

Approved Document K – General Access and Utility Stairs: Final Report

Milestone-M4V1

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Executive Summary

The findings presented in this report support the option to improve the guidance provided in Approved Document K for General Access stairs and Utility Stairs, reducing the risk of falls on such stairs and reducing the confusion caused by the current stair category definitions and their limited scope of application.

The Building Safety Regulator has a duty under the Buildings Safety Act 2022 to keep the safety and standard of buildings under review. The Regulator would like to consider extending a previously published report (MHCLG, 2025) to include General Access stairs and Utility stairs, which are stairs located in and around buildings other than dwellings. The project is limited to two objectives.

Objective 1 considers the evidence that supports the proposal to revise guidance for General Access stairs in Approved Document K (HM Government, 2013) to match the guidance given in BS 5395-1:2010 (BSI, 2010) for Normal Use stairs. The main aspects of these changes would be to consider the potential change in risk of:

1. Increasing the minimum going to 300 mm
2. Increasing the range of acceptable rise heights to a maximum of 180 mm
3. Increasing the minimum number of steps in a flight before an intermediate landing is required

Objective 2 considers the difference between Private stair guidance given in BS 5395-1:2010 (BSI, 2010) and those given for Utility stairs in Approved Document K. Consideration is given to the potential number of descents that might occur on such stairs, and how stairs used less frequently could have less restrictive dimensional criteria without increasing the potential risk compared to more frequently used General Access stairs.

For General Access stairs, this report considers the range of rise and going recommendations made in British Standards and Approved Documents since 1977. Step dimensions were fairly consistent until the introduction of Approved Document M looking to provide access for people with disabilities.

The report also shows the increased range of stairs that can be built by increasing the range of rises from 150-170 mm to 130-180 mm, and the evidence to suggest this has little effect on overall risk. It also highlights how increasing the number of steps in a flight can offset any additional cost of increasing the size of the minimum going. Further research would be

required to determine whether this change in rise would increase the risk to people with ambulant disabilities.

The report highlights how increasing the minimum going from 250 mm to 300 mm would have a dramatic effect on the risk of a large overstep in descent, known to be a leading cause of falls on stairs. It has the potential to reduce the risk of all falls on stairs by up to 80%.

For Utility stairs, this report highlights how increasing the rise from 190 mm to 200 mm would have a negligible effect on the risk of a large overstep and hence the risk of a fall in descent. The report also shows that increasing the number of uses of a stair is likely to increase this risk. It is therefore highlighted that increasing the minimum going to 275 mm, while keeping the maximum rise at 190 mm, would reduce the risk of a large overstep when the frequency of use is below 12 uses per day on average, to values similar to the risk associated with 75 or more uses per day on a General Access stair. Where a proposed Utility stair is likely to have more than 50 descents per day on average, it may be sensible to recommend using dimensions similar to those recommended for General Access stairs. Suggested wording to describe which stair to recommend is provided in the conclusions to this report.

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Introduction

In 2022/2023, the then Department for Levelling-Up, Housing, and Communities (DLUHC), now the Ministry for Housing, Communities and Local Government (MHCLG), commissioned a review of the differences between the guidance given in Approved Document K 2013 (HM Government, 2013) and British Standard BS 5395-1:2010 (BSI, 2010) with the potential to update the Approved Document guidance to bring the two documents to a similar level of guidance. The project only considered domestic stairs, which were seen to be the stairs that generated the greatest amount of risk in use. The final report was completed in 2023 and published in 2025 (MHCLG, 2025).

The Building Safety Regulator has a duty under the Buildings Safety Act 2022 to keep the safety and standard of buildings under review. The Regulator would like to consider extending this first report (MHCLG, 2025) to include General Access stairs and Utility stairs, which are stairs located in and around buildings other than dwellings. The project is intended to be limited to two objectives.

Objective 1 considers the evidence that supports the proposal to revise the guidance for General Access stairs in Approved Document K (HM Government, 2013) to match with the guidance given in BS 5395-1:2010 (BSI, 2010) for Normal Use stairs. The main aspects of these changes would be to consider the potential change in risk of:

1. Increasing the minimum going to 300 mm
2. Increasing the range of acceptable rise heights to a maximum of 180 mm
3. Increasing the minimum number of steps in a flight before an intermediate landing is required

Objective 2 considers the difference between Private stair guidance given in BS 5395-1:2010 (BSI, 2010) and those given for Utility stairs in Approved Document K1. The potential change in risk associated with making the guidance for Utility stairs similar to the British Standard guidance for domestic stairs will be determined.

Methodology

Previous approach

It was noted in the previous report (MHCLG, 2025) that the guidance in the British Standard BS 5395 part 1 (BSI, 2010) and in part 4 (BSI, 2011) of the same standard, were based on the findings of 10 years of research funded by the Department between 1998 and 2008. This first report “Evidence to support potential changes to Approved Document K guidance on domestic stairs” (MHCLG, 2025) considered all the research associated with stair design conducted by BRE on behalf of the Department during this period. In addition, relevant publications associated with these topics were considered. Consideration was also given to any more recent research provided by a list of stair colleagues, both in the UK and international.

The same research and references will be used to support this part of the project, as they relate to General Access stairs and Utility stairs. Some colleagues will also be approached to see if any additional research should be included.

Objective 1 - General Access Stairs

In part 1 (MHCLG, 2025) the relative risk of stairs with goings of various sizes was compared. In addition, the increased risk associated with variations between steps was also illustrated. These comparisons will be used to assess the relative risk of General Access stairs built to the existing guidance in Approved Document K (HM Government, 2013) and the guidance given in BS 5395-1 (BSI, 2010) for Normal Use stairs. Consideration will also be given to the potential number of users of General Access stairs, and how this may affect the risk of an incident.

The rise of a step is determined by the floor-to-floor height, as the rise should be equal on every step in the flight, or flights. The range of allowed rise dimension in the guidance will determine how many steps are required in each flight to reach the next floor. Consideration will be given to the restrictive nature of tighter tolerances on rise heights especially for shorter flights. Reference will also be made to the educational stairs experiment.

The origin of maximum and minimum rise will also be considered, and hence the potential variation in space required to enclose a stair with 180mm maximum rise compared to 190 mm or 170 mm used for General Access and Utility stairs. Consideration will be given to the profile of steps and the use of proprietary nosings to mark the leading edge of the step.

In addition to the direct comparison of steps with different rise values, consideration will be given to the effect of changing the number of risers in

a flight from a maximum of 12 with a shorter going in Approved Document K (HM Government, 2013) to align with the guidance in BS 5395-1:2010 (BSI, 2010) which has a maximum of 20 steps with a larger going. Emphasis will be made to the additional risk associated with transitioning from steps to a landing and the ability to rest on any step in the flight.

Objective 2 - Utility stairs

A Utility stair is defined as a stair used for escape, access for maintenance, or purposes other than as the usual route for moving between levels on a day-to-day basis. Currently the Utility stairs in Approved Document K (HM Government, 2013) are based on General Access stairs with an increase in the recommended range of rise values that could be used. Using the proposed dimensions for Private stairs in the first part of this study (MHCLG, 2025), which mirrors the guidance in BS 5395-1:2010 (BSI, 2010), for Utility stairs would increase the maximum rise still further. A comparison between the various dimensional options will be made to determine the relative risk associated with the changes in rise, and the cost benefits of keeping the minimum going as current at 250 mm, rather than increasing the minimum in line with the proposed changes to General Access stairs. The potential number of uses of Utility stairs will be taken into account.

Risk Measurement

The information obtained from the review will be used to help provide an indication of the risk assessment associated with any proposed changes. This will be mainly formed around potential costs of the proposed changes and the potential reduction in risk associated with such changes. The assessment will draw heavily from risk assessments used to determine the influence of health and safety hazards in dwellings.

Background

Historic values

The range of rise and going dimensions that are considered acceptable for stairs in buildings other than dwellings is given in Table 1. The values are usually described with maximum and minimum values for Rise and Going. In addition, limits were put on a comfortability criteria described as twice the Rise plus the Going (2R+G). In some cases limits were also placed on maximum pitch. It should be noted that all these values are intended as guidance.

Standard	Stair Location	Year	Rise (mm)		Going (mm)		2R + G (mm)		Pitch
			Min	Max	Min	Max	Min	Max	Max
BS 5395-1	Semi-public	1977	100	190	250	350	550	700	38°
	Public		100	180	280	350	550	700	33°
	Public Assembly	2000	100	190	250	350	550	700	38°
			100	180	280	350	550	700	33°
AD K	Normal Use	2010	150	180	300	450			
	Access to Building		100	180	300	450			
	Common Assembly	1985		190	244		550	700	38°
	Other			180	280		550	700	
AD M	Assembly	1992		190	250		550	700	
	Other			180	280		550	700	
	General Access	2013	150	170	250	400	550	700	
	Utility		150	190	250	400	550	700	
AD M	Access to Dwellings	1992			280*				
	Internal			150	250				
	Access to Building	1999		150	280				
	Internal			170	250				
AD M	Access to Dwellings	2004	75	150	280				
	Common			170	250				
	Access to Building	2015	150	170	280	425			
	Internal		150	170	250	400	550	700	
AD M Vol 1	Internal General	2015	150	190	250	400	550	700	
AD M Vol 2	Internal Utility		150	190	250	400	550	700	
AD M	Access to Dwellings	2015	75	150	280				
	Common - no lift		150	170	250	400	550	700	
	Common - lift	2015	150	190	250	400	550	700	
			150	190	250	400	550	700	

*Tapered Treads Only

TABLE 1 DIMENSIONAL RESTRICTIONS IN STAIR GUIDANCE BY YEAR PUBLISHED

In the 1985 version of Approved Document K, the Assembly and Other stair categories mirrored the Public and Semi-Public categories in BS 5395-1:1977. The dimensions remained consistent for the 1992

Approved Document K, although the dimensions for Common stairs serving a small number of apartments, were removed from the guidance. The 2000 version of the British Standard BS 5395-1:2000 also retained the same dimensional constraints as the previous 1977 version. However, around the same time, the range of acceptable dimensions became more complicated with different range restrictions introduced in Approved Document M, considering the expected needs of users with disabilities in different locations for Public stairs. Approved Document M (1992) introduced maximum rise values and minimum going values for stairs providing access to buildings and stairs found inside these buildings. While the going dimensions mirrored Approved Document K dimensions, the maximum rise dimensions were considerably lower. However, the dimensional restrictions did not include a limit on the other side of the range, suggesting no minimum rise and no maximum going. It is noted that larger goings and smaller rises lead to a flight taking up a larger footprint making them more expensive to manufacture and more costly in terms of usable floor space.

Approved Document M was revised in 1999, maintaining the same limitations as provided in the 1992 version for access to buildings and internal stairs to these buildings. However, the 1999 version introduced two more categories for access to dwellings, in line with access to all other buildings but with a minimum rise of 75 mm, and reintroducing Common stairs previously dropped in Approved Document K. The constraints on Common stair dimensions matched those of internal stairs for other buildings.

Much of the guidance in Approved Document M appeared to be based on subjective opinions and focus groups containing people with ambulant and visual disabilities. There was very little experimental evidence, if any, to support these changes. However, the stair research at BRE, funded by the Department and outlined in the first part of this report, began around this time providing experimental investigation into the relative risks of dimensional constraints on stairs.

Approved Document M was revised again in 2004 introducing a minimum rise of 150 mm for stairs providing access to buildings and stairs within these buildings. A maximum going was also introduced into this version for external stairs providing access to buildings. This value was increased to 425 mm on the advice of BRE, since experimentally BRE were already introducing stairs with these dimensions to the experimental subjects in the Experimental Rig projects (MHCLG, 2025). The guidance in Approved Document M was given preference over Approved Document K where they differed.

By 2008 the research at BRE on stairs was drawing to a close, with a request to provide updated guidance to Approved Document K. Unfortunately this guidance was not progressed into a full revision of Approved Document K. Instead, BRE was commissioned to provide this guidance to update the British Standard. BS 5395-1:2010 was therefore based on the BRE research, subjected to the constraints of consensus within committee. A new term to describe stairs was introduced, suggesting that all Normal stairs should have a going range between 300 mm and 450 mm, and a rise range of 150 mm to 180 mm. These ranges are extended for Private stairs and stairs providing access to buildings.

While BS 5395-1:2010 was being published, changes were being made to Approved Document K to bring the guidance on stairs from Approved Document M and Approved Document K into one single guidance document. The intention was to make no changes to the guidance provided when compared to previous versions of the guidance in Approved Document K and M. The 2013 version of the guidance was introduced, which created two new categories of stairs, General Access and Utility. A General Access stair is defined as “A stair intended for all users of a building on a day-to-day basis, as a normal route between levels.” A Utility stair is defined as “A stair used for escape, access for maintenance, or purposes other than as the usual route for moving between levels on a day-to-day basis.”

Utility stairs mirrored the guidance for Other stairs from the previous version of Approved Document K, with the addition of a minimum rise of 150 mm taken from Approved Document M and introducing a new maximum going of 400 mm, possibly taken from the maximum going in BS 5395-1:2010 for Private stairs. Note the $2R+G$ relationship range was also applied, which means this maximum going restriction never applies. General Access stairs mirrored the guidance in Approved Document M, reducing the rise to a maximum of 170 mm and a minimum of 150 mm. The new maximum going was also introduced for General Access stairs alongside the $2R+G$ criteria. The access to dwellings from Approved Document M was also intended to be included under note [2] of Table 1.1, however it was worded in such a way as to only apply to tapered treads.

The guidance in Approved Document K (2013) and BS 5395-1:2010 is quite different. This report is intending to consider the potential change in risk between the dimensional restrictions in the Approved Document and the guidance proposed in the British Standard. This difference is illustrated graphically in Figure 1.

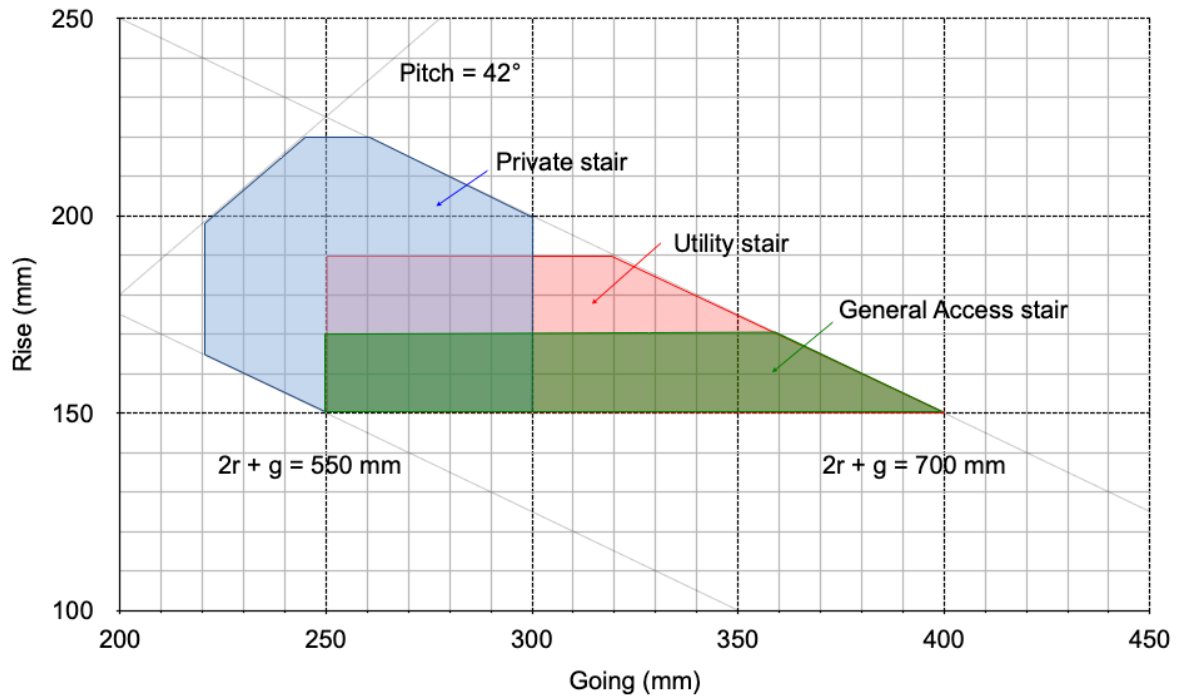


FIGURE 1A RESTRICTIONS IN RISE AND GOING DIMENSIONS IN APPROVED DOCUMENT K (HM GOVERNMENT, 2013)

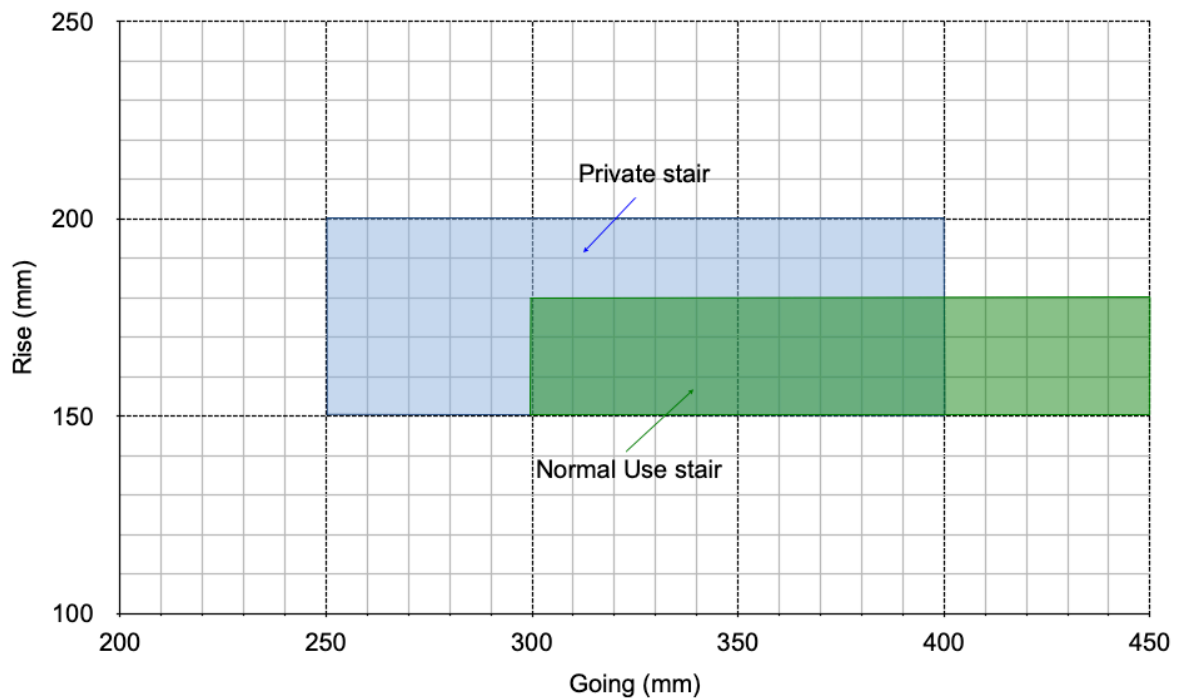


FIGURE 1B RESTRICTIONS IN RISE AND GOING DIMENSIONS IN BS 5395-1:2010 (BSI, 2010)

FIGURE 1 GRAPHICAL REPRESENTATION OF RESTRICTIONS IN RISE AND GOING DIMENSIONS FOR APPROVED DOCUMENT K 2013 AND BS 5395-1:2010

It is noted from Table 1, that Approved Document M was revised again in 2015. Here the document refers to Approved Document K for all internal stairs, and copies the guidance from the previous version of Approved Document M for external stairs providing access to buildings and dwellings.

Additional Papers

Consideration was given to the possibility of more research papers on stair design that may have been published since the first report (MHCLG, 2025). On examination of papers relating to stairs linked to authors on ResearchGate it appears that stair research is still popular. However, the research seems to fall into a few categories: studies relating to patient recovery from differing ailments, studies relating to teaching robotic devices to navigate stairs, and papers on falls prevention through interventions.

No papers were found that might influence the findings of this report. However, a couple of papers from the Toronto Rehabilitation Institute may be relevant to any additional research relating to stair designs, full papers have not been requested but the titles and abstracts are included here for context:

Benjamin Elkin et al (2025) **A top-of-flight stairway defect affects foot overhang on lower steps during stair descent.**

This is a topic particular to domestic stairs in the USA where the top step of the flight, where it joins the floor, is built without an additional nosing. This makes the going on the first step in descent larger than subsequent steps, which may lead to an increased overhang, and hence an increased risk of falls. This type of stair design is currently not typical in the UK.

Marko Bjelica et al (2021) **Increasing the contrast of tread edge highlighters improves stair descent safety in older adults with simulated visual impairment**

Contrasting nosings are not common in other countries. This research considers the effect such contrasting nosings have on cadence, heel clearance and foot overhang. Blurred vision was observed to be a greater factor influencing bio-mechanical measures of fall risk than low ambient lighting. Results suggest higher contrast highlighters improve measures of safety, even more so during simulated vision impairment, and that at least 50% contrast difference provides adequate visual information for safer stair ambulation.

Sanaz Agha et al (2021) Determining the effect of stair nosing shape on foot trajectory during stair ambulation in healthy and post-stroke individuals

Stair design can influence the risk of stair falls. Stair nosings are intended to provide greater foot accommodation, although to date little is known about how the nosing shape can affect foot trajectory during stair ambulation. This study investigates the impact of different nosing shapes (round, square, tapered, and no nosing) on foot clearance and overhang measures during stair ascent and descent among healthy and post-stroke older adults. Slower cadence in ascent and descent, and greater foot overhang during descent highlighted the increased risk of stair falls for persons with chronic stroke. For both healthy and post-stroke participants, the tapered and round nosing shapes resulted in the largest horizontal foot clearance, and smallest foot overhang, respectively. However, given the greater step-to-step variability detected with round nosings, the tapered nosing presents as the safest choice among all evaluated designs.

Alison C Novak et al (2015) Age-related differences in dynamic balance control during stair descent and effect of varying step geometry

The incidence of stairway falls and related injuries remains persistently high; however, the risk of stair injuries could be reduced through improved stairway design. The current study investigated dynamic balance control during stair descent and the effects of varying the step geometry. Data were collected from 20 healthy young and 20 older adults as they descended three staircases (riser heights of 7, 7.5 and 8 inches (178, 190 and 203 mm, respectively)). At each riser height, the tread run length was varied between 8 and 14 inches (203 mm and 356 mm) in one-inch (25 mm) increments. Kinematic data provided measures of segmental and whole-body dynamic control. Results demonstrated that older adults had greater lateral tilt of the upper body than young adults, but actually had larger margins of stability than the young in the antero-posterior direction as a result of their slower cadence. Nonetheless, for both age groups, the longer run lengths were found to provide the largest margins of stability. In addition, increase in run length and decrease in riser height tended to reduce forward upper body tilt. These results help to explain the underlying bio-mechanical factors associated with increased risk of falls and the relationship with step geometry.

General Access Stairs

Going

Objective 1 considers the possibility of changing the dimensions associated with General Access stairs (HM Government, 2013) to align with the dimensions proposed within British Standard BS 5395-1:2010 (BSI, 2010).

From Figure 1, the specific changes required to go from Approved Document K General Access stairs guidance to BS 5395-1:2010 Normal Use stairs guidance, when considering the range of going sizes, is to increase the minimum going from 250 mm to 300 mm, while increasing the maximum going to 450 mm. Note the 2R+G criteria is no longer proposed to be applied.

As outlined in part 1 of this report (MHCLG, 2025), the relative risk of a fall is related to the overhang of the user's foot in descent. This was illustrated in a table from BRE Information paper 15/03 (Roys & Wright, 2003) on proprietary nosing for non-domestic stairs. The first part of this table is reproduced in Table 2 below, with risk of an event occurring in less than 50 years highlighted in bold. There is clearly a big change in the risk associated with falls in descent once the going increases beyond 300 mm. The chances of a large overstep decreases to once in a thousand years or less, with typical usage of 100 descents a day or less. Even in places with 2,000 descents per day, like places of public transport, the risk of a large overstep is once in 73 years. This compares to the risk associated with 250 mm goings where the risk of a large overstep, even with 5 descents a day is once every 11 years, increasing to once every 10 days with 2,000 descents per day. It should be noted that not every overstep will lead to a fall, however, such an event is a key indicator of the likelihood of a fall occurring.

Risk on a 14-step flight where there is no variation in going between steps				
Going	Average time between occurrences of a large overstep			
	5 runs per day	25 runs per day	100 runs per day	2000 runs per day
225 mm	4 years	298 days	75 days	4 days
250 mm	11 years	2 years	198 days	10 days
275 mm	145 years	29 years	7 years	133 days
300 mm	>1000 years	>1000 years	>1000 years	73 years
325 mm	>100,000 years	>1000 years	>1000 years	568 years
350 mm	>100,000 years	>100,000 years	>100,000 years	>1000 years
375 mm	>100,000 years	>100,000 years	>100,000 years	>100,000 years
400 mm	>100,000 years	>100,000 years	>100,000 years	>100,000 years

TABLE 2 VARIANCE IN RISK OF A LOSS OF BALANCE BY GOING SIZE ON A 14-STEP STAIR WITH NO VARIATION BETWEEN STEPS (ROYS & WRIGHT, 2003)

Figure 2 shows the relative risk of stairs with the same rise but with differences in the going and where there may be variation in going between consecutive steps (Roys & Wright, 2013). The variation in risk is two orders of magnitude greater when comparing 300 mm goings with 275 mm goings, and a further order of magnitude when compared to 250 mm goings. In fact, the estimated risk at 250 mm, the current Approved Document K minimum going size for General Access stairs, is 2,708 times greater than expected if the minimum going were to be increased to 300 mm.

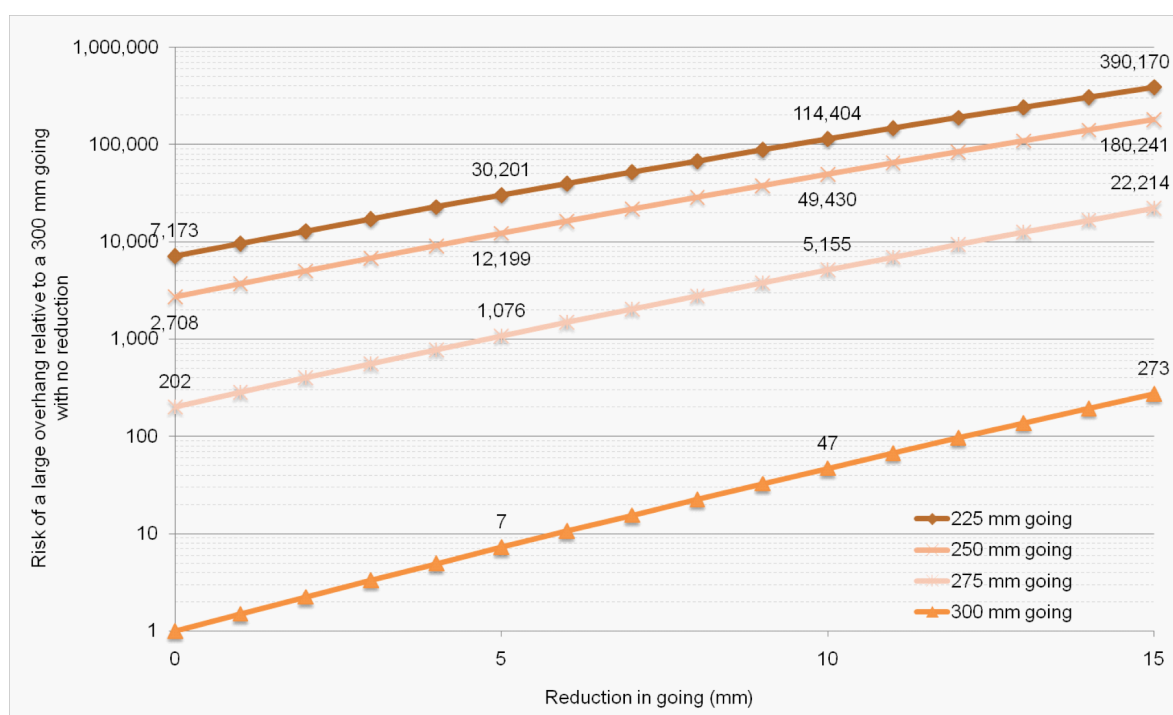


FIGURE 2 RELATIVE RISK OF A LARGE OVERHANG COMPARED TO A STEP WITH 300 MM GOING AND NO VARIANCE BETWEEN STEPS (ROYS & WRIGHT, 2013)

It is also noted that some building techniques make it difficult to ensure every rise and going is exactly the same throughout the flight (BSI, 1990). Consistent step size is a current expectation in Approved Document K, but step size is very difficult to measure in-situ, and therefore not readily checked by building control inspectors. From the Accuracy in Buildings standard (BSI, 1990), we can expect to see variation going-to-going of 4-6 mm, which increases the relative risk from a 300 mm going stair with no variance by up to a ten-fold increase. A similar variance at 250 mm increase the relative risk from 2,708 times at no variance to over 15,000 times the risk at 6 mm of variance step to step.

The British Standard BS 5395-1:2010 allows for this expected variation in steps by providing tolerances from a uniform design going of $\pm 1.5\%$ for Normal Use stairs. At 300 mm going this could result in the maximum step to step variance of 9 mm, or an increase in risk of 30 to 40 times that of a 300 mm stair with no variance. From Table 2, the risk of an overstep at 400 mm goings is about 2,000 times less than the risk of an overstep at 300 mm. Hence a larger variation, i.e. a maximum step to step variance of 12 mm, would not increase the risk significantly compared to a smaller going with no variance.

Any allowance in step variance is therefore likely to increase the risk of a fall in either ascent or descent, compared to a stair with no variance in dimensions. However, if some allowance is to be given for building tolerances, increasing the going as large as possible is the most favourable option to make the impact on risk as small as possible. Consistent steps would be better, but some tolerance could be allowed without a significant increase in risk, especially for in-situ construction methods.

Suggesting a maximum going for General Access stairs is not as straight forward as the suggestion for a minimum going. It has been noted that the use of larger goings is unlikely to occur in many buildings as the amount of space required for the stair, and hence the cost in terms of usable space, increases with going size. However, in external step situations the cost may be less important. A larger going may make for a more gradual pitch matching better the topography of the surrounding. Experimentally, the largest going tested was 425 mm. At this point some smaller individuals with shorter stride lengths were starting to use an asymmetrical gait which required one foot to be placed on the tread away from the nosing and the second step on the same step nearer the nosing. This occurred both in ascent and descent. The 425 mm maximum going was already introduced in Approved Document M in 2004. It is also noted that the maximum going allowed on larger public spiral stairs is 450 mm (BSI, 1984). An upper limit

to going size seems sensible, but whether this is 400 mm, 425 mm, 450 mm or something else can not be determined without further experimental work. Given how unlikely steps with such large goings might be specified the value recommended in the BS 5395-1:2010 seems a sensible choice, as it matches the span length of the range of going values for Private stairs.

Rise

From Figure 1, the recommendation for rise is to increase the maximum rise from 170 mm to 180 mm. It may also be necessary to consider the minimum rise, particularly for short flights. Note the 2R+G criteria is no longer proposed to be applied.

As noted in part 1 of this report (MHCLG, 2025), the rise on stairs has less flexibility in the options that can be provided, and is controlled by the floor-to-floor dimension between which the stair is located. As the desire is to have equal rise between each step on the flight, this overall dimension must be divided by the number of rises in the flight. Table 3 illustrates the potential range of rise values, along with an indication of where the recommendation originated.

	Minimum (mm)	Maximum (mm)	Range options
	180	200	Higher rise values which should only be considered if the number of uses on the stair is likely to be low
	170	180	Additional rise values recommended in BS 5395-1:2010 guidance
	150	170	Values recommended in Approved Document K 2013 edition
	130	150	Originally suggested minimum rise values for BS 5395-1:2010 but not included in the final draft
	100	130	Absolute minimum rise values which might be required for short flights that provide access to buildings

TABLE 3 RANGE OF RISE VALUES CURRENTLY RECOMMENDED IN THE GUIDANCE FOR GENERAL ACCESS STAIRS

Figure 3 illustrates the range of floor-to-floor values that can be supplied by stairs with up to 20 steps in a flight. Only the middle three ranges from Table 3 are included in this figure. The central range is that which is currently recommended in Approved Document K 2013 edition, with a rise value of between 150 mm and 170 mm. This is a very narrow range of rise values, which in practice means that many flights only have one option of rise that can be considered. Unfortunately, where the flights are shorter,

i.e. eight rises or less, there are some floor-to-floor values for which no stair can be provided within the recommended range of rise.

The top range in Figure 3 includes the additional rise values recommended in the BS5395-1:2010 guidance, i.e. increasing the maximum rise to 180 mm. This improves the range of floor-to-floor values covered, but still falls short of some values when the number of rises is five or less.

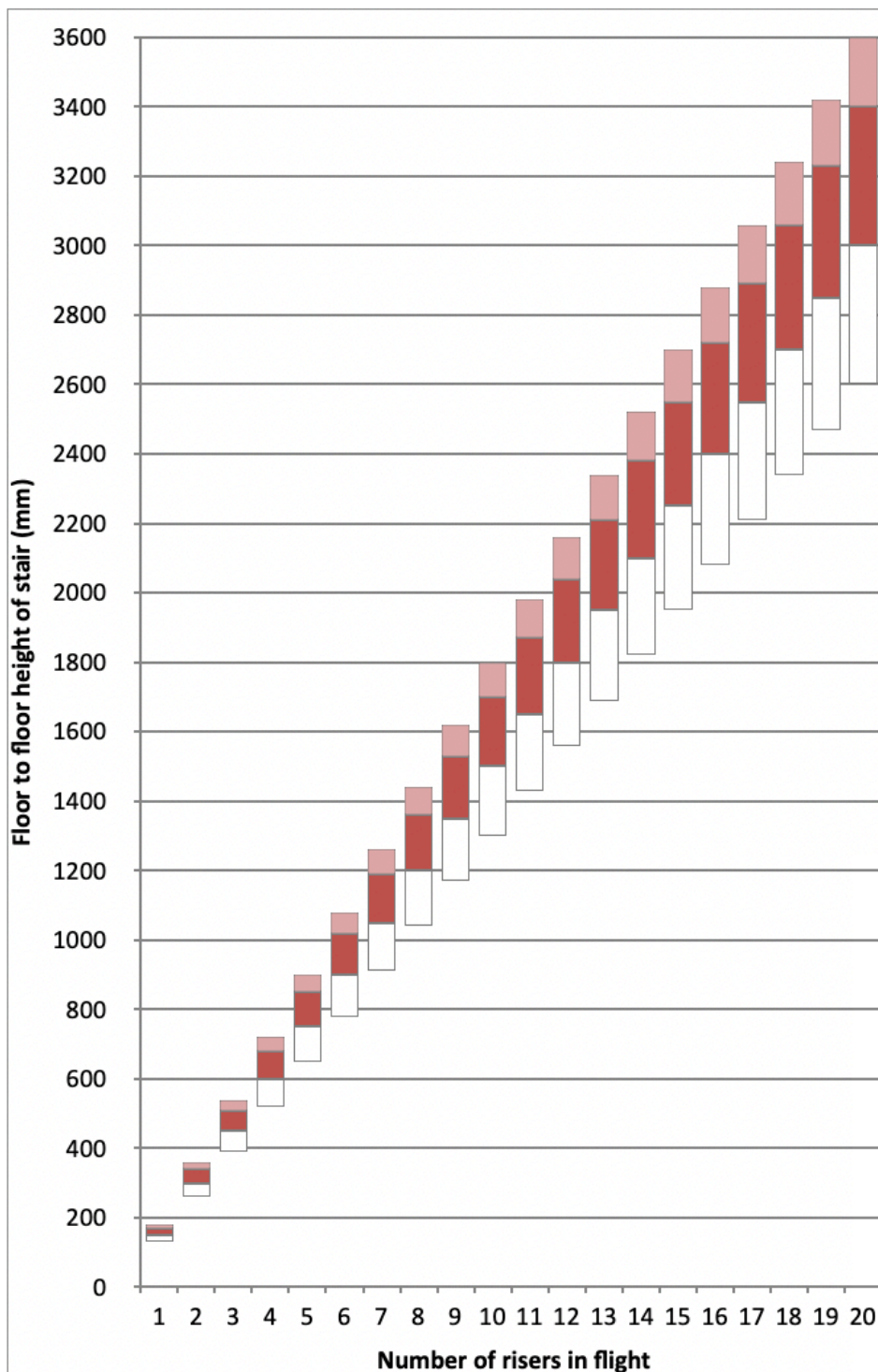


FIGURE 3 RANGE OF RISE VALUES BETWEEN 130 MM AND 180 MM FOR FLOOR-TO-FLOOR VALUES UP TO 3600 MM WITH 20 OR FEWER RISES

The lower range in Figure 3 covers rises between 130 mm and 150 mm. The 130 mm value was recommended from the BRE research and helps fill in the gaps for shorter flights down to two rises. Even though this extended range was recommended by BRE, the range was rejected in committee, probably to bring it into line with guidance in Approved Document M, leaving a similar problem for shorter flights in BS 5395-1:2010. However, the British Standard does recommend on shorter flights, less than 3 rises, not connected to a larger stair through landings or winders, the minimum rise can be reduced to 100 mm.

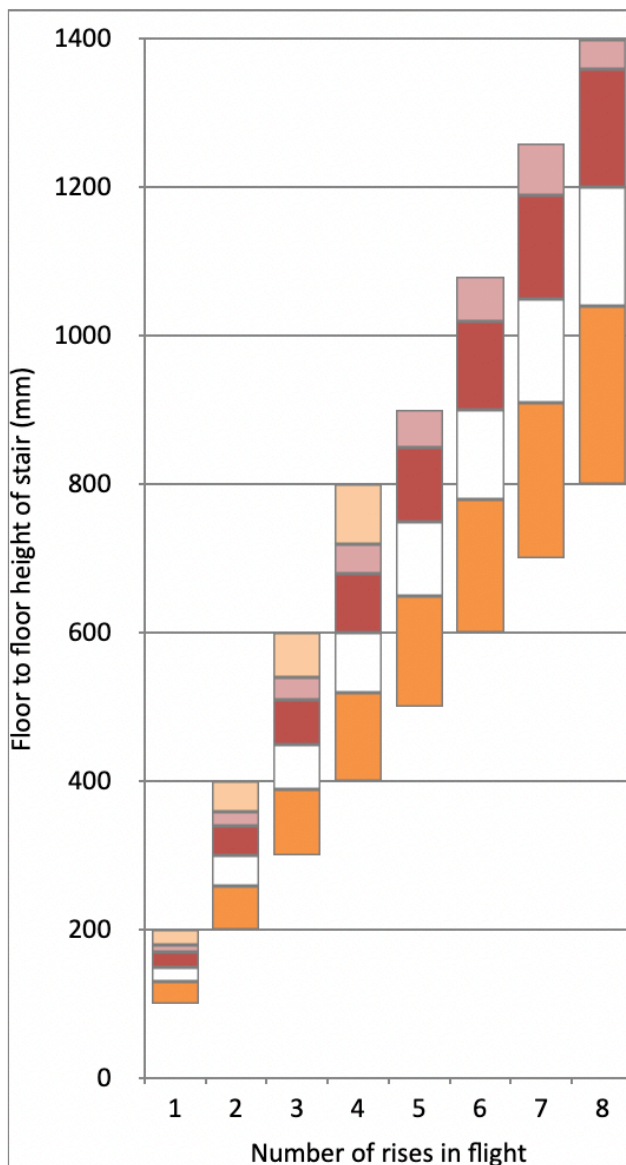


FIGURE 4 RANGE OF RISE VALUES BETWEEN 100 MM AND 200 MM FOR FLOOR-TO-FLOOR VALUES UP TO 1400 MM WITH EIGHT OR FEWER RISES

Figure 4 considers the difficulty with shorter flights in more detail, highlighting the ranges of floor-to-floor values not covered by the range 130 mm to 180 mm. It also illustrates how decreasing the minimum rise to 100 mm or increasing the maximum rise to 200 mm solves this problem on shorter flights.

From the Experimental Rig 2 research project, referred to in the previous report (MHCLG, 2025), the subjective evaluations of users on stairs with goings from 200 mm to 425 mm and with rises from 160 mm to 210 mm were compared, see Figure 5. It is noted that the mean score for all evaluations from 300 mm going upwards were significantly more favourable than the evaluations for any rise at 250 mm going or less (Wright & Roys, 2005). It is impossible to distinguish between evaluations at 170 mm rise, 180 mm rise and 190 mm rise at these larger going sizes (Wright & Roys, 2005). In terms of rise, only significant differences were found for rises of 200 mm or more on most statements, with more positive responses for 180 mm, followed by 170 mm (Wright & Roys, 2005).

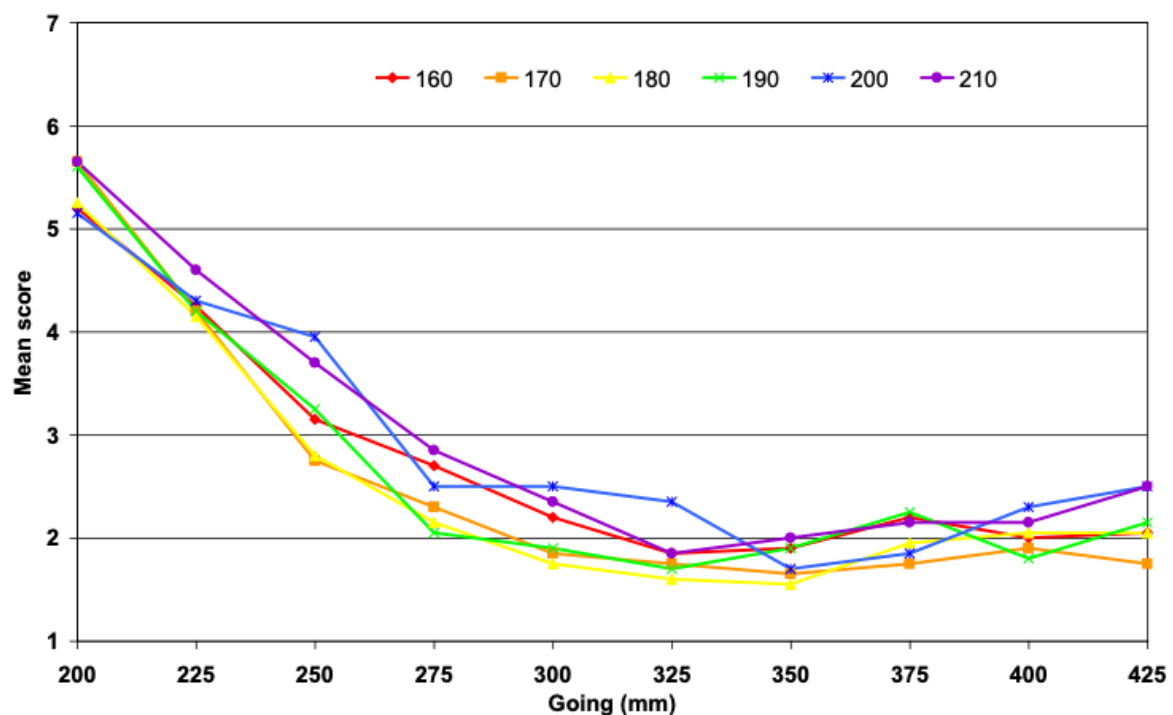


FIGURE 5 SUBJECTIVE EVALUATION OF STAIRS BY RISE AND GOING (EXPERIMENTAL RIG 2 RESEARCH PROJECT, MHCLG, 2025)

The objective results showed a similar profile, with significant positive assessments for 180 mm rise compared to a rise of 200 mm or more across all criteria. For going, the negative assessments were mostly found in smaller goings, 275 mm or less. There was one difference at 300 mm compared to larger goings, with fewer users placing all of their foot on the tread in descent. Figure 6 illustrates the average length of foot overhanging the nosing in descent for the range of rise and going values. From 300 mm goings and larger the length of the overhang is on average less than 20 mm, irrespective of the rise height. It is worth noting that the users only tested two of the rise values each, and hence any differences between foot overhang could be due to population differences more than the rise differences.

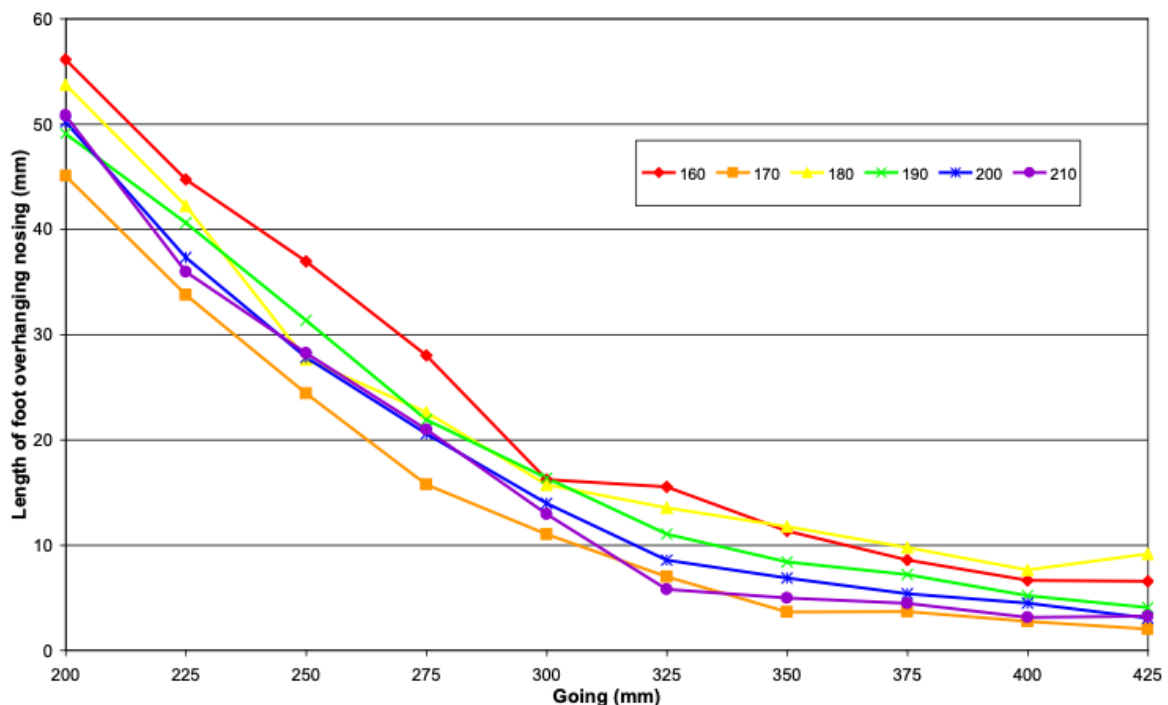


FIGURE 6 OBJECTIVE EVALUATION OF STAIRS BY RISE AND GOING (EXPERIMENTAL RIG 2 RESEARCH PROJECT, MHCLG, 2025)

One other experiment was conducted on a group of secondary school children, who experienced a flight of stairs with a rise of 170 mm, and a second flight with identical goings but with a rise of 180 mm (one conducted in the morning and one in the afternoon). The stairs were discussed after the evaluation and none of the students were able to determine what had changed between the two sets of stairs (Experimental Rig 2 research project, MHCLG, 2025).

Further experimental work would be required to see if this is also true for people with ambulant disabilities. Without this additional analysis it is very difficult to justify the change to the maximum rise from 180 mm to 170 mm in Approved Document M in the 1992 addition, which remained in Approved Document M for the later versions and copied into the 2013 version of Approved Document K.

Number of steps in a flight

How many risers should you have in a flight before an intermediate landing? This question has seen many different answers throughout the various guidance documents.

In many of the guidance documents a set of steps is only considered a stair flight if there are 3 or more rises. With a 130 mm to 180 mm range for rise, every flight with an overall rise of 390 mm or more can be built. Those with fewer rises, typically for external steps providing access to a building, a wider range, of 100 mm to 200 mm, is required to cover all possible overall rises of 100 mm or more. The 75 mm minimum value seen in Approved Document M for access to dwellings, provides a similar function of filling in the gaps of smaller overall rise values, however the 150 mm maximum rise for such steps is very restrictive, and outside the acceptable range for all other locations. It is noted that a 75 mm or smaller rise was seen as a potential trip hazard in BS 5395-1:1977, however, this was revised to any rise lower than 100 mm being considered a potential trip hazard by BS 5395-1:2000.

For the maximum number of rises in a flight, traditionally a value of 16 rises has been recommended. This would accommodate most domestic floor-to-floor heights, with a maximum of 3,520 mm at 220 mm rise, or 3,200 mm at a 200 mm rise.

Typical floor-to-floor heights for General Access stairs are more likely to be between 3,000 mm and 4,000 mm, especially from ground floor to a first floor access. With 16 rises and a maximum rise of 170 mm or 180 mm, all such flights would require an intermediate landing. Ideally the intermediate landing should try to make the 2 or more shorter flights as even in length as possible, and no flight should be less than 3 rises.

Approved Document M 2004 edition, introduced different flight requirements. For external stairs, providing access to a building, the number of rises was reduced to a maximum of 12 for flights with a going less than 350 mm, and increased to 18 rises for a flight with a larger than 350 mm going. For internal stairs to buildings other than dwellings, the maximum number of rises before an intermediate landing was 12, with no

more than 16 rises in smaller premises where the plan area is restricted. For access to dwellings, the maximum overall rise of a flight before an intermediate landing was 1.8 m, which could be anything between 12 and 24 steps, given the rise range of 75 mm to 150 mm, it also allowed a stepped threshold into the dwelling of up to 150 mm if one could not be avoided. There was no restriction for Common stairs in blocks of flats.

The 2013 edition of Approved Document K kept the Approved Document M suggestion for internal stairs when limiting the flight length of General Access stairs, with a maximum of 12 rises, except in small premises where the plan is restricted when it could be increased to a maximum of 16 rises, and the 16 rises maximum is applied to Utility stairs. It is also noted that the size of the intermediate landing length is at least as great as the smallest width of the flight, whereas Approved Document M expects a minimum landing length of 1.2 m.

For Approved Document M Volume 1, 2015 edition, the maximum overall rise of 1,800 mm for steps forming part of an additional route providing access to dwellings is applied with a rise between 150 mm and 170 mm. This applies to M4(2) and M4(3). M4(1) has 1,800 mm maximum overall rise as a stepped approach to the dwelling with a range of rise values of 75 mm to 150 mm.

In Volume 2 of Approved Document M, 2015 edition, for external stairs providing access to a building the number of risers was reduced to a maximum of 12 for flights with a going less than 350 mm, and increased to 18 rises for a flight with a larger than 350 mm going, as in the 2004 edition. This is justified in the design considerations, where 1.31 says "... People with a weakness on one side or with a sight impairment need the dimensions of the tread to be sufficient for them to be able to place their feet square onto it. If the going is towards the upper end of the dimensional range, the flight may rise to a greater height without the need for an intermediate landing, as the tread is sufficiently deep to allow a person to stand and rest at any point within the flight. It should be noted that excessive rounding of nosings reduces the effective going."

For internal stairs in buildings other than dwellings, the design considerations note that "For mobility-impaired people, a going of at least 300 mm is preferred." Otherwise reference is made to Approved Document K for General Access stairs, i.e. a maximum of 12 rises, except in small premises where the plan is restricted when it could be increased to a maximum of 16 rises.

Finally, BS 5395-1:2010 allows a maximum of 20 rises in a flight. Similar to the Approved Document M justification for increasing the length of the flight, the BSI committee agreed that the increase to 300 mm minimum going would allow users, who needed to rest mid-flight, to stop on any step safely rather than being forced to reach the designated intermediate landing. They were also aware that people with sight impairments find the transition from the flight to a landing, and visa versa, to be the most challenging aspect of using stairs, as there is little to distinguish intermediate landings from landings at the storey heights. Reducing the number of intermediate landings could therefore be beneficial to more users. Finally, the BSI committee were also aware that the larger goings would require a larger footprint on the building, and the square meterage given to circulation areas is the most costly aspect of the larger goings. The gain in space required to increase the going from 250 mm or 280 mm to 300 mm could be reduced over the whole flight if one fewer intermediate landings were required.

Figure 7 tries to illustrate this potential saving by comparing the current guidance in Approved Document K, with the guidance in BS5395-1:2010. The dotted red line represents the overall rise and overall going of a stair with a rise of 170 mm and a going of 250 mm. Every 12 rises there is an intermediate landing. Note the landing on the real stair would be mid-way along the flight, but the final overall going would remain the same. The dotted blue line shows the same stairs but with a 150 mm rise. At a floor-to-floor height of between 3,600 mm and 4,080 mm, depending on the rise height, a second intermediate landing would be required. Higher floor-to-floor heights would also require 2 or more intermediate landings.

The solid purple line represents the overall rise and overall going of a stair with a rise of 180 mm, a going of 300 mm and an intermediate landing every 20 rises. The solid green line shows the same stairs but with a 130 mm rise. Once the current guidance requires an intermediate landing, at 12 rises, the overall going of the stair is reduced when using the wider range of rise values. This is true until the wider range of rise heights also requires a landing at 20 rises. This reverses again at 24 rises of the current guidance as a second intermediate landing is required. The purple shaded areas in Figure 7 illustrate the floor-to-floor heights where the larger range of rises takes up less overall space. Note also that the flight would require 1 or 2 less steps to reach the same overall rise.

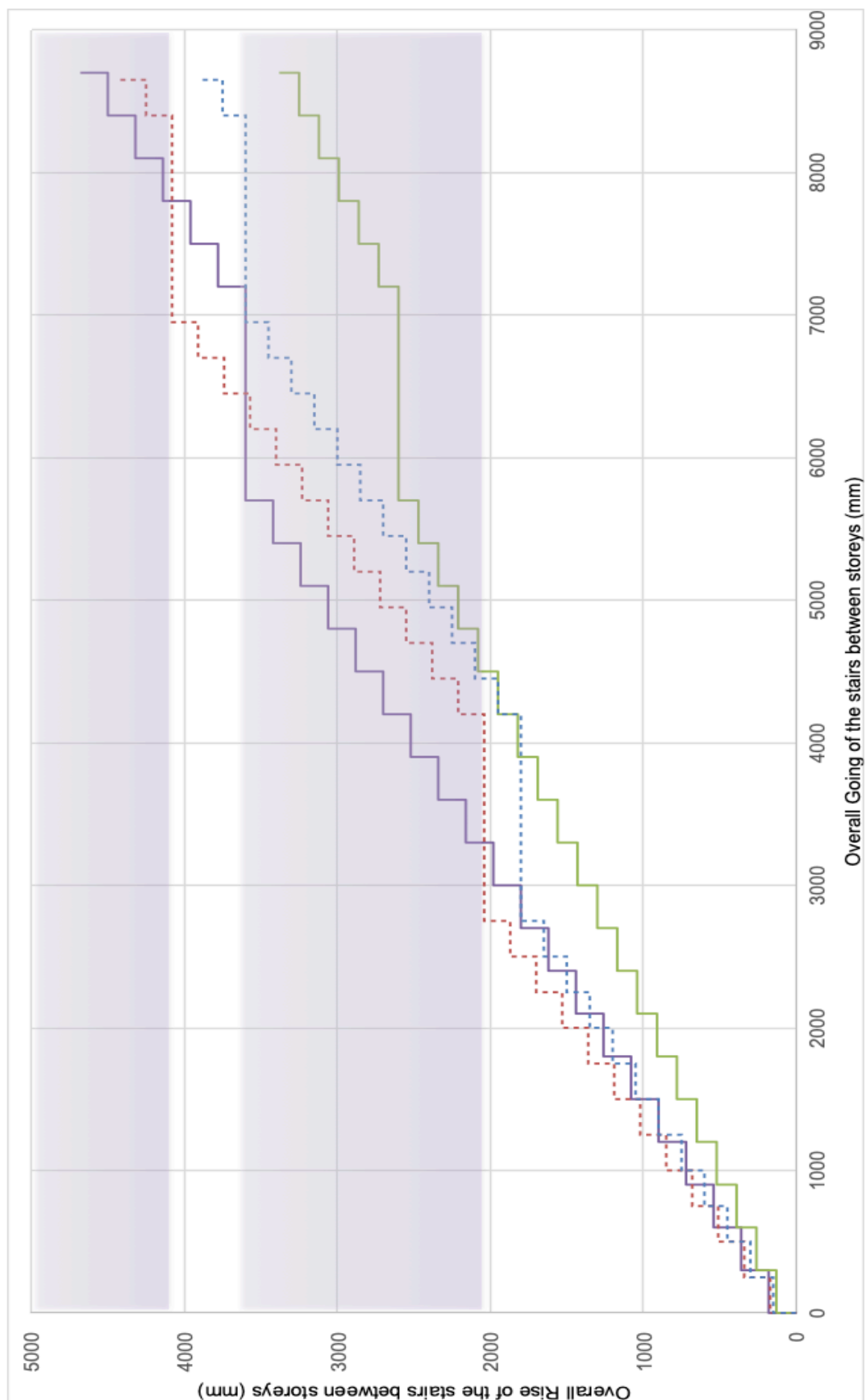


FIGURE 7 COMPARISON OF OVERALL RISE AGAINST OVERALL GOING OF STAIRS BUILT TO APPROVED DOCUMENT K GUIDANCE FOR GENERAL ACCESS AGAINST BS5395-1:2010 NORMAL STAIRS WITH EXTENDED RISE RANGE TO 230 MM. BOTH STAIR OPTIONS ARE FOR MINIMUM GOING ONLY.

Risk Assessment

The evidence suggests that the risk of a fall on stairs can be reduced by changes to the size of the going on treads. Given that the actual risk of falls on stairs is high, the relative risk between step geometries is the best indication of the potential reduction in risk between different designs, with large oversteps in descent being the main risk.

Going	Chance of 50% overhang in each step	Likelihood 1 in X steps	Relative risk reduction compared to 250 mm going	Relative risk compared to 300 mm going
250 mm	0.00038898467%	257,080	0%	2,715
275 mm	0.00002894676%	3,454,618	92.558380%	202
300 mm	0.00000014329%	697,884,478	99.963163%	1
325 mm	0.00000001847%	5,415,098,849	99.995253%	87.11%
350 mm	0.00000000020%	488,062,815,212	99.999947%	99.86%
375 mm	0.00000000007%	1,490,271,220,176	99.999983%	99.95%
400 mm	0.00000000002%	5,729,770,518,283	99.999996%	99.99%

TABLE 4 RELATIVE RISK OF A LARGE OVERSTEP BY GOING SIZE

Increasing the minimum going for General Access stairs from 250 mm to 300 mm relates to a 99.96% reduction in risk, see Table 4. It is noted that the relative risk at 275 mm going is two orders of magnitude greater than the risk with 300 mm goings, and that the relative risk at 250 mm going is three orders of magnitude greater than the risk with 300 mm goings.

For a full risk calculation, consideration should be given to both the severity of the potential injuries as well as the likelihood of harm occurring. The change in going size is unlikely to change the harm outcomes, and hence the risk is directly related to likelihood of harm. Calculations for the spread of harms have been assessed for domestic stairs. It is reasonable to assume the spread of harms remains the same for stairs in other buildings. Therefore, the likelihood and spread of harms for a General Access stair built to current regulations (250 mm minimum going) is shown in Table 5. For this calculation the cost to the NHS for each class of harm is taken from Roys et al (2016). Likelihoods are based on 80% of falls being

in descent, and a 99.96% decrease in likelihood of such falls when increasing the minimum going to 300 mm. The decrease in likelihood is also calculated for a minimum going of 325 mm, which is a 99.995% decrease. It is noted that these values highlight that nearly all the risk of falling in descent due to an overstep is removed by increasing the going to 300 mm or more. It is difficult to know how many new stair flights are built in buildings other than dwellings in England each year. There are approximately 1.8 million non-domestic buildings in England, with an estimated 8,000 new buildings built each year. It is noted that a number of the existing buildings will also be refurbished in any one year. For this calculation the costs and savings are calculated on building 8,000 new buildings per year, and each of these buildings will on average have 10 times the flights found in dwellings, and 50 times the potential users of a typical dwelling stair. Savings would be cumulative.

TABLE 5 POTENTIAL SAVINGS TO THE NHS OF CHANGING MINIMUM GOING FOR GENERAL ACCESS STAIRS (BASED ON COSTS REPORTED IN ROYS ET AL, 2016)

Spread of harm outcomes		1.90%	6.70%	21.70%	69.70%	Cost to NHS	Potential saving
Cost to the NHS		£90,000	£30,000	£1,800	£120		
Minimum stair sizes	Likelihood	Class I	Class II	Class III	Class IV		
250 mm	842	£8,123,515	£9,548,694	£1,885,582	£397,340	£19,925,131	£0
300 mm	26,312	£259,957	£305,564	£59,380	£12,715	£637,616	£19,287,514
325 mm	210,500	£32,494	£38,195	£7,422	£1,589	£79,701	£19,845,430

The cost implications for increasing the going size are more difficult to calculate given the wide range of stair construction types, the range of building heights and the additional requirements associated with circulation areas in buildings other than dwellings.

The increase in going size, from 250 mm to 300 mm, is to some extent offset by the increase in the range of rise values, 150-170 mm to 130-180 mm, and the potential increase in the maximum number of steps per flight, 12 to 20. For a typical floor-to-floor of 3-3.6 m, the increased maximum rise and the increase in steps per flight would mean the stair would take up less space than the equivalent at current Approved Document K guidance, see Figure 7. Between 3.6 m and just over 4 m floor-to-floor the benefit of the BS5395-1:2010 guidance is no longer apparent as such flights would also require an intermediate landing. However, it is noted that higher storey heights (greater than 3.6-4.08 m depending on the rise) may require a second intermediate landing under the current Approved Document K guidance.

It is also noted that the increased range of rise values would allow shorter flights, with lower overall rise values, to be supplied with a stair that meets the guidance. Under the current Approved Document K guidance gaps in overall rise are seen up to 1,200 mm, see Figure 4. By increasing the maximum rise to 180 mm and decreasing the minimum rise to 130 mm, short flights above 390 mm (3 or more rises) can all be supplied with a stair that meets the guidance recommendations. For shorter flights, potentially providing external access to buildings, the range of rise values may need to be extended further, however, it is noted that flights with one or two rises often do not fall within the definition of a stair.

While these calculations are appropriate for the general population, it is true that the proposed changes may have an adverse effect on the usability of some flights for people with ambulant disabilities. Further research is required in order to establish whether this adverse effect is true or just perceived. It is also noted that the increase in flight length may have a positive effect on people with visual disabilities.

Additional Aspects of General Access stair design

There are a number of other stair parameters that are applied to General Access stairs but not to Private stairs. In particular, the General Access stairs are not expected to have open risers, the profile of the step should be such that a user's foot is unlikely to be caught on the underside of the nosing, and that the flight and steps are easier to detect by people with impaired vision through tactile surfaces and contrasting nosings. It is worth noting that steps with a larger going (300 mm or more) are unlikely to require slip resistance on the leading edge of the nosings (Roys & Wright 2003). In that document the effect of nosing profile on the effective going is also highlighted, something that is addressed in Approved Document M.

In addition, the location of handrails, local and general lighting of stairs, and glare from south-facing glazed areas could all affect the risk associated with using General Access stairs.

This report does not cover any of these aspects.

Utility Stairs

What is a Utility stair?

A Utility stair has been given a definition in the Approved Document K (HM Government, 2013), as a stair used for escape, access for maintenance, or purposes other than as the usual route for moving between levels on a day-to-day basis.

It should be noted that Document K (HM Government, 2013) also says under “Access for maintenance”:

1.42 Where the stairs or ladders will be used to access areas for maintenance they should comply with one of the following.

- a. If access will be required a minimum of once a month: follow provisions such as those for private stairs in dwellings or for industrial stairs and ladders in BS 5395-3.
- b. If access will be required less frequently than once a month: it may be appropriate, for example, to use portable ladders. The Construction (Design and Management) regulations 2007 give provisions for safe use of temporary means of access.

At the time of publication of the Approved Document, BS 5395-3 had been withdrawn as all relevant parts had been moved to other documents, and BS 5395-1:2010 (BSI, 2010), states that industrial stairs are covered in BS 4592-0. Because of this reference in the Approved Document, BS 5395-3 had to be reinstated, but is no longer the expected document to be referenced in British Standards.

This section of the Approved Document also highlights the possibility of stairs suitable for maintenance could be designed to the provisions for Private stairs.

In previous versions of Approved Document K (HM Government, 1992) the category Other stairs had similar dimensions to those described for Utility stairs, suggesting this was the norm for stairs in buildings other than dwellings. Instead the guidance in earlier documents made provision for stairs serving a place where a substantial number of people will gather as the exception from the norm, recommending a smaller rise (180 mm) and a larger going (280 mm). This type of stair (Institutional and Assembly stairs) is no longer a category by the 2013 version of the Approved Document.

It appears therefore, that the defining factor for Utility stairs is the potential usage expectations. The phrase “... purposes other than as the usual route

for moving between levels on a day-to-day basis” implies that the Utility stair will not be a route normally taken by users to traverse between levels, but instead only used occasionally and then by a limited number of people.

Ideally, all stairs should have safer step dimensions, as suggested by the term Normal-use stairs in BS 5395-1:2010. However, some exception is given to Private stairs defined as a stair within a dwelling, intended for use only by occupants and visitors, with a sub-note, “a private stair is commonly steeper and narrower than a normal-use stair, saving space at the expense of both safety and amenity”. It is possible to conceive that some stairs in buildings other than dwellings would also have limited use and, therefore, a stair which compromises the safety and amenity of users could be described similar to those recommended for Private stairs. Perhaps this is best illustrated with some examples.

Multi-storey buildings with more than one lift or escalators, will also have alternative stairs to allow passage between storeys, and would require these stairs as a means of egress in an emergency. It is likely that a small number of potential users (perhaps less than 5%) would consider taking the stairs rather than the lift in such buildings, especially if their journey is between one and three storeys. These people may appreciate the exercise that comes from using stairs this way, or prefer not waiting for the lift to arrive at the desired floor, or dislike enclosed spaces. Most, however, if requiring longer journeys or accompanied by heavy luggage, will still prefer to take the lift between floors. These stairs might be used 10-50 times per day on average.

In the case of emergency egress, most users will be experiencing the stairs for the first time under stressful conditions with a desire to evacuate rapidly but safely. The stairs are likely to be filled by other users doing the same, and as such their passage maybe slowed. Such events may occur once or twice a year based on fire drills or false alarms, and hopefully never happen for a real evacuation. On average though, these stairs might be used less than 1-10 times per day.

It is worth noting that in an emergency egress situation, a building with escalators would most likely have the escalators stopped once the alarm is sounded, but these can still be used as an escape route. The escalator steps when stationary do not have equal dimensions along the whole flight, often containing far more than the maximum number of steps expected in a flight, and have rise values exceeding those given in the stair guidance for General Access stairs. The going on escalator steps will be, however, quite large making it easier for users to be stationary on steps while they are

moving or allowing users to pause on steps to rest should they be not moving. While this does not fit within the definition for utility stairs, it shows how steps outside the expected norm can be used in a limited fashion, especially when ascending rather than descending.

Access to plant and machinery may require stairs, to allow users to access critical components or to maintain fixtures and fittings. Such access is the subject of an European Standard, EN ISO 14122-3 (CEN, 2016) which expects the rise and going dimensions to have a $2R+G$ relationship between 600-660 mm, with a going between 210-310 mm. This allows for rise values up to 225 mm. Access to such machines may be limited, for example used by less than five different people and not necessarily every day.

If a Utility stair is only going to be used by a limited number of people, or for a limited number of times within a year, should the dimensions be as controlled as those recommended for General Access?

Going

Table 2 and Table 4 above show the relative risk of a large overstep while descending a stair with 14 rises, for flights with goings between 225 mm and 400 mm. Table 2 also highlights the likelihood of an overstep for different frequencies of use, from 5 descents per day on average through to 2000 descents per day. Another way to consider these same numbers is to look at the likelihood of an overstep occurring in any one year, so for example, in Table 2 an overstep with 2000 descents a day and a going of 300 mm is recorded as having an event once every 73 years. It is noted that the likelihood of an event is not limited by this value, but rather it is equivalent of a likelihood of 1 in 73 years every year. If an event occurs in any one year, the likelihood of a similar event next year is still 1 in 73 years.

When considering Utility stairs, the number of descents might be less than once per day, or may occur only once or twice a year. Such rare events would perhaps allow steps with smaller goings to still provide equivalent risk to larger steps used everyday by more people. Figure 8 illustrates this with a number of lines representing the average number of descents expected in use from 2,000 time per day down to one use per month.

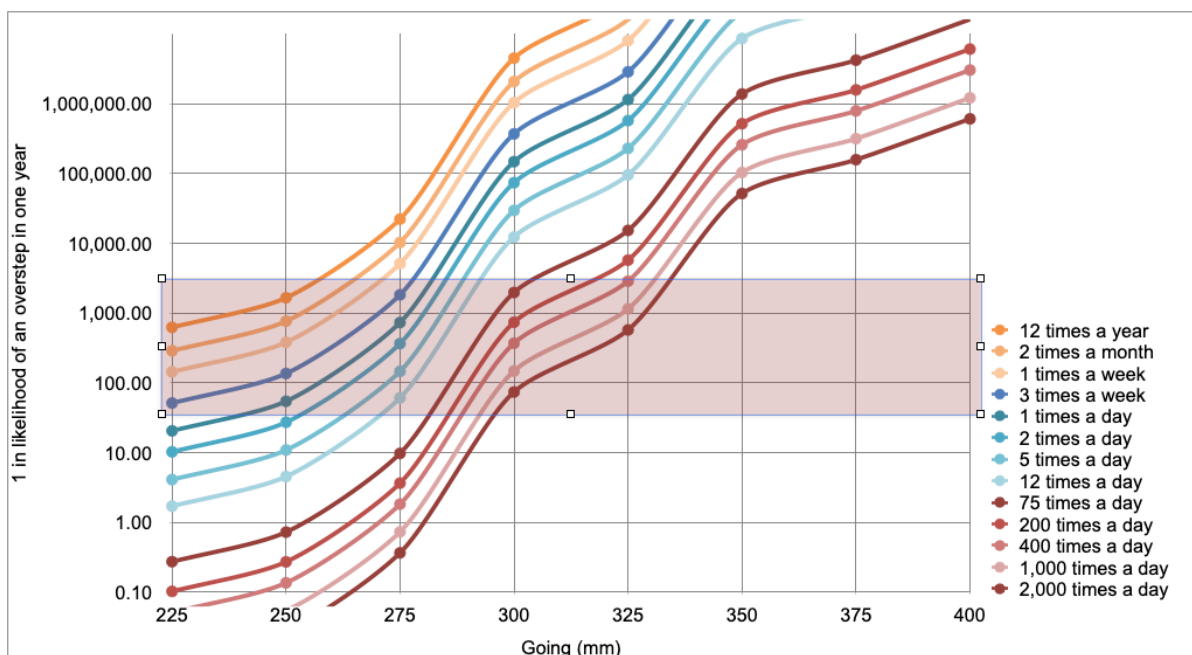


FIGURE 8 RELATIVE LIKELIHOOD OF AN OVERSTEP WITH FREQUENCY OF EXPOSURE AT VARIOUS GOING SIZES

General Access stairs may see 75 descents or more a day, which could be 25 people descending the flights three times a day, or 75 people descending them once per day. Similarly 2,000 descents per day could be 2,000 different people descending them once, for example leaving a

stadium, through to 100 people descending them 20 times every day. Plotting these values the red lines (75 to 2,000 descents per day) fall within the shaded area, i.e. between 1 in 50 and 1 in 5,000 times a year, when the going is 300 mm. Larger goings show less risk and smaller goings show greater risk. Note, the Y-axis on this chart is logarithmic, such that each unit increase is an order of magnitude increases in risk. As not every overstep would lead to a fall, it is reasonable to assume that the likelihood of an injurious event would be much rarer. For example, if a fall occurred for 1 in every 500 oversteps, the likelihood of a fall at 300 mm goings would be 1 in 50,000 to 1 in 1 million depending on the number of descents.

Stairs that are used less rarely, perhaps once a day to once every month on average, would have a similar likelihood of harm to General Access stairs when the going is 250 mm. Where it is known that the expected use of a stair is this rare, it seems reasonable to suggest allowing a smaller going, i.e. stairs built to the minimum going recommended for Private stairs. It is worth noting that the 250 mm minimum going is the current minimum going expected for all General Access stairs. This change for Utility stairs with low usage would therefore not increase the risk compared to existing guidance.

It is also clear that there is a middle band of risk equivalency for stairs with a 275 mm going. In these cases where the likely number of descents falls between 3 times a week and 12 times a day, the blue lines in Figure 8, the likelihoods of an overstep fall into the same shaded area. It could be argued that stairs with this higher frequency of use, for example Common stairs in flats or small office buildings, could have slightly smaller steps without increasing the overall risk of falls compared to larger 300 mm going General Access stairs with more frequent use.

The choice for going size for Utility stairs is therefore clearly dependent on the likely frequency of descents. Many of the stairs that would fall into this category would have frequencies of descent measured in the few times a week or less, and therefore a smaller minimum going of 250 mm could be recommended without increasing the risk, compared to more frequently descended General Access stairs with 300 mm goings. The risk of an overstep would also be no greater than is currently recommended in the guidance, as 250 mm is the minimum going size for both General Access stairs and Utility Stairs in the current guidance (HM Government, 2013). Where stairs are likely to be used more frequently than once a week, a decision as to the acceptable risk should be made. At 250 mm the risk of a large overstep is clearly larger than that expected for stairs with 300 mm

goings with more frequent use. The risk would, however, be similar to current guidance and no greater than the risk associated with BS5395-1:2010 Private stairs.

Rise and 2R+G

As noted in part 1 of this report (DLUHC, 2025), the rise on stairs has less flexibility in the options that can be provided, and is controlled by the floor-to-floor dimension between which the stair is located. As the desire is to have equal rise between each step on the flight, this overall dimension must be divided by the number of steps in the flight.

For Utility stairs in Figure 1, the recommendation for rise is to increase the maximum rise from 190 mm to 200 mm, to bring it into line with the maximum rise for BS5395-1:2010 Private stairs.

Figure 5 highlights how the risk associated with different rise values is only significantly different with goings less than 250 mm for most subjective statements, and only for stairs with a rise of 200 mm or greater. The recommended minimum going and maximum rise is right on the border of where perceived differences are apparent. Objectively from Figure 6, the difference in rise between 190 mm and 200 mm appears to be minimal with slightly more overhang for the people using stairs with a 190 mm rise than those using stairs with a 200 mm or 210 mm rise. Therefore, there is nothing to suggest that changing the rise will increase the risk of an overstep or a fall for potential users of Utility stairs.

The other difference in Figure 1 relates to larger goings, such that twice the rise plus the going exceeds 700 mm. It is noted that Utility stairs are likely to be used in places where space is limited, and hence smaller goings are expected, however, it is possible that access to some machines might require the user to remain standing on the stair rather than on a platform. This would not be recommended, but in these situations a larger going would be preferable. There is no logical reason to force a restriction on these larger goings where they might be required.

Risk Assessment

As for General Access stairs, increasing the minimum going for Utility stairs from 250 mm to 300 mm relates to a 99.96% reduction in risk, see Table 4 above. Similarly, increasing the minimum going for Utility stairs from 250 mm to 275 mm relates to a 92.56% reduction in risk. It is noted that the relative risk at 275 mm going is two orders of magnitude greater than the risk with 300 mm goings, and that the relative risk at 250 mm going is three orders of magnitude greater than the risk with 300 mm goings.

For a full risk calculation, consideration should be given to both the severity of the potential injuries as well as the likelihood of harm occurring. The change in going size is unlikely to change the harm outcomes, and hence the risk is directly related to likelihood of harm. Calculations for the spread of harms have been assessed for domestic stairs. It is reasonable to assume the spread of harms remains the same for stairs in other buildings. Therefore, the likelihood and spread of harms for a Utility stair built to current regulations (250 mm minimum going) is shown in Table 6. For this calculation the cost to the NHS for each class of harm is taken from Roys et al (2016). Likelihoods are based on 80% of falls being in descent, and a 99.96% decrease in likelihood of such falls when increasing the minimum going to 300 mm. The decrease in likelihood is also calculated for a minimum going of 275 mm, which is a 92.56% decrease. It is noted that these values highlight that nearly all the risk of falling in descent due to an overstep is removed by increasing the going to 300 mm or more. It is difficult to know how many new stair flights are built in buildings other than dwellings in England each year, and how many of these would fall under the definition of Utility stairs. As stated for General Access stairs, there are approximately 1.8 million non-domestic buildings in England, with an estimated 8,000 new buildings built each year. It is noted that a number of the existing buildings will also be refurbished in any one year. For this calculation the costs and savings are calculated on building 8,000 new buildings per year, and each of these buildings will on average have 10 times the flights found in dwellings with 80% of these falling into the category of Utility Stairs, and an average of 12 uses per day. Savings would be cumulative.

TABLE 6 POTENTIAL SAVINGS TO THE NHS OF CHANGING MINIMUM GOING FOR UTILITY STAIRS (ROYS ET AL, 2016)

Spread of harm outcomes		1.90%	6.70%	21.70%	69.70%	Cost to NHS	Potential saving
Cost to the NHS		£90,000	£30,000	£1,800	£120		
Minimum stair sizes	Likelihood	Class I	Class II	Class III	Class IV		
250 mm	842	£1,559,715	£1,833,349	£356,272	£76,289		
275 mm	10,667	£123,116	£144,715	£28,122	£6,022	£301,976	£3,523,649
300 mm	26,312	£49,912	£58,668	£11,401	£2,441	£122,422	£3,703,203

While the usage numbers for Utility stairs are much smaller than expected for General Access stairs, in percentage saving terms the savings for increasing the going from 250 mm to 275 mm (92.56%) or to 300 mm (99.96%) are still potentially beneficial.

The cost implications for increasing the going size are more difficult to calculate given the wide range of stair construction types, the range of building heights and the additional requirements associated with circulation areas in buildings other than dwellings. However, the increase in maximum rise, and the maximum number of steps per flight are likely to reduce the impact on costs, as overall footprint of the stairs is unlikely to increase significantly.

When the expected number of uses of a flight is very small, perhaps once per day or less on average, the exposure to the risk is so low that a smaller going could be considered acceptable. The number of uses of such stairs is likely to be lower than the number of uses on Private stairs in dwellings, and the infrequency of use may also lead to the users being more cautious on such stairs, compared to the stairs in their own home.

The relative risk of Utility stairs is partially driven by the definition, and partially by the expected reduction in the number of uses compared to General Access stairs. Utility stairs as they are defined in the current guidance (H M Government, 2013) covers all non-domestic stairs that are not used as the main stair between storeys within any building. The range of potential usage numbers on these stairs could range between less than once per day up to hundreds of uses every day. Since the current guidance has the minimum going for such stairs at 250 mm, applying a 250 mm going to all Utility stairs would not increase the risk of a large overstep and hence the risk of a fall in descent. This would be true even if the maximum rise was increased from 190 mm to 200 mm to match the proposed limitations for domestic stairs.

However, Figure 8 tries to illustrate that the relative risk of a large overstep at 300 mm goings, as proposed for General Access stairs, can be matched at 275 mm if the usage falls below 12 uses per day on average, or at 250 mm for usages below one use per day on average. The definition for Utility stairs could therefore be refined to better accommodate these potential risks. The following could be a suggested option for General Access Stairs and Utility Stairs.

General Access stairs are stairs that provide the main access to different levels within a building, likely to be used by 50 or more people every day, and by people with visual or ambulant disabilities.

Utility stairs are not expected to be used by people with visual or ambulant disabilities, except in emergency egress situations. If the expected number of users exceeds 50 descents per day on average, Utility stairs should be

built to the guidance given for General Access stairs. If the number of descents per day on average is expected to be less than 50, the going of the Utility stair can be reduced to a minimum of 275 mm, and the maximum rise can be increased to 190 mm. Where usage is expected to be less than once per day on average, for example access to machinery or plant, or a fire escape serving less than 100 people, then the Utility stair can be built to the guidance given for Private stairs with a reduction in going to 250 mm, and an increase in the maximum rise to 200 mm. These options are shown in Figure 9.

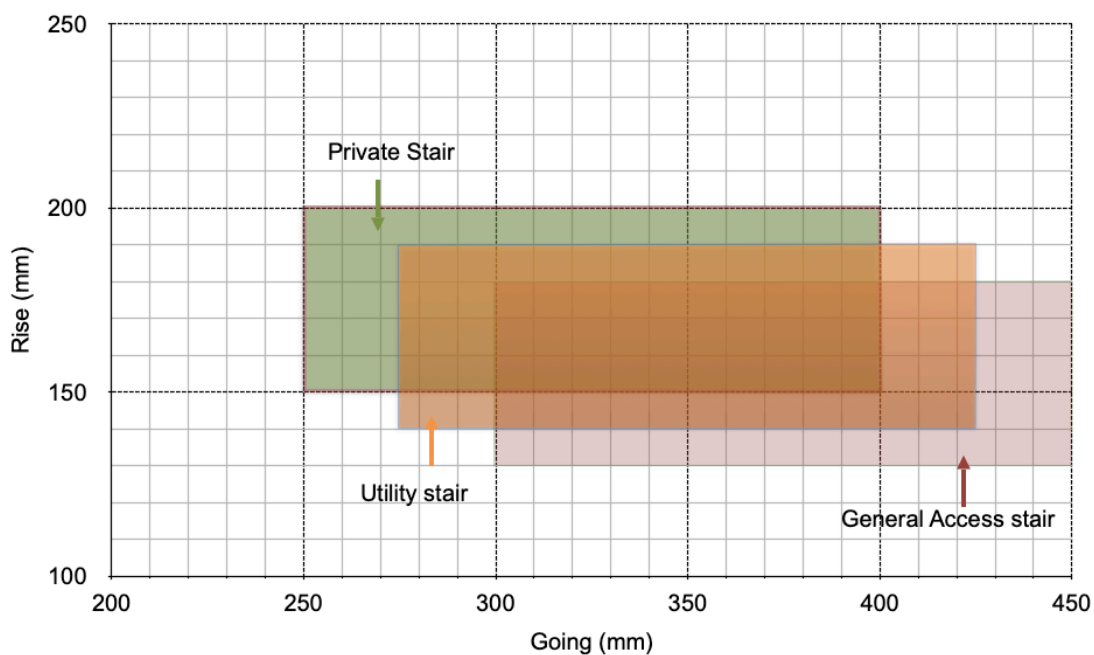


FIGURE 9 GRAPHICAL REPRESENTATION OF PROPOSED RESTRICTIONS IN RISE AND GOING DIMENSIONS FOR PRIVATE STAIRS, UTILITY STAIRS AND GENERAL ACCESS STAIRS

Conclusions

General Access stairs are likely to be used by many different users, with a variety of abilities and often with multiple users at the same time. The risks, while similar to Private stairs in dwellings, are clearly more onerous. The guidance provided in Approved Documents and the British Standards have acknowledged this difference and recommended dimensions with larger goings and smaller rises.

The recommendations in the current version of Approved Document K (2013) are very different from those provided in the latest version of the British Standard (BS 5395-1:2010). The history or guidance in both documents and in Approved Document M have been tabulated and described in this report to highlight the differences between these two documents, as well as the differences found between Approved Document K (2013) and previous versions of Approved Document K and Approved Document M, even though the intention of the revision was to bring these two documents guidance on stairs together into one document with no changes in the guidance.

Two new stair descriptions were created in Approved Document K. General Access Stairs are defined as “A stair intended for all users of a building on a day-to-day basis, as a normal route between levels.” This would include people with ambulant and/or visual disabilities. Although Assembly stairs from previous guidance, and stairs providing access to buildings had a 280 mm minimum going, the 250 mm minimum going for Internal stairs (Approved Document M, 2004) and Other stairs (Approved Document K, 1992) was carried over into the General Access stairs guidance. However, the guidance for rise was restricted to the more onerous limits placed on stairs within Approved Document M (2004). Utility stairs, the second new category of stairs, is defined as “A stair use for escape, access for maintenance, or purposes other than as the usual route for moving between levels on a day-to-day basis.” This definition appears to be a catch all for other stairs not covered by the definition of General Access stairs. The last part of this definition “... other than as the usual route for moving between levels on a day-to-day basis” would allow many stairs to fall into this category. Utility stairs guidance has the same minimum going as General Access stairs, but with a higher maximum rise value, in line with Other stairs in Approved Document K (1992).

The evidence presented to support changing the guidance for General Access stairs to mirror the guidance provided by BS 5395-1:2010 for Normal stairs, highlights the potential benefit to users and the expected

reduction in risk associated with such changes. Six potential changes for General Access stairs are considered:

- Increasing the minimum going from 250 mm to 300 mm, as recommended in BS 5395-1:2010, would provide all users a larger platform on each step giving additional support to users both in ascent and descent. This is particularly relevant in descent, where the larger going reduces the size of the overhang (the amount of the foot extending beyond the nosing) that people typically experience. The majority of falls in descent are related to overstepping, where the amount of overhang is too large to maintain traction with the nosing edge. Data from the research indicates that Increasing the minimum going from 250 mm to 300 mm would decrease the likelihood of a large overstep by 99.96%, or three orders of magnitude.
- BS 5395-1:2010 also considered that some stair construction techniques made it very difficult to ensure the dimensions were consistent between steps across the whole flight. While consistency is desirable and variation will increase the risk of a large overstep, where concrete shrinks in manufacture, particularly in-situ pouring, the result dimensional differences cannot be controlled. BS 5395-1:2010 introduced the notion of tolerances in stair dimensions, similar to tolerances allowed for all other building components. With a tolerance of 1% to 1.5% of the design going, a 300 mm going may have a maximum difference between adjacent steps of 6-9 mm. The increase in risk of an overstep is still lower than the risk associated with a smaller going and no variance in dimensions.
- The proposed increase in minimum going would mean that the amount of the building floor area dedicated to the stair would increase 700 mm or more over the width of the stair. However, the area required for stair installation, the stair enclosure, is also affected by the number of steps required before an intermediate landing. The different expectation for maximum flight lengths, or overall rise, before an intermediate landing is required is highlighted in the document. While traditionally this restriction was a maximum of 16 rises in a flight, this was reduced to 12 in Approved Document M (2004), although if the minimum going was increased to 350 mm, then the length of the flight could be increased to 18 rises. BS 5395-1:2010 used a similar argument to that provided in the Approved Document M guidance to recommend a maximum length of flight to 20 rises. This allows users who require rest in ascent or descent to stop on any step with the larger going, without being forced to rest only at the provided intermediate landing. It also reduces the number of transitions between stairs and landings for people with visual impairments, which is

what they find to be the most difficult part of stair usage. In many typical floor to floor arrangements a longer flight with larger goings can take up less overall space than a stair with shorter flights and smaller minimum goings as recommended current guidance.

- The rise range was also considered. The guidance in BS 5395-1:2010 has a maximum allowable rise of 180 mm, whereas current guidance has a maximum of 170 mm. Many users cannot tell the difference between stairs with these different rise heights, and the difference in risk for the population of potential users is negligible. On longer flights this change in maximum rise could reduce the number of steps required to reach the upper level by one, again reducing the overall space required for the stair. It is noted that this recommendation is based on ambulant users, and further research is recommended to assure the same is true for people with different ambulant disabilities.
- The minimum rise guidance was also considered. Current guidance restricts the minimum rise to 150 mm, giving a very tight tolerance for rise. Since the rise is determined by the floor-to-floor dimension, most flights can only meet the guidance recommendations with one rise option. When the flights are shorter (8 steps or less) no flight can be provided within the recommended rise range at some floor-to-floor dimensions. Decreasing the minimum rise to 130 mm would provide a greater range of stairs that can meet the guidance and in extreme conditions, 2-3 rises in the flight, like external stairs leading to a building or dwelling, the minimum rise could be reduced still further to 100 mm. It is noted that rises less than 100 mm could create a trip hazard in ascent, although a minimum rise of 75 mm is recommended in Approved Document M for external steps leading to a building.
- The maximum going was also considered, increasing the maximum from 400 mm given in the current guidance to 450 mm as recommended in the BS 5395-1:2010 guidance. There is little evidence to suggest that the 400 mm restriction is required, although at 425 mm some smaller users with shorter stride lengths were found to be required to take two steps to reach the next nosing. It is also noted that the twice the rise plus the going criteria ($2R+G$) is still present in the current guidance and this is more restrictive than the 400 mm going over the current rise range.

For Utility stairs consideration was given to the possibility of extending the rise range to include stairs typically recommended for dwellings in BS 5395-1:2010. This would increase the maximum rise to 200 mm while maintaining the reduced minimum going to 250 mm. Some stairs that fall

into this category have very limited use, likely to be used by a small number of users and/or very infrequently. This may result in the stairs being descended by someone unfamiliar with the stair once per day or less. In such conditions the risk of an overstep in descent is similar to the risk associated with General Access stairs with a minimum going of 300 mm and a frequency of use of 75 descents a day on average or more. In these low use situations the guidance provided for private stairs would be acceptable.

Where the likelihood of use is between these values, once per day to 75 uses per day on average, the risk equivalence is provided by a stair with a minimum going of 275 mm. Guidance would therefore be required to guide designers into providing stairs that do not increase the risk for potential users. The following could be suggested:

- Where stairs do not form the main route between floors, but are still expected to be descended many times within a day by all potential users, including people with disabilities, then the guidance provided for General Access stairs is recommended.
- Where stairs are expected to be used by a restricted population, for example buildings that provide a lift between floors, or that cater for smaller numbers of staff members (30 or less), or that are rarely used like fire escape stairs, a Utility stair can be recommended with a minimum going of 275 mm and maximum rise of 190 mm.
- Where stairs are providing access to machinery or industrial settings, likely to be used less than once a day on average, stairs that meet the guidance for Private stairs with a minimum going of 250 mm and a maximum rise of 200 mm are recommended. Alternative guidance for access to plant and machinery is provided in EN ISO 14122-3 (CEN, 2016). For industrial stairs, alternative guidance is provided in British Standard BS 4592-0 (2006).

It is noted that the scope of this report is limited to the rise and going dimensions and length of flight associated with General Access stairs and Utility stairs. While these are likely to be the most relevant to reducing the risk of falls on stairs in buildings other than dwellings, other aspects of stair design may also need to be considered. These include width of flights, length of intermediate landings, continuation of handrails beyond the flight, lighting, nosing contrast, tactile surfaces and shape of steps.

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