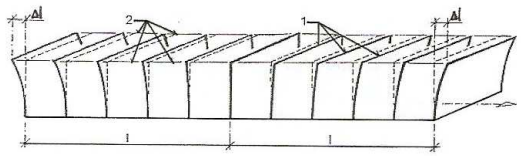


Fig.1.5 Scheme of a thermal deformation: 1- frame, 2- longitudinal members

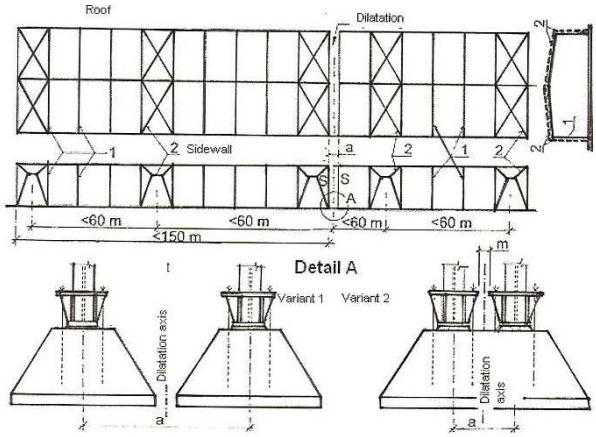


Fig.1.6 Location of dilatation: 1- frame, 2- roof and sidewall bracing

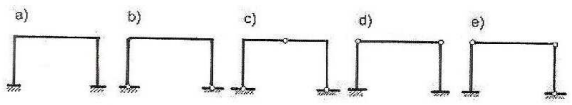


Fig.1.7 Static schemes of single-span primary frames

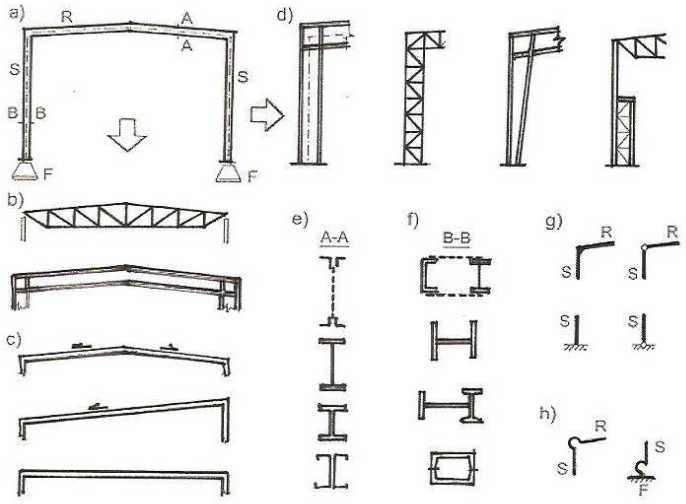


Fig.1.8 Construction of single-span frames

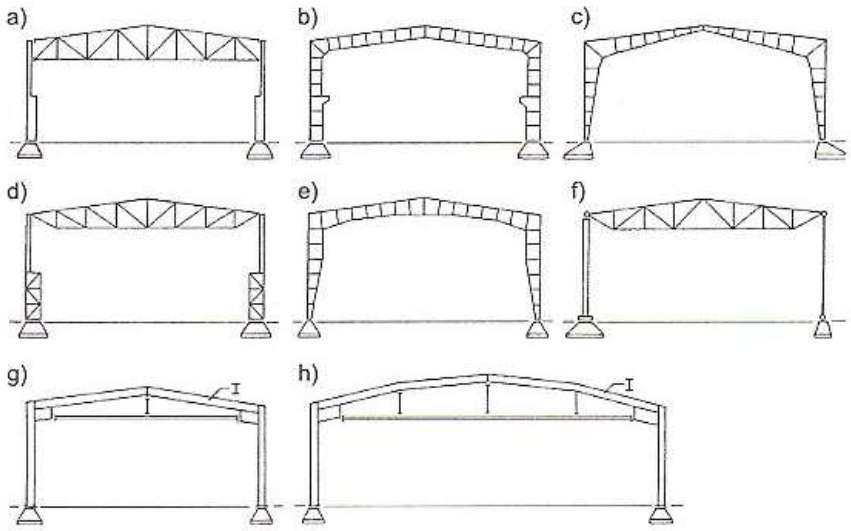


Fig.1.9 Construction of single-span frames

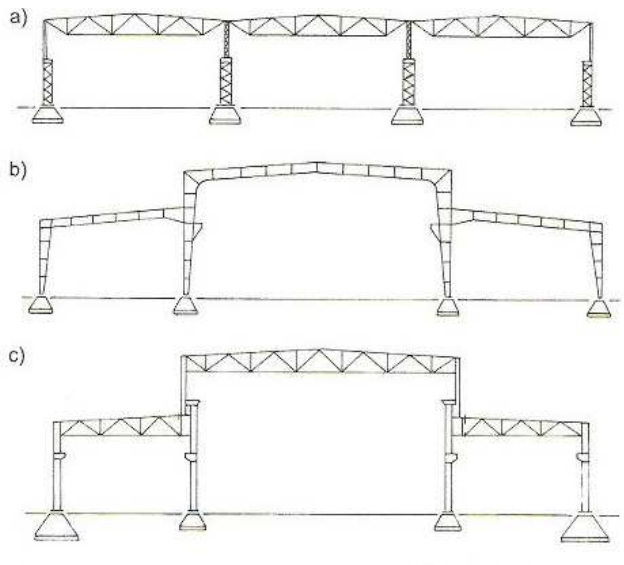


Fig.1.10 Examples of multi-span frames

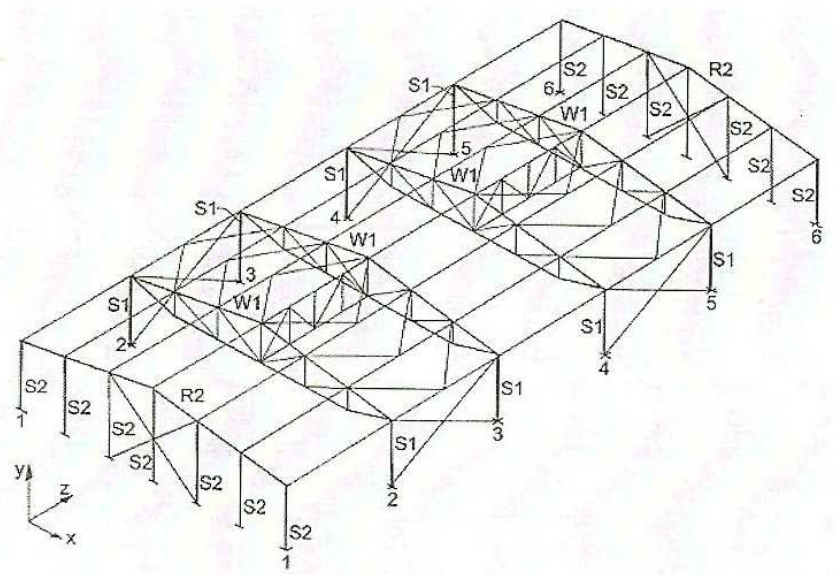


Fig.1.11 Scheme of industrial building with braced endwall: S1- primary column, W1- frame rafter, S2- endwall column, R2- endwall rafter

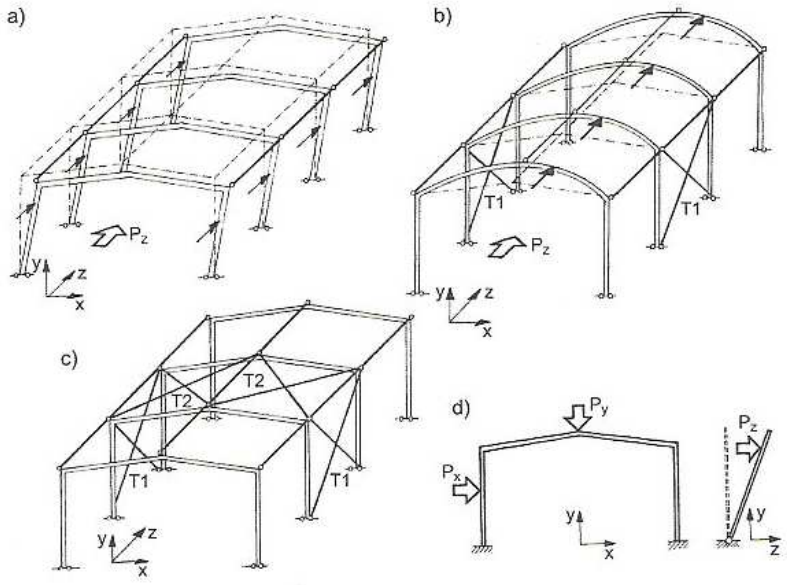


Fig.1.12 Possible deformations of the a), b) unbraced system, c) braced properly framing

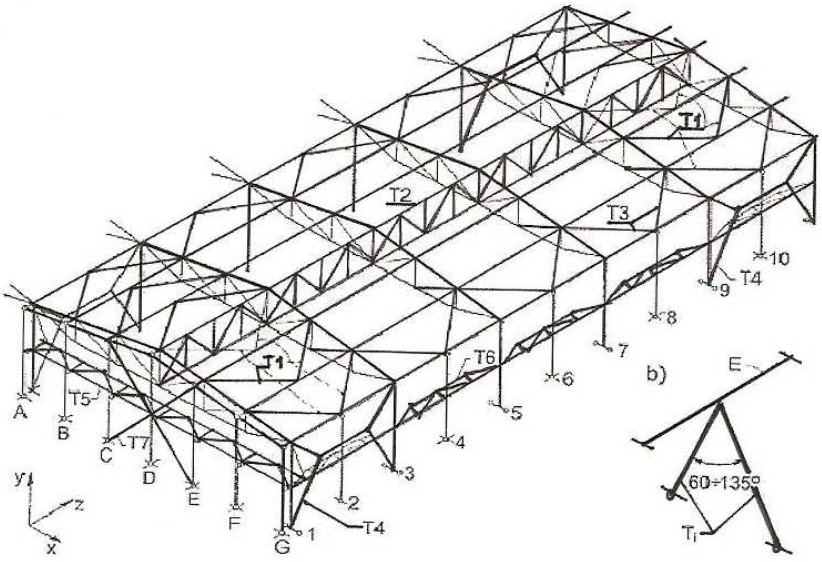


Fig.1.13 Location of different bracing systems: T1- transversal roof bracing, T2- vertical roof bracing, T3- longitudinal roof bracing, T4- sidewall bracing, T5- wind endwall bracing, T6- wind sidewall bracing, T7- endwall bracing

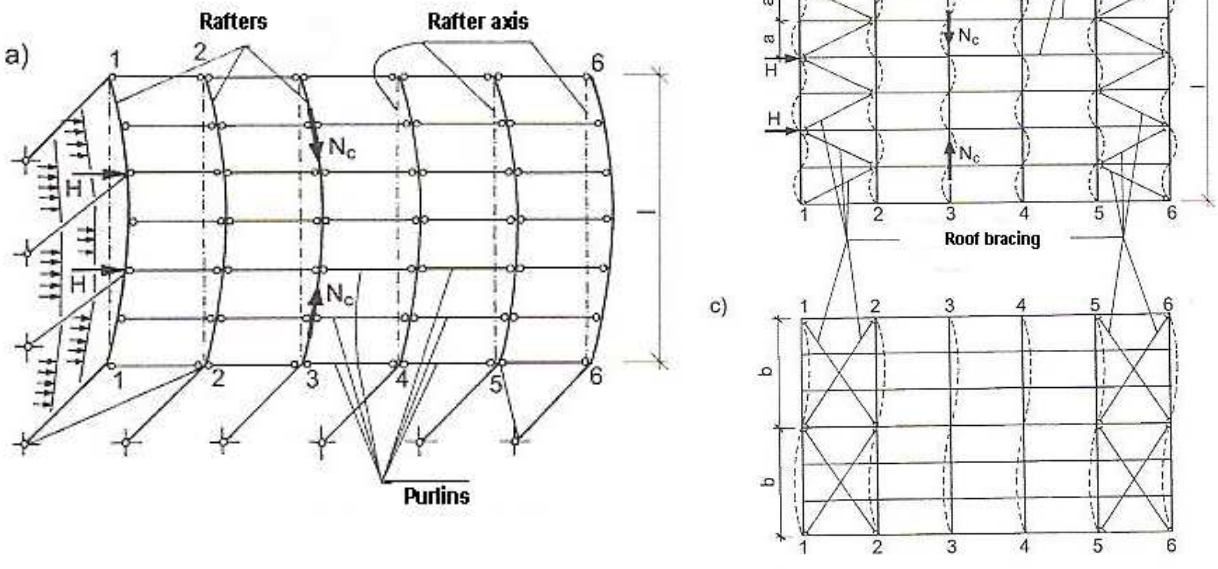


Fig.1.14 Possible deformations of roof members

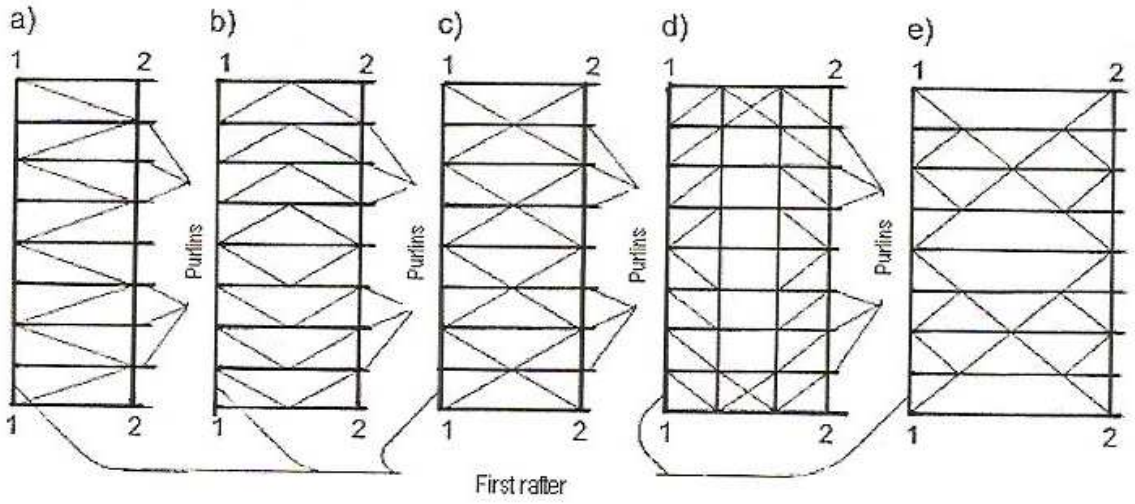


Fig.1.15 Examples of roof transversal bracings

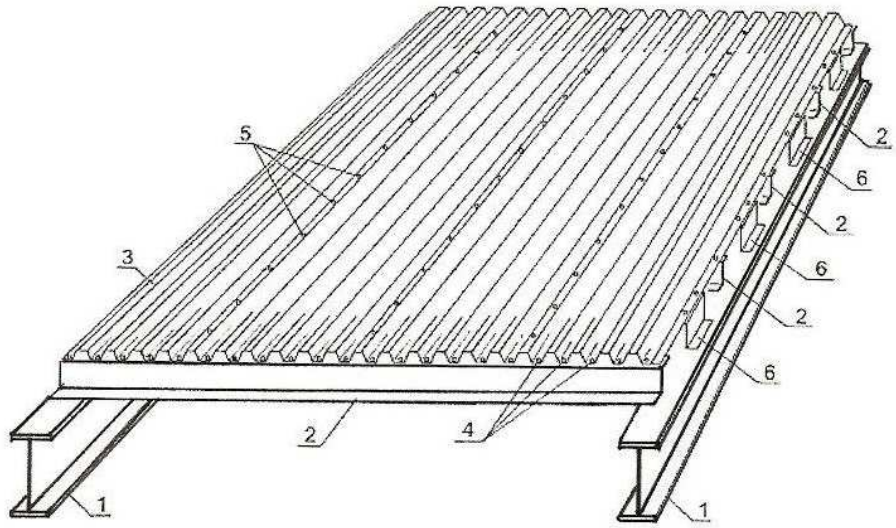


Fig.1.16 Construction of the roof braced by corrugated sheets: 1- roof rafter, 2- purlin, 3- corrugated sheet, 4,5- fasteners, 6- side bearings

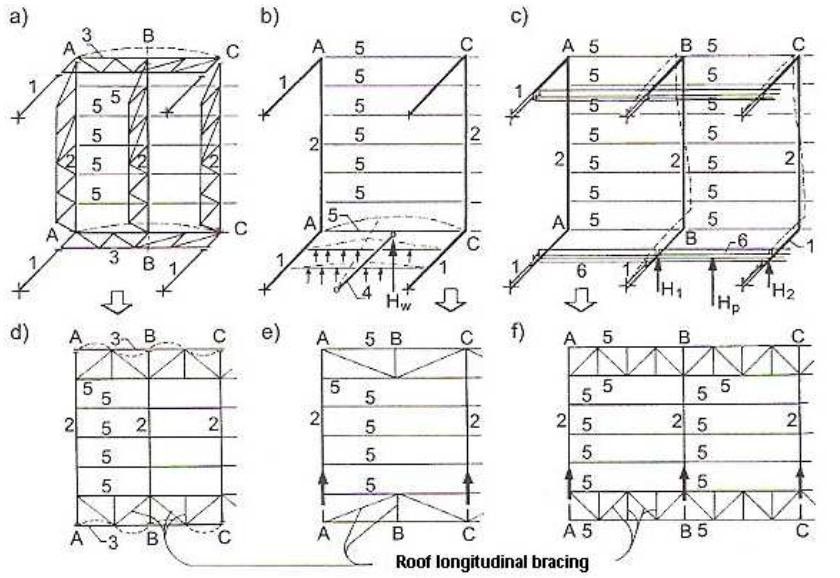


Fig.1.17 Possible deformations systems a),b),c): 1- primary column, 2- roof rafter, 3- main girder, 4- secondary column, 5- purlin, 6- crane runway beam, d),e),f): effect of longitudinal bracing

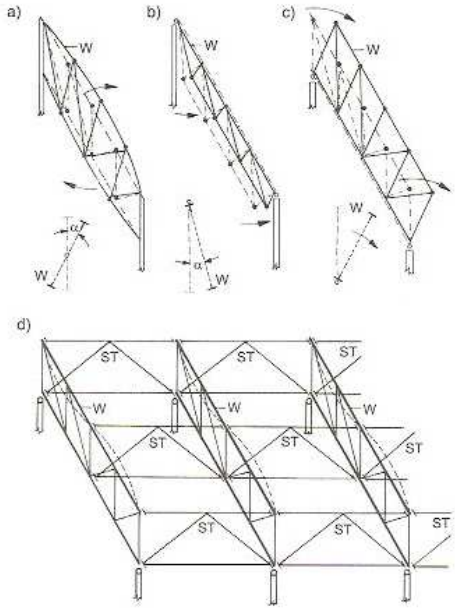
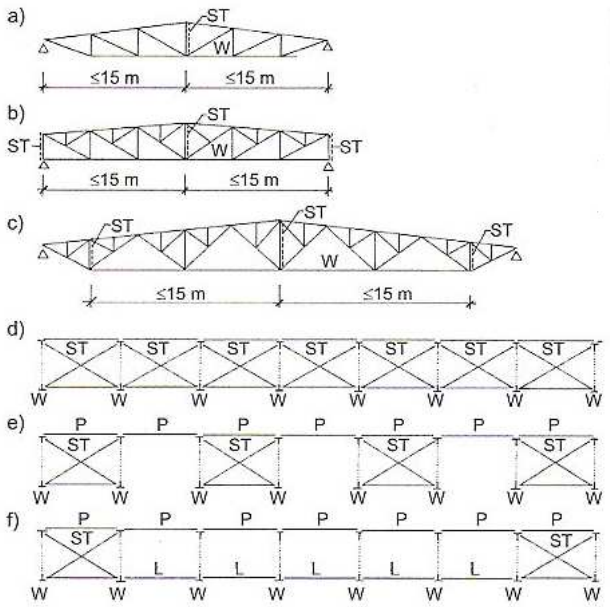


Fig. 1.19 Possible lateral deformations of truss rafter: W- rafter, ST- bracing, a),b) tilting, c) turn over



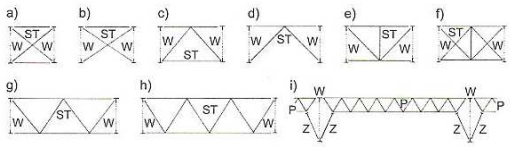


Fig.1.21 Examples of vertical bracings

Fig.1.20 Location of vertical bracings of truss rafters: W- rafter, P- purlin, ST- truss bracing, L- longitudinal bar

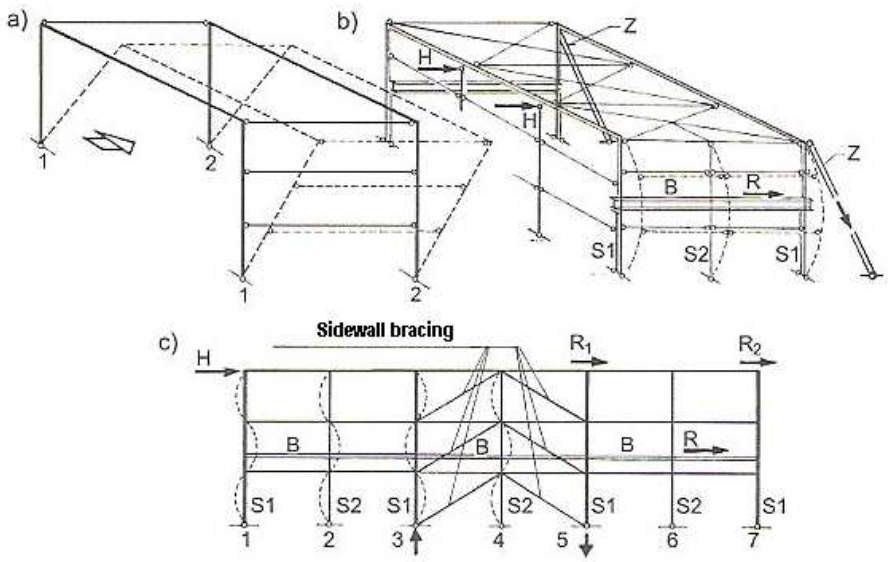


Fig.1.22 Possible sidewall deformations and the required effect of bracings: S1- main column, S2- secondary column, B- runway beam

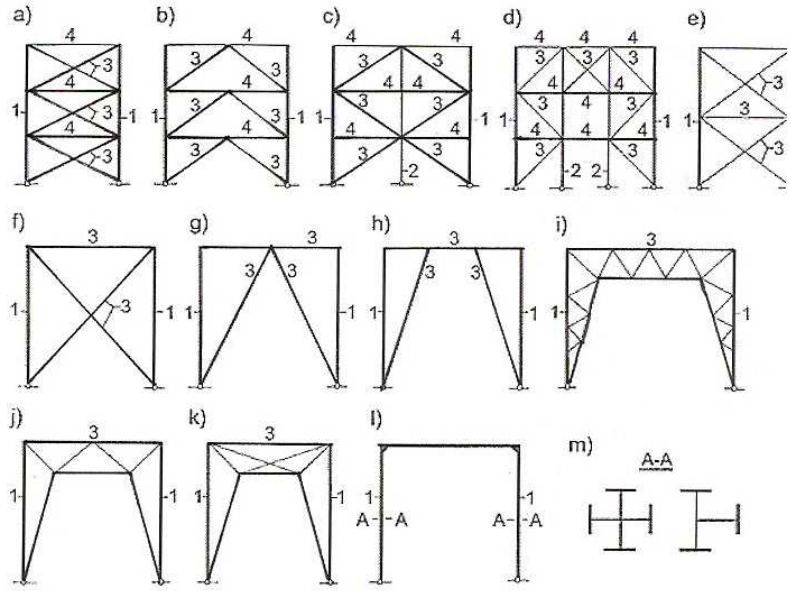


Fig.1.23 Schemes of sidewall columns bracings: 1- primary column, 2- secondary column, 3- bracing, 4- wall girt

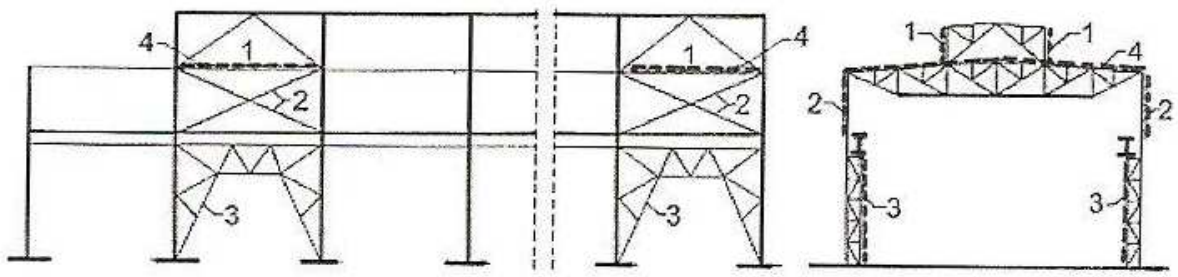


Fig.1.24 Location of sidewall bracings in industrial building with top-running crane: 1- skylight, 2- bracing over crane runway beam, 3- bracing under the crane runway beam, 4- roof bracing

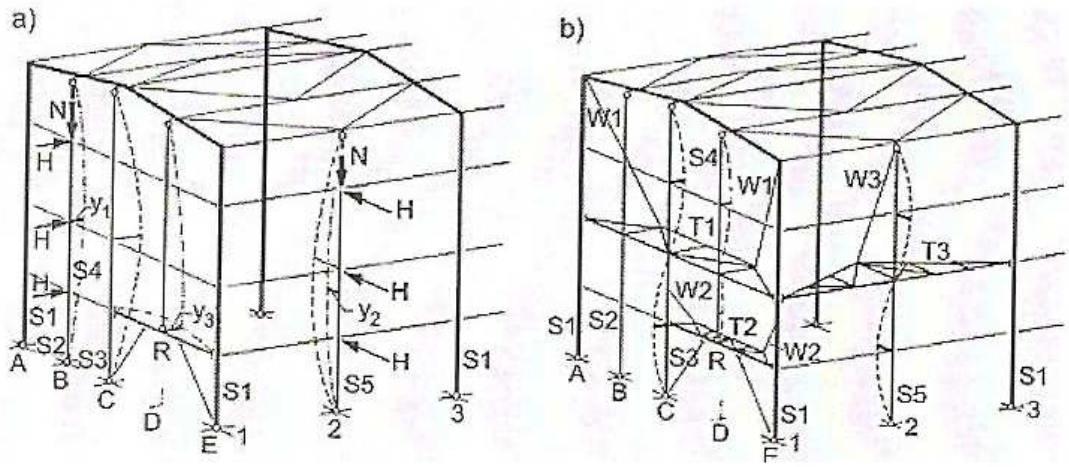


Fig.1.25 Possible deformations and the effect of wind horizontal bracings: S1- main column, S2-S5- secondary columns, T1- T2- horizontal wild bracings, W1-W3- suspension members

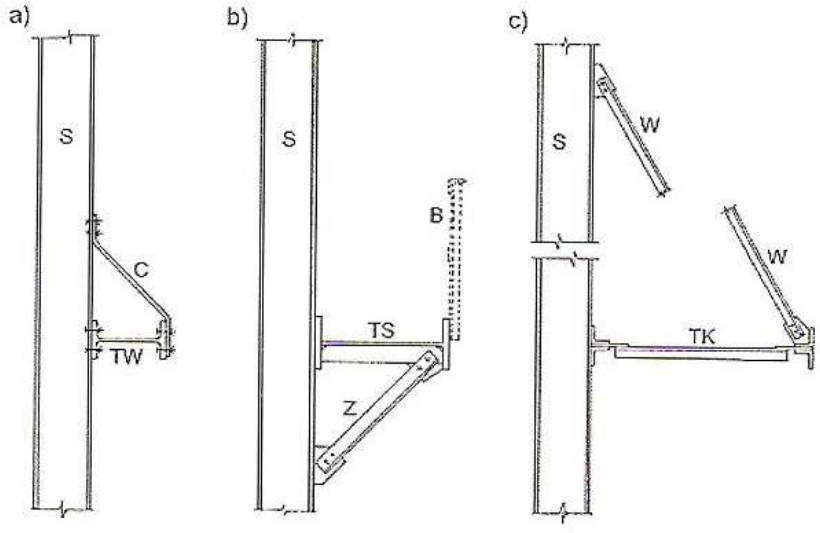


Fig.1.26 Constructions of wind horizontal bracings: S- column, TW- bracing from rolled member, TK- truss bracing, TS- built-up bracing, C- tie, Z- diagonal stay, W- suspension member

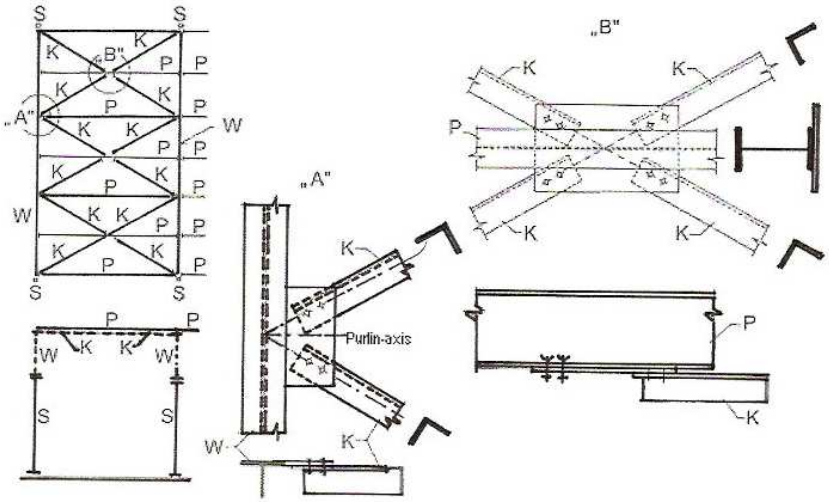


Fig.1.27 Details of purlin bracing: S- column, W- rafter, P- purlin, K- bracing

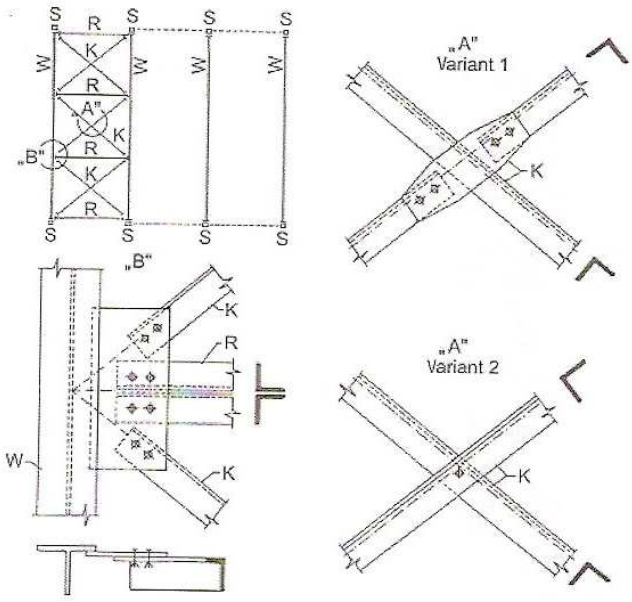


Fig. 1.28 Detail of bracing of a roof without purlins: S- column, W- roof rafter, R- bracing member, K- bracing diagonals

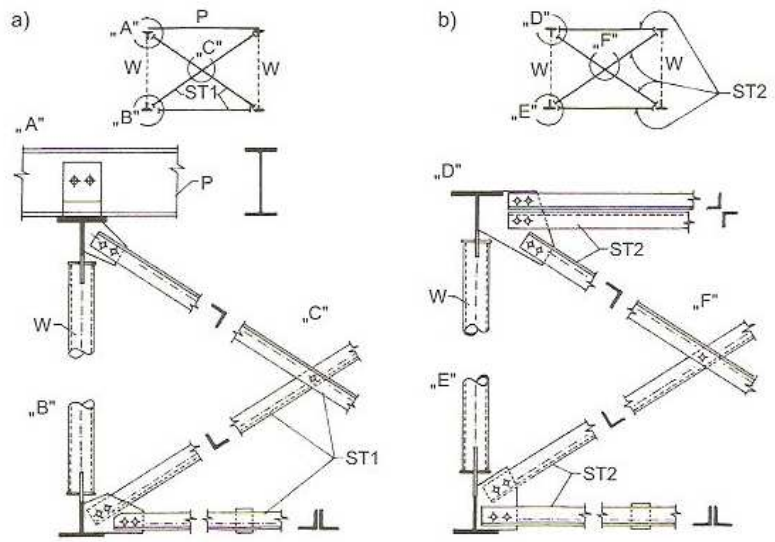


Fig.1.29 Details of vertical truss bracing constructed: a) with beam purlins, b) without purlins: W- roof rafter, P- purlin, ST1,ST2- bracings between truss rafters

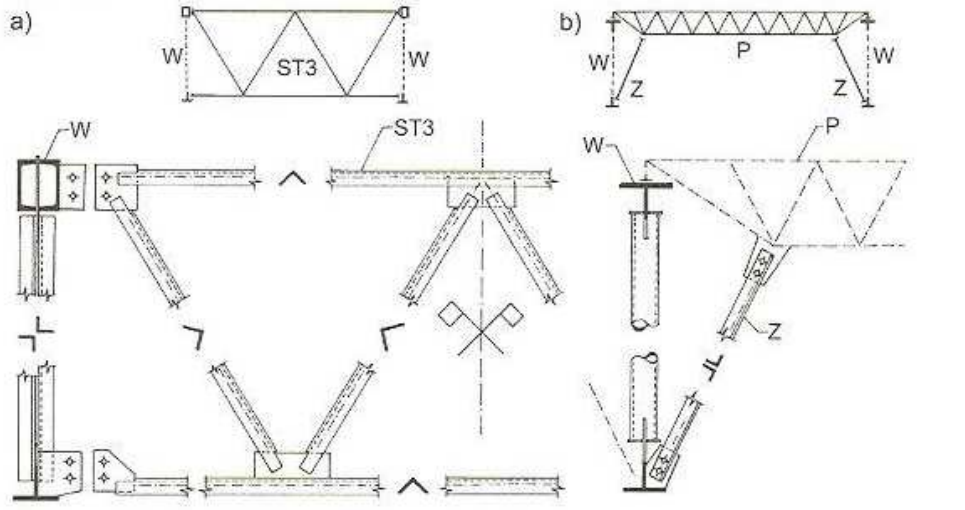


Fig.1.30 Detail of vertical bracing: a) of V- shape, b) when open web joists are used, W- rafter, P- purlin, ST3- bracing, Z- diagonal stay

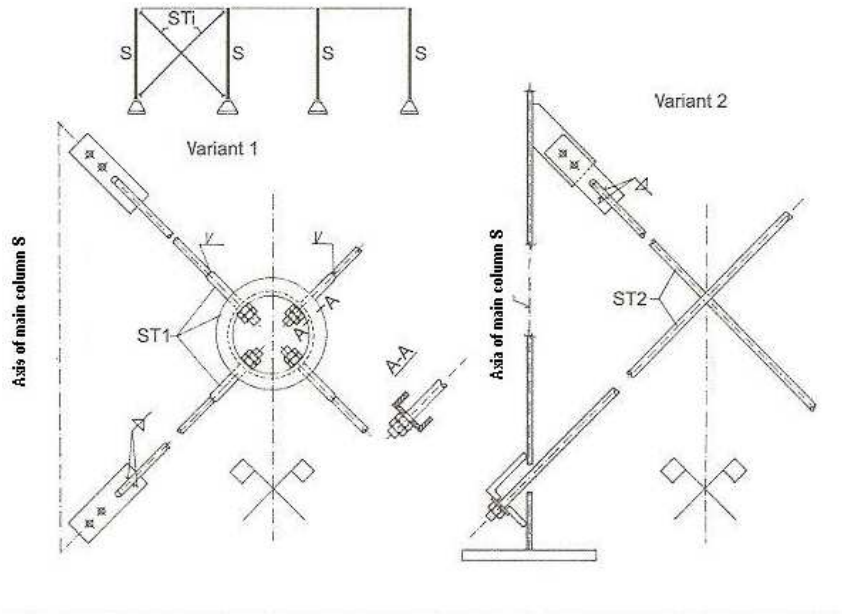


Fig.1.31 Detail of cross-tie column bracing: S- main column, ST1,ST2- column vertical bracings

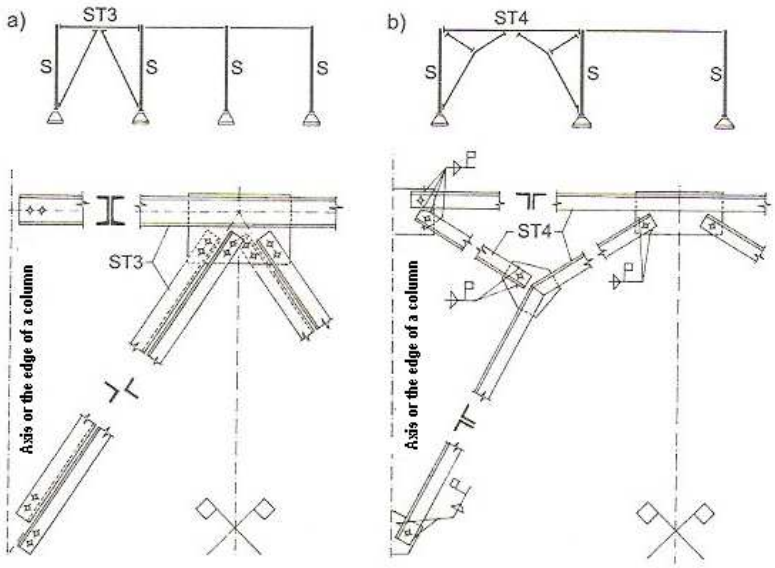


Fig.1.32 Detail of a portal bracing between columns: S- main column, ST3,ST4- column bracings