

AD 553:

Provision of sprinklers and fire compartments in single-storey buildings

The need to provide so-called Constrado (moment-resisting) bases to perimeter columns of single-storey buildings, when the wall is (or could become) sufficiently close to an adjacent building, is widely understood. In the event of fire, the building may collapse, but the perimeter wall must remain standing to provide a fire barrier for the adjacent property. It does this by acting as a cantilever. This note considers the provision of sprinklers to prevent the possible building collapse, and the design of internal walls used to separate the volume of a single building into a number of separate fire compartments.

Provision of sprinklers and compartmentation

Attention is drawn to Table 8.1 of *Approved Document B (AD B)*, volume 2, and its differentiation between 'industrial' and 'storage' buildings (readers should check equivalent guidance for use in Wales, Scotland and Northern Ireland as the guidance given below may not apply). There are two height measurements within this table. The height of the floor of the top storey above ground level is used for multi-storey buildings, but for single-storey buildings there is an alternative definition of 'maximum height' (Table 8.1 Note 5). This considers the compartment height, and is stated as being measured from finished floor level to the underside of the roof or ceiling.

Although the table makes no mention of mezzanines, it is worth noting that the introduction of a mezzanine, when it is of considerable size, can alter the defined number of storeys in a building. Reference should be made to the definition of 'storey' in *AD B volume 1 & 2 Appendix A* for more information.

'Storage' buildings:

For single-storey 'storage' buildings the table notes that for a 'maximum height' below 18m, the maximum compartment size is limited to 20,000m² when there are no sprinklers. If the 'maximum height' of a 'storage' building exceeds 18m, and there are no sprinklers, the compartment size limit is noted as N/A. The table suggests that 'storage' buildings have no limit to compartment size when sprinklers are provided, whatever the height. One interpretation of all this would be that you cannot have a 'storage' building above 18m with no

sprinklers. Another interpretation could be simply that the table gives no guidance for such buildings.

'Industrial' buildings:

For single-storey 'industrial' buildings below 18m there are no compartment size limits, whether or not sprinklers are provided. The table is however confusing because the N/A referring to compartment size for 'industrial' buildings over 18m, with or without sprinklers, is believed to be because single-storey industrial buildings of that height were not considered by the authors to be likely.

The meanings of N/As in the table therefore appear to be different, and are certainly unclear. Remembering that this is an Approved Document, not the Regulations themselves, it can be concluded that the only guidance for single-storey buildings exceeding 18m to the haunch requires the provision of sprinklers. A growing number of 'mega sheds' could fall into this category, in which case the structure for such buildings should be designed to support the weight of the sprinkler system, and sprinklers should be provided in order to comply with this guidance.

Although there will be an additional cost, a distinct benefit of providing sprinklers is that, should there be a requirement to divide the internal volume into a number of separate spaces, either at first build or retrospectively (including when fit-out is considered after structural design), non-load bearing partitions could be used to achieve this purpose. Being merely partitions, they would not need fire resistance. They would need deflection heads able to accommodate the potentially substantial movements of the structural members above them, but they would not need to accommodate the large deformations associated with the fire condition. Load bearing partitions could also be used, but their overall structural implications would need to be taken into account (as discussed below).

Provision of compartment walls

For single-storey 'storage' buildings with a 'maximum height' below 18m a compartmentation strategy, without sprinklers, would be possible to subdivide a larger compartment to meet the 20,000m² limit, or to provide separate units within such a building.

This could be achieved through the provision of internal compartment walls, used to prevent fire spread from one part of the building to another. Unlike a boundary wall, the compartment wall, which will become one of the perimeter walls of the surviving compartment, must be able to support the loads resulting from not only the potentially collapsed structure on one side of it, but also the remaining structure on the other side. As such, this cannot be an entirely non-load-bearing wall, and must be properly designed as part of the overall structure in its post-fire condition. The purpose of such a wall could include not only load bearing resistance but also the other attributes associated with a compartment wall, namely ensuring integrity and insulation criteria are satisfied for the required duration. That would be the case if the wall divided the building into parts used for different purposes.

The lateral loads from the collapsing side of the structure are likely to be considerable and must be resisted by a competent structural arrangement to hold the top of the compartment wall in place. The measures to restrain the top of the wall will probably involve bracing in the plane of the roof, transferring force to the foundations on the 'protected' side. The possibility of fire (separately) on either side of the wall may need to be considered.

The need to restrain the top of a compartment wall in the event of a fire means that the wall should ideally be located on the line of a primary frame. Compartment walls parallel to the apex of a frame are complex and should be avoided if possible – the entirety of the structural frame is likely to need protection. In multi-span frames, longitudinal compartment walls should ideally be located on the valley lines.

If a compartment wall falls between frames, the arrangement to restrain the top of the wall will involve protected members spanning between frames and protection to the frame within the fire compartment. The design should consider the effect of fire on any secondary members (typically purlins) which pass through the compartment wall.

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