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Ref: 45/1/196

Note: The following letter was issued by our former department, the Department for Transport, Local Government and the Regions Department for Environment, Transport and the Regions (DTLR). DTLR is now Communities and Local Government - all references in the text to DTLR now refer to Communities and Local Government.

Building Act 1984 - Section 16(10)(a)

Determination of compliance with Requirement B1 (Means of warning and escape) of the Building Regulations 2000 in respect of a loft conversion

The proposed work

4. The building to which this determination relates is a two storey, two/three bedroom mid-terrace property approximately 9m x 5m in plan area under a pitched slate roof. The ground floor comprises an open plan living area extending from the front elevation to the rear where a kitchen, of approximately 3m x 2.25m, is located to one side and accessed through a pair of sliding doors. French doors from the living area open on to an enclosed rear garden. The stair to the first floor is located on a party wall and to the front of the house. It discharges approximately 1.5 m from the front door. As existing the partition wall between the hall area and the living area has been part removed to form an opening of approximately 2m between two nibs that remain on either side.

5. As existing, the first floor comprises a front and rear bedroom, with a small bedroom/study to the front, and a bathroom to the rear.

6. The building work primarily comprises the conversion of the roof space (ie the loft) into a third storey (second floor) accommodating a master bedroom with en suite bathroom. In addition, provision is to be made at this storey level for a large storage area under the front roof slope; a walk-through closet housing a boiler and wardrobe facilities; and a washer dryer cupboard located off the stair (referred to as the laundry cupboard).

7. The conversion of the roof space is to be achieved by breaking open the rear roof slope just below the ridge and constructing a mansard-style elevation with an inset dormer window. The retained front slope of the roof is to receive two roof-light windows. One of these is to be of appropriate dimensions and position to form an escape window suitable for assisted escape and is accessed from the storage area on the new (second) floor. A new stair will be constructed above the existing stairway and, via a quarter landing, will lead to the second floor where an FD 20 (20 minute fire resistant)

self-closing fire door will be installed at the entrance to the new bedroom, consistent with the specifications of the existing bedrooms.

8. It is also proposed to carry out general improvements and refurbishment of the property, the most significant part of which will be the widening of the existing opening in the partition wall separating the ground floor living area from the stair by removal of the existing nibs - thus achieving complete access from the stair area to the living area across an extended opening of 4.75m.

9. To compensate for the lack of separation of the stairway and the open ground floor living area, it is proposed to install a sprinkler system throughout the house designed generally in accordance with *BS DD 251 Sprinkler Systems for residential and domestic occupancies - code of practice*. The sprinkler system will be linked to an 'LD2' fire detection and alarm system in accordance with BS 5839 part 6 *Fire detection and alarm systems for buildings - Code of practice for the design and installation of fire detection and alarm systems in dwellings*, with separate inter-linked fire detectors (comprising either smoke or heat detectors) and alarm sounders.

10. A single optical type smoke detector is to be provided in the ground floor living area near the stairway. Smoke detectors are also to be provided in the stairway at first and second floor levels with heat detectors provided in the kitchen and the second floor laundry cupboard. Fire alarm sounders are located at ground and second floor levels, and outside the front door.

11. The power supply for the alarm system is to a Grade C standard as described in BS 5839 part 6, except that the standby battery duration specified is reduced from the specified 72 hours to 16 hours.

12. These proposals were the subject of a full plans application which was rejected by the Borough Council on the grounds of non-compliance with Requirement B1 of the Building Regulations. The reason stated was that the stairway in the ground floor storey would not be separated from other parts of the floor area by fire resisting construction leading to a final exit. However, you took the view that your fire safety engineering proposal, which had been prepared by your fire safety engineering consultants specifically for this project, satisfied the guidance in *Approved Document B (Fire safety).* You therefore applied to the Secretary of State for a determination in respect of the question as to whether your proposals comply with Requirement B1.

The applicant's case

13. You take the view, as both a homeowner and practising architect, that the use of self-closing fire resisting doors is undesirable within many dwellings and that they will often be disabled or removed after the final building control inspection. You believe that a system such as you propose provides a greater level of fire safety in real terms than that achieved through strict adherence to the guidance in *Approved Document B*.

14. You consider that the proposed design and specification for the fire detection and alarm system is appropriate for the risk, but you are willing to modify these proposals if this determination should so indicate.

15. You have obtained a letter from the Chairman of the Residential Sprinkler Association's Technical Committee who is supportive of your case and has referred to the effects of the sprinkler policy in the town of Scottsdale in Arizona, USA.

16. To support your application you commissioned a report from a fire safety engineer who has concluded that your proposals provide sufficient time for the occupants of the building to escape in the event of fire. The report also refers to international experience with residential sprinklers such as in Scottsdale Arizona; full scale demonstrations held in Kirklees; and the support you refer to offered in a House of Commons Adjournment Debate by the then Minister for Housing and Planning, Nick Raynsford.

17. To support the conclusions in your fire safety engineer's report, a zone-type computer fire simulation package has been used to establish the expected conditions of a fire in the ground floor living area within the period that the occupants would be evacuating. A time has been calculated of 1 minute and 38 seconds for complete evacuation of the first floor only.

18. To provide a comparison between your proposed arrangement and the conventional solution, two geometries have been modelled, each with two rooms representing the ground floor living area and the stairway. You acknowledge that only basic modelling has been used which does not allow for the height of the stairway.

19. The first geometry includes a wall and doorway separating the living area and the stairway. It has been assumed for the purposes of this comparison that the door has been wedged fully open to reflect the fact that there are no statutory provisions to ensure that fire precautions are properly maintained in houses. The second geometry has no physical separation between the two spaces and simulates the effect of sprinkler protection in the living area.

20. For modelling purposes the worst case fire-growth scenario has been used which, in the view of your fire safety engineer, is the normal fire safety engineering approach. It is assumed to be a fire in a sofa comprised of a wooden frame, California form and polydefin fabric. The same fire growth scenario has been used for each geometry.

21. The results of the computer simulation indicate that the sprinklers would operate within the evacuation period and, as a result, the smoke temperature and heat release rate would be lower, and the clear layer height higher, compared with the scenario of a wedged open door within a wall. After a period of 1 minute and 38 seconds for the wedged open door scenario the predicted layer heights are 0.68m and 1.61m above the floor level in the living room and the stairway respectively. For the sprinklered open plan scenario the predicted clear layer heights are 1.79m and 1.83m respectively.

22. In response to the Borough Council's concerns regarding sprinklers in the kitchen above a fat fryer you have stated that water spray is an effective method of controlling fat fires. You consider that any initial fat spillage / flame spread that may occur will be extinguished or controlled by the continuous water spray from the sprinkler.

The Borough Council's case

23. The Borough Council refers to your fire safety engineering approach - which acknowledges that the open plan proposal at ground floor level does not accord with *Approved Document B* - and questions whether it compensates for the loss of passive fire protection to the stairway. The Council notes that the computer model figures are based on a particular type of fire hazard, ie a living room fire ignited on a sofa comprised of a wooden frame, California foam and polydefin fabric. However, the Council believes that there are other sources of fire hazard which are equally or more likely to arise - for instance the possibility of a slowly smouldering fire on the sofa producing more smoke before the activation of the sprinklers. Additionally, the Council refers to the potential for fire spread where a sprinkler is located in the kitchen above a fat fryer.

24. The Borough Council also takes the view that:

(i) The comparison of the sprinkler system with the worst case scenario of a door wedged open within a compartment wall is unreasonable and that, if comparison is to be used, it should be with a recommended fully functional FD20 self-closing fire door in the closed position.

(ii) The calculated time for complete evacuation of the first floor of 1 minute and 38 seconds is unrealistically optimistic. *BS DD 240 Fire safety engineering in buildings - Part 1. Guide to the application of fire safety engineering principles* suggests that response times are typically 5 to 6 minutes, which is dependent on occupants being familiar with the building.

(iii) The calculated smoke layer height of 1.83m above floor level is below the 2m normally considered to be appropriate for achieving means of escape.

25. The Borough Council concludes that the proposed provision for fire detection is inadequate in the circumstances of the case and should be extended to all other habitable rooms within the dwelling.

The Secretary of State's consideration

26. The Secretary of State takes the view that the main consideration in this case is the safety of the occupants of the new second floor if a fire occurs on the ground floor. In the case of a loft conversion to an existing two storey dwelling house it is considered adequate to demonstrate that means of escape would be achieved by the provision of a primary escape route supplemented by an assisted escape route from the habitable rooms at second floor level.

27. When following this approach it would normally be necessary to upgrade existing stairway enclosures by making existing doors self-closing and by replacing any conventional glass with fire resisting glass. If, as in this case, there is not a full enclosure of the stairway at one or more levels in the house then additional doors and partitions necessary to complete the enclosure should be provided. However, in this case you are proposing to install new 20 minute fire resisting self-closing doors to the first and second floor levels only, whilst retaining the ground floor in an open plan arrangement.

28. Your proposals comprise a separate but inter-linked fire detection and alarm system covering the kitchen and living area at ground floor level; the first and second floor landings; and the laundry cupboard on the second floor. This is to work in combination with a domestic sprinkler system covering all areas except bathrooms and the laundry cupboard. You consider that these systems will provide a greater level of fire safety in real terms than would be achieved by strict adherence to the guidance in *Approved Document B*.

29. However, the Borough Council has taken the view that your proposals are not adequate. They have raised some concerns about the fire safety engineering report and the computer modelling which has been carried out to justify your proposals. They have also identified some circumstances where the active systems which you propose may not perform as well as passive protection provided by partitions and closed doors.

The fire safety engineer's computer simulation

30. The Secretary of State takes the view that the fire safety engineer's computer simulation using a zone type model is of limited value. It would appear from the report that the results have been derived by using an inappropriately simple geometry which takes no account of the variations in ceiling height between the ground floor accommodation and the stairway. The simulation is based on a single fire-growth scenario and no sensitivity analysis has been carried out for this important parameter. It is also inappropriate to use a wedged open door as part of the computer analysis in making a comparison between current approved guidance (which assumes, of course, that doors are self-closing and are not wedged open) and an alternative approach. Moreover, the prediction of egress times appears only to assess the egress of the occupants of the first floor of the property and not those of the second floor - and it is the safety of the occupants of the latter which is in question.

31. The Secretary of State accepts that no safety system is entirely infallible and that there will always be scenarios where active or passive systems will not perform as intended. Therefore, notwithstanding his concerns about the results of the computer simulation which you have presented, he has proceeded to make a subjective assessment of the overall level of safety offered by the alternative approach you are proposing, and has compared this with the conventional solutions offered in the Approved Document. These are set out in the paragraphs which follow.

The principle of a system of early warning and fire suppression

32. The Secretary of State considers that in this case the proposals for a combination of early warning from the fire detection system and fire suppression from the sprinkler system, when considered as a whole, could have the potential to provide a similar level of safety for the occupants of the house as would be provided by a self-closing door of undetermined fire resistance and thereby provide for unaided escape to the final exit (ie the front door). Equally, if the circumstances described by the Borough Council were to occur and the occupants of the habitable and other rooms on the second floor found their primary escape route blocked, then adequate provision would be available for assisted escape via the second floor escape window. Sprinkler protection might also extend the period for which the occupants of the second floor could await assisted escape via the second floor escape window.

33. For this approach to be acceptable it would be essential to ensure that the fire detection system and the sprinkler system were adequately designed and installed to an appropriate specification.

The fire detection and alarm system

34. In this case the fire detection and alarm system is part of a package of measures being provided as an alternative to the provision of a physical enclosure to the stairway and the final exit which would normally serve to protect the primary escape route from the upper stories, from the smoke and flames generated by a fire at ground floor level. It follows that the risk to be addressed is the effect of a fire occurring anywhere in the ground floor accommodation. The Secretary of State has therefore given attention to the detection system in general and to the ground floor in particular.

35. In this respect it is noted that at ground floor level you have proposed only a single optical type smoke detector to be located in the living area near the stairway. Whilst the radius of detection which this would provide would be in accordance with current good practice, it is important to recognise that a better standard could be achieved by increasing the number of detectors. It is considered that an acceptable improvement in the time to detection would be achieved if two detectors, evenly distributed, were installed in the open plan area at ground floor level.

36. With regard to the overall provision of detectors on the first and second floors, it is noted that the Borough Council has expressed its view that detectors should be provided in every habitable room throughout the dwelling. This compares with your proposed provision for smoke detectors in the stairway at first and second floor levels, and a heat detector in the laundry cupboard at second floor level. You have stated that should it be necessary you would be willing to provide the extra detectors but that you do not consider this to be the case.

37. The Secretary of State acknowledges the benefits that this enhanced level of coverage would provide but, in the circumstances of this case, he considers it would be unreasonable to require this degree of detection to satisfy the functional requirements of Requirement B1. However, there is a related matter concerning the laundry cupboard which is accessed off the second floor landing and which has a folding door of undetermined fire resistance. The effect a fire in this cupboard could compromise the safety of the occupants and therefore in addition to the proposed heat detection inside the cupboard, protection should be afforded to the stairway by making this cupboard a fire resisting enclosure.

38. Your intention to provide only 16 hours of reserve power for the fire detection and alarm system has been noted. This is at variance with the specification for a Class C systems detailed in BS 5839 part 6. It is recognised that when considering the specification for fire detection and alarm systems it is necessary to assess the balance between fire risk and system reliability and success rate. In the circumstances of this case there is a greater dependence on early warning of fire and as such the need for reliability of the system is increased. However, in these circumstances 16 hours of reserve power is considered to be adequate for the purposes of complying with Requirement B1; but precautions, such as those recommended for Class E systems, should be taken to ensure that the mains supply to the system is sufficiently robust.

The sprinkler system

39. A detailed specification for the sprinkler system is contained in the fire safety engineer's report. However there is some contradiction between this and what is specified in the submitted plans. The report specifies quick response type sprinkler heads and suggests that concealed or recessed heads may be used, but the plans state that exposed type heads will be used. The report goes on to state that sprinkler heads should comply with BS DD 252 which is the, as yet unpublished, component standard to partner BS DD 251.

40. It is considered that concealed and recessed type sprinkler heads are generally slower in response than conventional pendant type heads. Therefore, to ensure that the sprinkler system would react to a fire as quickly as possible the sprinkler heads would need to be selected carefully and be of the pendent type and quick response type (as defined in *BSEN 12259 pt 1: Fixed fire-fighting systems. Components for sprinkler and water spray*

systems. Sprinklers). In this respect the Secretary of State is concerned about the acceptability of your proposals, as specified in your submitted plans, in so far as he is not satisfied that the design of sprinkler head is appropriate for the purpose proposed.

The determination

41. The Secretary of State has given careful consideration to the particular circumstances of this case and the arguments presented by both parties. Although he considers that the principle of your proposals has the potential, in the particular circumstances of this case, to comply with Requirement B1, on the basis of your specific proposals as submitted he is not satisfied that the number and location of fire detectors at ground floor level is adequate or that the design of the sprinkler heads is appropriate for the purpose proposed. He has therefore concluded that your proposals do not provide adequate compensation for the omission of enclosure of the stairway and final exit at ground floor level and therefore do not make adequate provision for safe escape. He hereby determines that your proposals do not comply with Requirement B1 (Means of warning and escape) of Schedule 1 to the Building Regulations 2000.