

QUALITY AS IT RELATES TO THE TILED INSTALLATION



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ACADEMIC BACKGROUND

BSc (Hon) in Physics, Manchester University, 1964

Fellow, Institute of Materials

PROFESSIONAL EXPERIENCE:

He worked for 35 years at CERAM formerly known as British Ceramic Research Association.

Initially, the research undertaken was in the tableware department. Several papers on the subject were published.

Further research was done on rheology and plastic forming, drying, distortion and process efficiency.

The last 20 years at CERAM were spent in the Tile Research Section where a range of similar projects was undertaken into various production topics. These included:

"Granulate characteristics"; "Pressing parameters"; "Drying cracks"; "Fast firing".

At the same time, there was more and more emphasis on tile performance and the installation of tiles.

This has led to membership of many British, European and World Standards committees and working groups on both tile tests and all aspects of tile application.

Many consultancies have been undertaken world-wide and he has lectured widely on the subjects of tile testing and tile installation over many years.

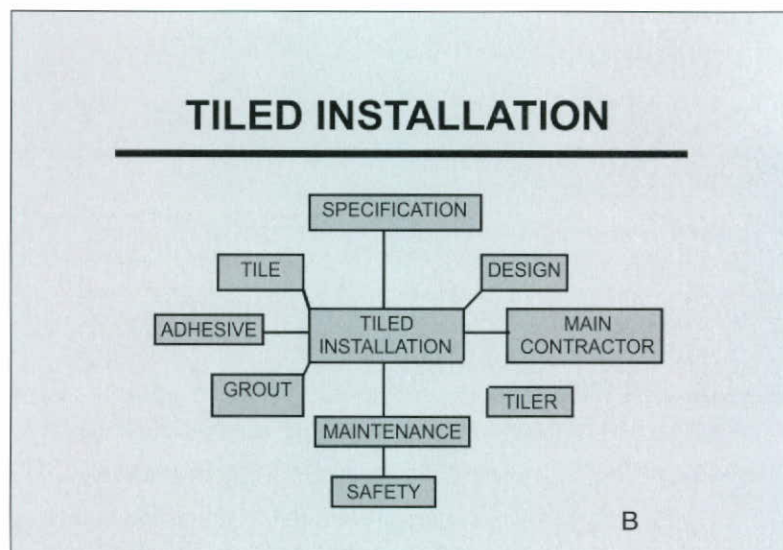
CURRENTLY: Tiling Consultant

1. INTRODUCTION

As Qualicer has become **The** world forum on tile quality, it seems appropriate for my address to try and encompass all the quality aspects as they relate to the ultimate end product. This end product is not, of course, the tile, but the tiled installation. Only when the tiles are in place on wall and floor can they begin to do the job they were intended for. For my own part, it is the product testing and installation, which has become my area of expertise. None of what I shall be talking about is new technology but I have to say that there are many companies at all stages from manufacture to installation who are 'letting the side down' and giving the whole industry a bad name. How often, for instance, have we all heard that tiles are 'no good' when in fact it is the installation or design, which is at fault.

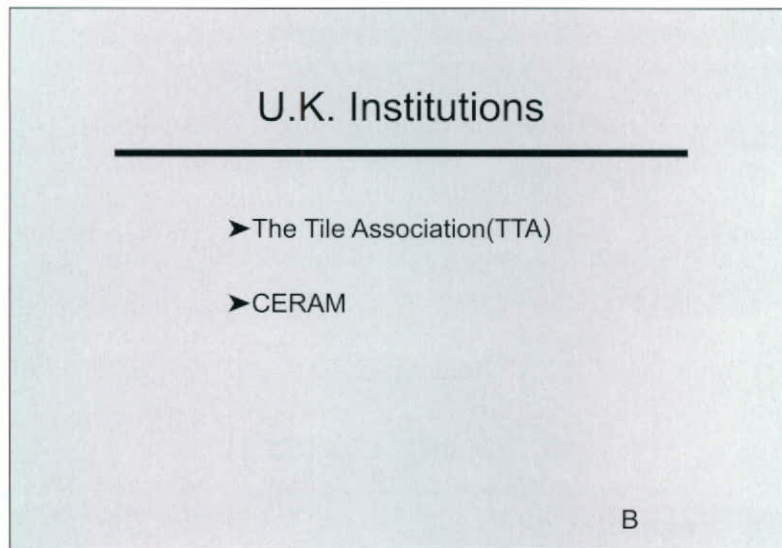
Qualicer has become established as a conference for all fields of tile quality and encompasses not only installation but also concentrates on process and manufacturing technology so it is essential for us all to be aware of all aspects of quality in achieving the best quality installation.

I have often shown slides of my concept of a tiled installation in lectures (Slide 1). You can immediately see how many factors go into the final product! The desire to ensure all quality aspects including design and installation is essential in a country like the UK. This is because tile sales are relatively low compared with Spain for instance and we have many strong competitors such as wood block, carpet, vinyl etc. They seize on any opportunity they can to argue against the tile industry. Hence it is in the interests of all in the UK tile industry to ensure a quality product and quality installation. As a result of all this, the UK tiling industry in all its facets has established a trade and technical organisation, The Tile Association or TTA, to further its own commercial interests and lay down technical guidance for installation, which encourages use of all relevant British, European and World Standards.



Slide 1

Coupled with CERAM, the UK representative of CERLABS and official UK approved tile and adhesives standards test house, the UK hopes to ensure the highest quality tiling contractors using best possible materials (Slide 2).



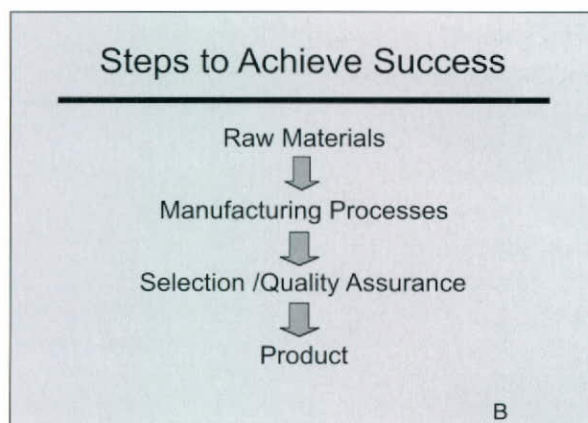
Slide 2

I'm sure this is the aim in all countries particularly those represented here today.

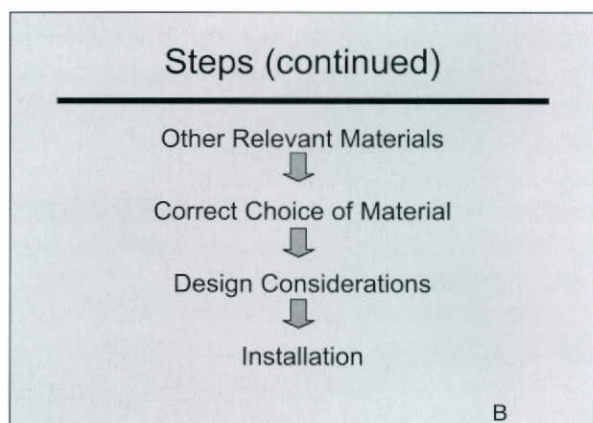
2. THE ROUTE TO PERFECTION

In this talk, I have taken a slightly different approach to achieving the goal of a high quality installation. Rather than the different requirements as shown in the first slide. I want to discuss quality on a step by step basis.

Hence we can have a basic route as shown here (Slides 3 and 4) ranging from the raw materials through many stages to actually applying the tiles.



Slide 3



Slide 4

My talk will deal with all these stages looking at the subject as a journey starting with raw materials and ending with the final installation. I will spend some time at the product testing stage to discuss some of the inadequacies of the tile tests as I see them. At the end, after the final assessment I shall make some comments on maintenance.

3. RAW MATERIALS AND MANUFACTURE

At the outset, it should be stressed that the situation is never static. Good quality today may not be adequate tomorrow. Certainly commercial pressures particularly on the manufacturing of tiles will always exist in an ever-changing world. Thus, in manufacturing, we will be seeing continuous demands for reduced unit costs /new body /glaze/decoration development/bigger tiles/random pattern application/enhanced technical characteristics/ environmental/legal requirements as shown in Slide 5. I'm sure you can think of many more.

Production Demands

- Reduced unit costs
- Bigger tiles
- New body/glaze/decoration development
- Random pattern application
- Enhanced technical properties
- Environmental/legal requirements

B

Slide 5

Basically therefore we need, raw materials which are consistent and precisely specified (Slide 6).

Raw Materials

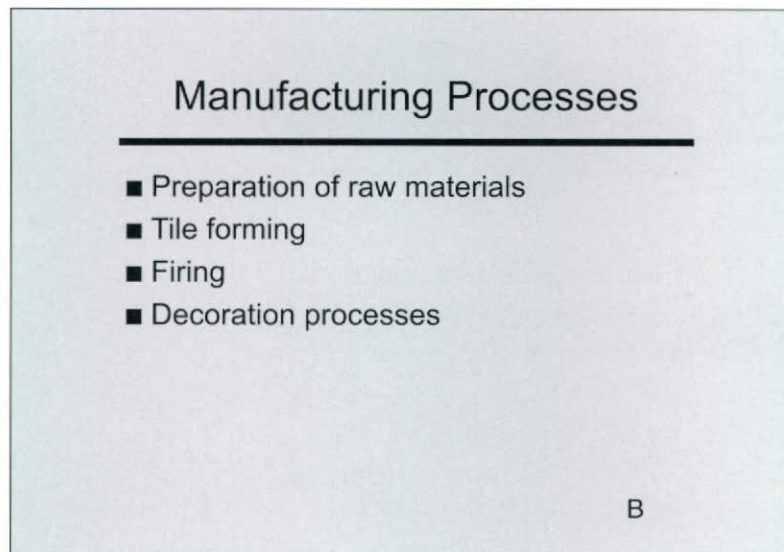
- Precise specification
- Regular supply
- Assured quality
- Assessment of new raw materials

B

Slide 6

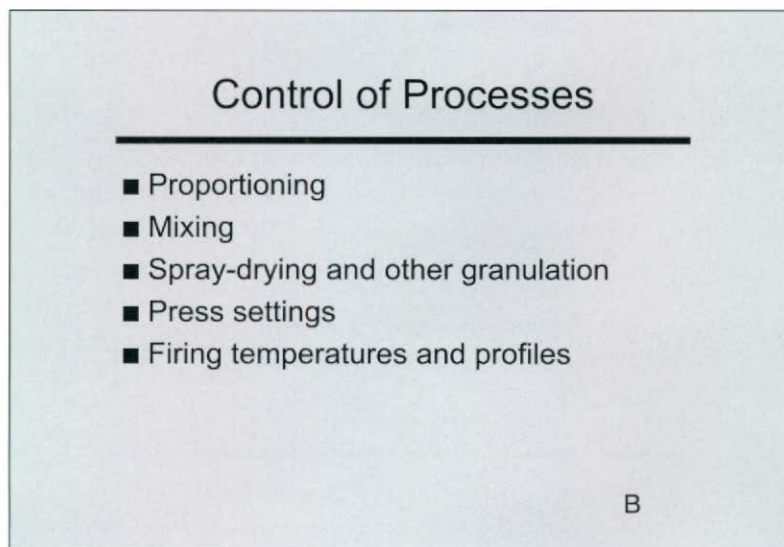
This applies to all raw materials from the body materials to colours and oxides used to create the decorative effect.

The same pressures outlined above also affect the manufacturing processes as seen in Slide 7.



Slide 7

The control of these processes is as critical as the control of raw materials. Slide 8 shows some key areas. All these areas need control and as processes are speeded up so the control needs to be more precise.



Slide 8

All factories are aware of this and have appropriate quality control checks in place. When all of this is under control, then we can pass to the next stages of the journey.

4. PRODUCT QUALITY AND PRODUCT STANDARDS

In product quality, the in-house quality control will include control of such things as colour and speckling i.e. control of individual patterns according to in-house limits. This

is outside national standards work but even standards limits are exceeded by many factory standards. For instance dimensions and flatness are often checked using much narrower limited than the standard would allow. Slide 9 reinforces these two points.

Product Quality

- Factory standards - often tighter than national standards
- Colour and pattern consistency

B

Slide 9

We come now to the subject of the international product standards. I want to ask some questions about the current tests and requirements at this point.

I did say I would make some comments here and I also said that we were in an ever-changing situation. This applied equally to product tests as it does to the manufacturing processes. In particular I hope my comments promote discussion. One very important part of a great conference like Qualicer is to air views with everyone and promotes positive discussion. We should never assume that everything is fine and improvements are not necessary. As a basis for this discussion on the standard tests, Slide 10 asks two questions. Following on from these, I now want to consider some of the actual tests.

Product Standards

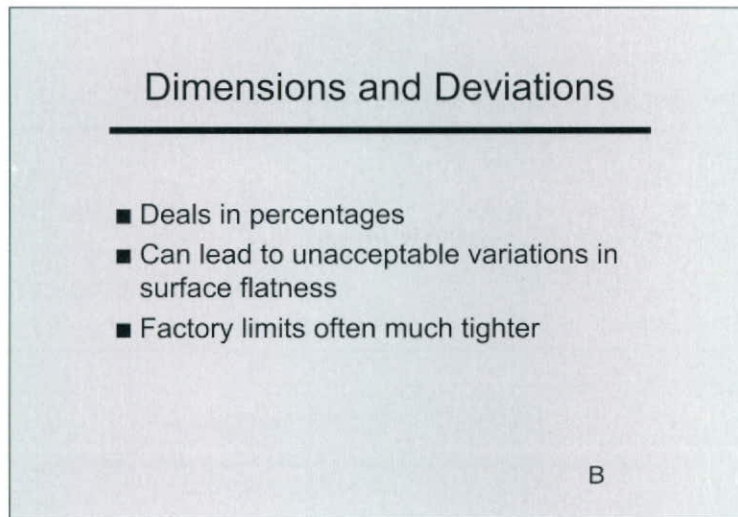
- Are they a true reflection of what the customer wants?
 - Not entirely
- Do the test give the quality guarantee that is claimed?
 - Yes and no

B

Slide 10

4.1 DIMENSIONS AND DEVIATIONS

Slide 11 deals with one test, Dimensions and Deviations.



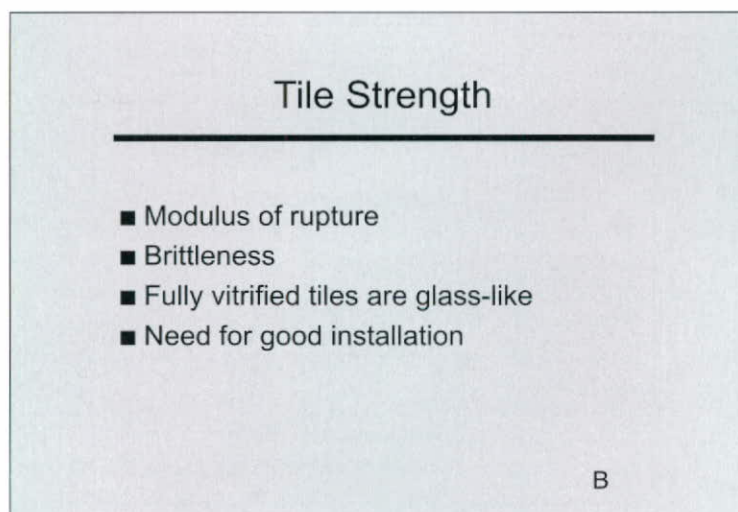
Slide 11

This test deals in percentages.

The concern is that larger and larger tiles can have larger and larger variations, which could lead to dangerous lipping, where one tile corner is several millimetres above the next one. Moreover size variation within the standard could lead to very variable grout lines. Grout line variation is often much criticised by both the installers and the customers in the UK. In some cases installation in accordance with the UK installation standard is not possible.

4.2 TILE STRENGTH

Slide 12 deals with this characteristic as measured by Modulus of Rupture. Other factors – brittleness for instance - can also lead to failure. This again is often seen in many installations and shows the absolute need for continuous bedding of the tiles.



Slide 12

I shall of course be speaking more on the subject of tile bedding later, but this reference here indicates how completely the various aspects of good tiling are linked together. So Modulus of Rupture is just one aspect of strength.

4.3 IMPACT TEST

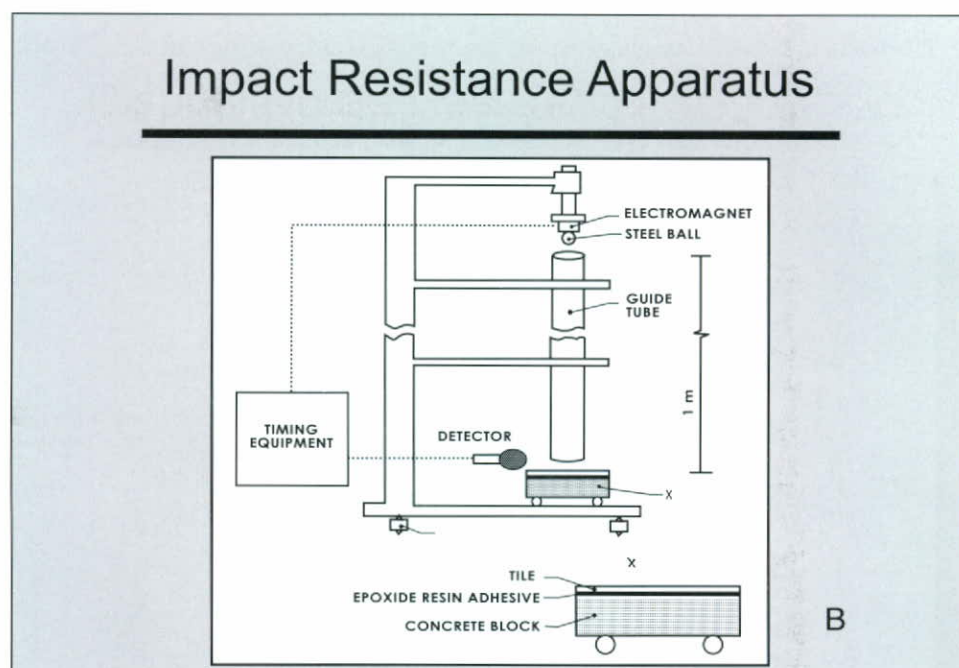
This test is one newcomer of the ISO series over the EN series of tests and claims to indicate resistance to impact by measurement of coefficient of restitution (Slide 13). It is seen in Slide 14 and I'm sure you have all seen it. Does the test as described in ISO actually tell us much? Slide 15 has some details based on my own experiences and Slide 16 suggests some other factors which can in fact alter the coefficient of restitution by larger amounts and can show types of damage possible with poor adhesive contact.

Impact Resistance

- New test
- Measures Coefficient of Restitution
- Relates this to damage resistance

B

Slide 13



Slide 14

Impact Test

- All tiles bonded with acrylic to concrete
- Test values all very similar
- No surface damage assessment
- Potential for other tests

B

Slide 15

Impact Test

- Gives information on many types of fixing arrangements
 - Type of adhesive
 - Adhesive percentage contact
 - Type of background
- Gives information on surface damage

B

Slide 16

In conclusion, as seen in Slide 17, the standard test give little useful information but can give lots of interesting results when used in other ways.

Impact Test

In summary, this test has the potential to
give many interesting results

but

Not in the standard form of the test

B

Slide 17

4.4 WEAR ASSESSMENT

There are of course two tests (Slide 18) for glazed and unglazed floor tiles. In this talk, I am not concerning myself with the unglazed, deep abrasion test, although it is always possible that there might be a hard surface skin especially with extruded tiles when the surface will be highly orientated.

Wear Assessment

Two tests

- Deep abrasion - Unglazed tiles
- Surface abrasion - Glazed tiles

B

Slide 18

I am much more concerned with the surface wear test (Slide 19) where we actually have a test for visibility of wear not actual wear. This visibility is greatly enhanced by darker colours and greatly hidden by pattern and mottling as opposed to plain.

Surface Abrasion

- Test of wear visibility
- Much more visible on dark glazes
- Much less visible on patterns and mottling

B

Slide 19

Thus a test on a light coloured tile might give class VI for instance but a similar dark tile would only be class I or II. Such tiles will be identical in terms of absolute hardness so how can the test and its guidance document on typical uses for the different classes be of any real help to potential customers?

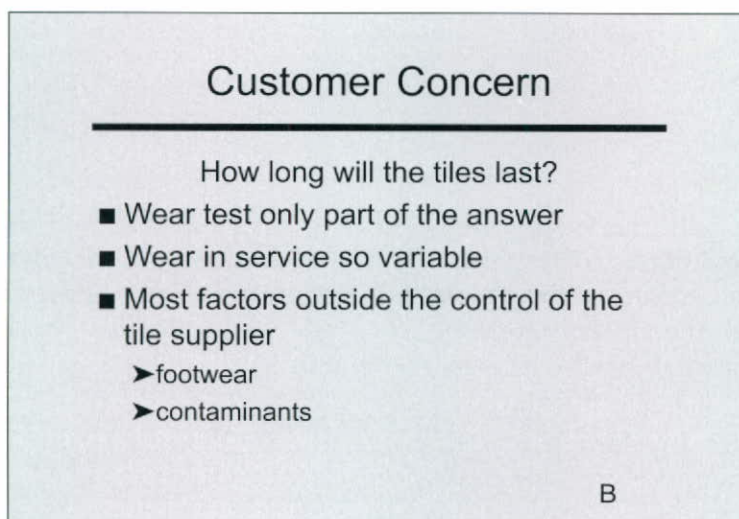
The fact is that wear will occur at the same rate on both.

In terms of this test, as in some others, the only two categories for tiles are glazed and unglazed as identified many years ago. Nowadays the demarcation is no longer so clear cut as a wide variety of new coating and finishing techniques find their way into the manufacturing process.

Polished tiles are a case in point. As a highly reflective surface it bears much more similarity to a glazed surface and wear marks will show on a polished tile just the same as a glazed item. Therefore, should this polished tile be subjected to the surface wear test?

There is no doubt that in service, such polished tiles do display the scratching also seen in glazed products.

This brings me back to our customers. (Slide 20) They always want to know how long the tiles will last. Architects need to know the same for the estimate of the life of the building. The surface wear test only partly answers this.



Customer Concern

How long will the tiles last?

- Wear test only part of the answer
- Wear in service so variable
- Most factors outside the control of the tile supplier
 - footwear
 - contaminants

B

Slide 20

To be fair, the question cannot be answered easily anyway due to vast number of variables. Since there are so many factors outside the control of the tile supplier, all that can be done is to try and categorise the tile.

Wall tiles can also show the same wear variations. Dark colours can show grout scratches more easily than light colours, the scratches appearing from careless cleaning off of excess grout.

4.5 CRAZING

This phenomena is most common on porous body glazed tiles where some moisture expansion can be experienced. (Slide 21) The problem is that crazing can occur at any time. Again it is more visible on darker colours and appears to occur more readily on

raised profile or 'dado' edge tiles. It is remarkable how variable customers' reaction to crazing is. For some, it is the ideal 'rustic texture', for others, the worst fault imaginable. Many tiles where crazing is apparent on the new tiles do not display the standards mark which remain at this time an optional standard.

Crazing

- Porous body problem
- Speed of appearance
- More visible on dark colours
- More common on raised profile or 'dado' edge tiles

B

Slide 21

4.6 STAINING

Here again customers see this problem differently than manufacturers and suppliers. In the first place, customers often do not think of this subject at all until the tiles are laid and stains occur. In the case of water staining where dampers in the tile body can be seen through the glaze, there is no test. If they knew of this problem I believe most people would not buy tiles which show water stains.

Unglazed tiles in class B1b and polished fully vitrified tiles B1a can be more vulnerable to staining due to some open pores at the surface.

Some points about this test can be seen in Slide 22.

Staining and Chemical Resistance

- Not always a clear-cut test
- Staining test only for glazed tiles
- Can occur on any unglazed tile (except class B1a)
- Customer finds out too late

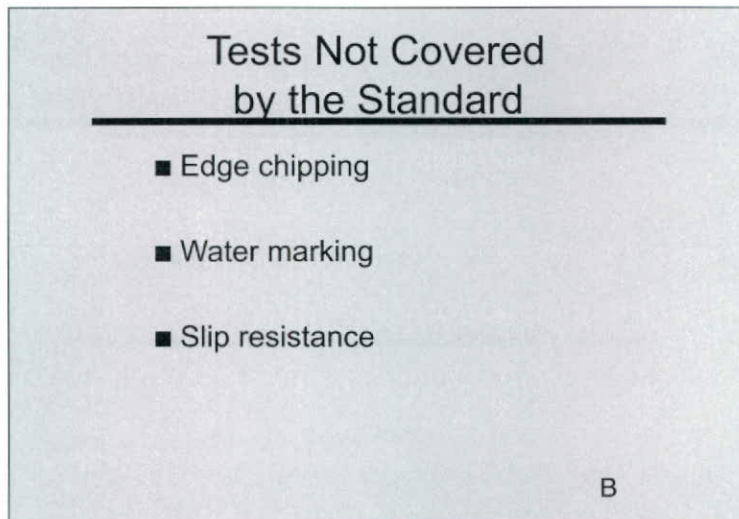
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Slide 22

5. TESTS NOT COVERED BY THE STANDARDS

Apart from tests confined to just glazed or unglazed tiles, there are a couple of others which do not feature in the standard test list. As might be expected they are either difficult to assess or very contentious or both.

Firstly there is edge damage (Slide 23). Tile edges vary enormously in terms of the chamfer, squareness, amount of glaze etc. but the resistance to damage is also affected by the grout fill and joint width.



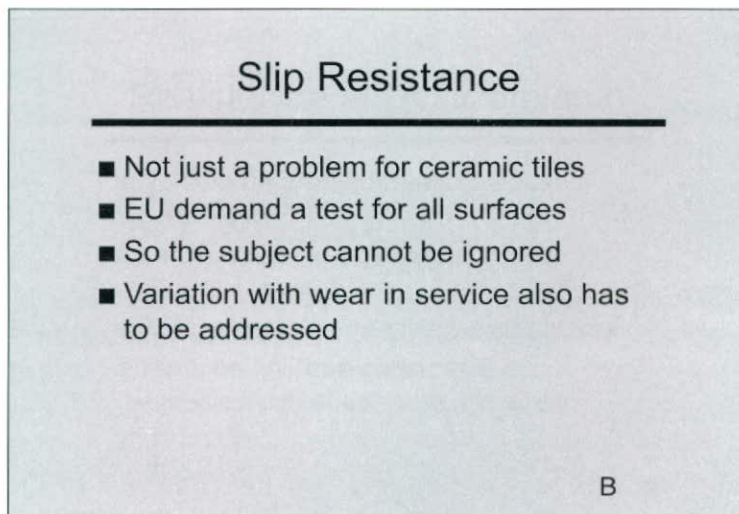
Tests Not Covered
by the Standard

- Edge chipping
- Water marking
- Slip resistance

B

Slide 23

The second characteristic on this list is slip resistance. The next four Slides (24-27) shows some of the key points which are discussed at length in the lecture.



Slip Resistance

- Not just a problem for ceramic tiles
- EU demand a test for all surfaces
- So the subject cannot be ignored
- Variation with wear in service also has to be addressed

B

Slide 24

Slip Resistance (continued)

- Many countries have national standards
- U.K. have guidelines
- Huge variations
- Desire for some simplification

B

Slide 25

Slip Resistance (continued)

- Commercial implications
- Contribution of footwear to slip
- Little information from the U.K. footwear industry

B

Slide 26

Slip Resistance (continued)

- Barefoot assessment
- DIN Ramp test
- No suitable on-site test
- Problems of site monitoring

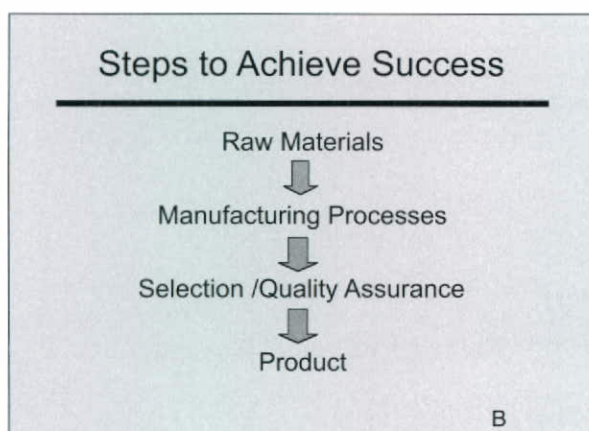
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Slide 27

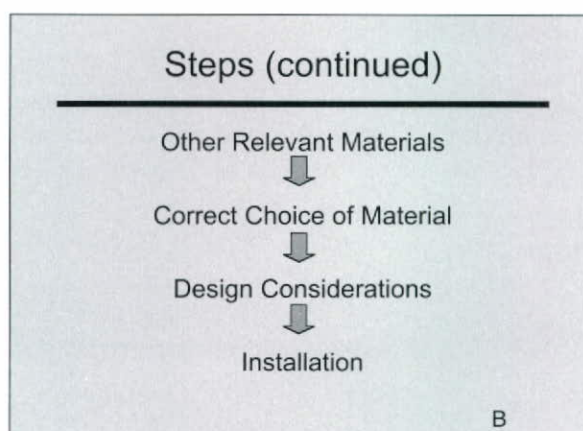
Having discussed at length some problems, as I see it, with the standard tests, it must be said that I am not suggesting that we abandon the existing tests. The tests we have are not bad considering the difficulties of agreeing test methods than have acceptable reproducibility. My main message is that we should not be complacent and, in particular, we should continue to consider test modifications when and where appropriate.

6. DESIGN AND APPLICATION

If we look at Slides 3 and 4 again at this point to remind ourselves of the position we have reached. We now have a tile of good quality. What else do we need. Obviously adhesive, bedding material, grout, suitable background. These of course need to comply with appropriate standards and adhesives and grouts in particular now have substantial European standard.



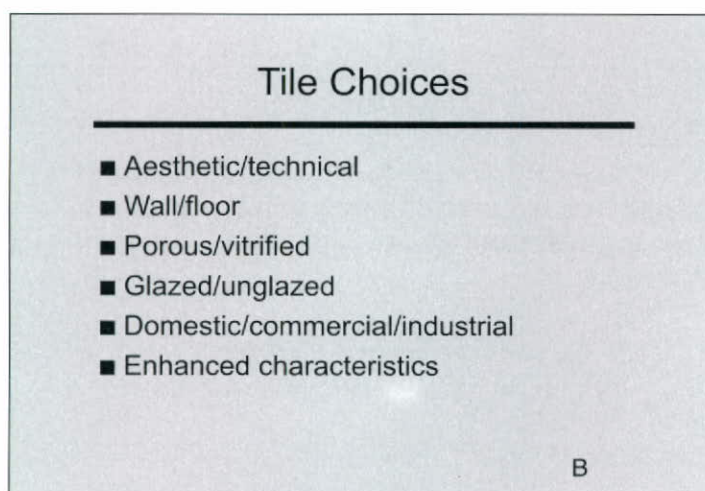
Slide 3



Slide 4

Both tile and adhesive manufacturers offer wide ranges of products for different applications and someone has to decide what exactly to specify in each case. How often do we see imprecise specification. Tiles to EN87 or BS6431 for instance or adhesives to BS5980. Such broad statements do not narrow the specification at all.

Considerable detail is needed for the tiles as in Slide 28. The same applies to other materials as in Slide 29.



Slide 28

Other Materials	
■ Adhesives	- cementitious - reaction
■ Grout	- rigid - flexible
■ Background	- concrete - compound - timber - plaster

B

Slide 29

Adhesive manufacturers in particular seem to be heavily involved in specification and can have great influence on correct choice of material. They also give strong guidance on other aspects of design as shown in Slide 30.

Design	
■ Movement joints	
■ Tanking	
■ Timber bracing	
■ Background stability	
■ Underfloor heating	
■ Damp	
■ Time-scales	

B

Slide 30

Finally we come to installation itself. Tiling Contractors are very variable if the UK is anything to go by. Anything from a reputable and long-established company to individuals to tile their own kitchen, think it is easy and set themselves up as tiling contractors. Some countries have well-established training and certification schemes and the UK is trying to move in this direction through TTA and the adhesive manufacturers' training schools. Nevertheless, there are still many people out there who are not competent to do tiling work.

The final Slide (31) gives some basic points on installation. Much of this would seem to be fairly obvious but so often the basics are ignored in the quest for speed, cost-cutting and tight deadlines.

There are still some important factors to any installation even after it has been accepted and handed over to the client. Maintenance must be adequate for the particular

installation. Two main points in maintenance are to keep the tiles looking good and to maintain safety. The latter is essential in public areas of course and slip resistance in particular can be greatly reduced by a build-up of contamination.

Installation

- Use materials as specified
- Planning and setting out
- Basic application techniques
- Proper adhesion bond
- Adequate tile/adhesive contact
- Precise and neat detailing
- Correct grout filling
- Correct cleaning up

B

Slide 31

Performance can also change over a longer time with use and wear. Again slip resistance is a key characteristic which can change. Stain resistance also comes into this category. Legislation in many countries puts responsibility for maintaining and monitoring any public access floor directly on the owners.