Laminated Sitka spruce scaffold boards - scoping study

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Executive Summary

The scoping study report is the output of the Forestry Commission contract (CFS 18 / 06) to investigate the market and potential for laminated Sitka spruce scaffold boards. The report shows that Sitka spruce, as a species, is omitted from BS2482[1] as it can not meet the strength requirements stipulated for scaffold boards. The standard also does not address the use of laminated scaffold boards, only broads made of one solid piece of timber. Therefore, the prospect initially did not look promising. However, laminating has the potential to increase structural strength over that of the raw feed stock, and this may be sufficient to meet the technical requirements of BS 2482; the indications are good. Also manufacturing the laminated scaffold boards under a "Technically Approved Product" scheme controlled by third party certification to demonstrate fitness for purpose is a potential route to market. This removes the imperative of complying with BS2482. BS2482 in not mandatory and many scaffold boards are produced that do not comply with it, though it is always good practice is to comply with relevant British Standards where ever possible. BS 5268[2] gives some indication as to the improvements in strength and stiffness that may be expected by laminating, but this is dependent upon the orientation of the laminates within the boards.

The market for scaffold boards is currently buoyant with a multimillion pound turnover in the UK and growing interest in Europe, particularly the Netherlands, though recent events with regard to a Health and Safety Executive (HSE) investigation into a failed scaffold board has undermined confidence The HSE investigation into the failed board and resultant fatality has thrown doubt on the grading and methods of production for boards. This in turn has led to a decrease in confidence amongst both manufacturers and end users as to the reliability of the grading process and consequentially the safety of the product. One of the UK's leading producer of scaffold broads (the John Brash Group) has expressed an interest in investigating the potential of laminated boards as they feel that an engineered product would give them greater quality control of boards leaving their factory, being a an engineered product with reduced variability.

The issue of the predisposition of Sitka spruce to develop compression creases has been highlighted as an area where there needs to be more work as at this time no indication can be gained as to whether laminating will reduce the incidence of compression crease development. If the development of compression creases can not be reduced then even laminated boards made from Sitka spruce would be unwise.

Whilst BS 2842 covers a range of species, some of which are UK grown, the market is dominated by European redwood / whitewood due to availability and price. Sitka spruce as a raw feed stock could compete in terms of ready availability and on price, though the cost of reengineering needs investigating.

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Introduction

Scaffold boards are a staple requirement of the construction industry for temporary access and working platforms. Though many other materials have been used and continue to be tried, timber scaffold boards still account for the largest share of the market, around 85%, for temporary access. They have many advantages; being simple in design and use, cheap and readily available. But they do have disadvantages; determination of service life and site damage are two such factors.

In general the industry is well regulated with active liaison between scaffold board producers and scaffolding installers, both having a vested interest in ensuring that the product and manner of use is safe and appropriate. The Health and Safety Executive (HSE) in its drive to reduce construction site injuries watches closely the activities of both producers and installers. In the view of the HSE all accidents have contributory factors. The producers of scaffold boards and scaffold installers are very familiar with this stance and hence seek ways to ensure they are fully compliant with health and safety requirements. Even with the diligence applied over the course of a year there are several reported near miss incidents or occasionally even a fatality. Therefore, scaffold board producers are always keen to investigate new methods and materials to improve the product and scaffold board safety.

BS 2482 – “Specification for timber scaffold boards”, has been the benchmark for ensuring that the technical performance of scaffold boards is maintained and this has ensured to large degree the safety for end users and some protection for producers. However, it can be seen as prescriptive and even restrictive document as it has not kept pace with developments in the timber processing industry or material science. It addresses solid timber of a limited number of species, of which Sitka spruce is not one. The standard, whilst it has been under review for a number of years, has not made any significant changes to the current 1981 document. In reality all standards and codes of practice lag a number of years behind what is commercially possible and even further behind what is technically feasible. It is with this view in mind that this scoping document attempts to address issues relating the use of laminated scaffold boards and in particular laminated scaffold boards made from Sitka spruce.

The aim is to address issues that may be barriers to their use and discuss methods by which these can be mitigated. At the same time, ensuring safety is not compromised and that board performance can meet or exceed the current technical requirements of BS 2482, whilst meeting the customers need for confidence in the product that British Standards confer in the mind of the purchaser. In most cases the customer wants the reassurance of a product made to a verifiable standard; however, there are still a considerable number of boards being produced and sold that have not been manufactured to or conform to BS 2482.

BS 2482 - Specification for timber scaffold boards: 1981

The scope of BS2482 states:

"*This British standard specifies requirements for scaffold boards made from sawn softwood. It specifies a single grade, which, may be assessed visually or by machine stress grading. Timber quality is stipulated for boards 225mm width and thickness of 38mm, 50mm and 63mm."*

In essence BS 2482 is designed to ensure that scaffold boards produced to the standard are safe and serviceable within the current limits of equipment, knowledge and acceptable commercial risk. It can be seen from the second sentence that whilst safety and serviceability are of the utmost importance there is always a degree of uncertainty involved in that process. The standard has two methods of grading the boards to ensure fitness for purpose, either visually or by machine. In consequence the layman would assume that by this process all risk of unserviceable boards entering the market place has been removed. However, anyone familiar with timber will realise its innate variability and further more anyone familiar with the grading system will appreciate that no system is totally accurate due to this variability. Visual grading relies on being able to accurately attribute values to a set on identifiable characteristics and being able to reconcile variations in the results such that definitive guidance can be given as to performance. Machine grading relies on the machine to measure some parameter that can be related back to strength and or stiffness. Both visual and machine grading systems are limited by the quality of the original samples used to establish the data bases on which the systems operate. There is a possibility that there are characteristics that are rare and therefore may never have been taken into account when developing the grading systems, but they may occasionally occur within boards. Though rare such features can have unfortunate consequences for strength and if unrecognised by the grader can enter service. Therefore, the accuracy of the grading system may not be as good as many would like to believe, leaving a small but significant risk of failure in service. Added to this situation is that visual grading of boards is only as effective as the grader that carries out the process chooses to make it, and many reputable producers are known to skip the more time consuming processes of the grading regime in a search for productivity. What should be stated is although the grading of scaffold boards is not perfect it is of significant value in helping reduce accidents in the work place and is highly desirable over no grading at all.

The standard contains a table that lists the acceptable timber species for the manufacture of scaffold boards, but a note also states that the table may be amended to include other timbers when information is available. Table 1 below reproduces the list of species suitable for BS2482, the species in this table will meet the strength requirements for scaffold boards when machine graded to the machine settings or visually graded to the criteria laid down in BS2482, which is independent of any other grading standard. What is clear is that UK grown Sitka spruce is missing from the approved list. This is not an oversight that can be corrected by demonstrating the fitness for purpose of Sitka spruce. The situation is that as a solid timber Sitka spruce is neither strong enough nor stiff enough to meet the requirements set down in Appendix C of BS 2482 (machine settings and visual grading rules). The standard addresses the requirements of solid timber only and not the requirements for laminated or re-engineered products. This should not be too surprising as re-engineered timber products are still a relatively new concept in the UK and still need to develop a proven track record.

Standard name
Imported
Redwood
Whitewood
Canadian species combinations
Douglas fir – larch
Hem - Fir
Spruce – pine - Fir
British grown species
European larch
Japanese larch
Douglas fir*
Scots pine

* machine graded only

Table1. Permissible species in BS 2482.

It is always advisable, and to be recommended, that where a British standard exists every effort should be made to work within its guidance and comply with the requirements, though they are not compulsory and many companies operate wholly outside their guidance. In certain cases it is possible to demonstrate compliance to a British standard yet go beyond its requirements to produce a product that exceeds the

minimum performance requirements, which may offer a marketing advantage. There are circumstances where even with the best intentions relevant British standards can not be complied with; as what is intended falls outside of the scope of that standard even when developing products covered by the standard. The use of laminated Sitka spruce for the manufacture of a scaffold board is one such occasion. Though compliance to the standard can not be demonstrated, exercising the spirit of the standard can. There are mechanisms that will allow the development of novel products where no appropriate BS standard applies. One such mechanism is the “Technically Approved Product” and this will be addressed in depth later in this report.

The current market for scaffold boards

The current market for timber scaffold boards is buoyant within the UK, based on three manufacturers machine grading and several more visual grading. All currently use European whitewood as their primary source of timber due to cost, easy of supply and fitness for purpose. The producers of scaffold boards and scaffold board using companies have a forum for industry discussion through the National Access and Scaffolding Confederation (NASC).

Whilst exact statistics for scaffold board production are difficult to acquire the NASC estimate that there are several million new scaffold boards per year entering the market place, most as replacements for existing boards. In financial terms this is a multi-million pound market for BS2482 graded boards alone, with possibly as much again for ungraded boards. The John Brash Group, one of the most progressive producers of scaffold boards, converts 50,000 m^3 of timber (mostly European whitewood) each year, which roughly equates to 1.2 million standard sized scaffold boards, a market for the John Brash Group of around £3.6 million pounds, excluding VAT.

However there are two pressures on this market; the first threat comes from Eastern European supplies (mainly Russia) and the second from the HSE. The Russian supply usually does not conform to the requirements of BS2482 in so much as the boards have not been graded and the basic dimension for thickness fall below the 38mm stated in the standard. Even with these variations from the accepted norm the boards sell in large numbers, at a cost below BS2482 boards. This puts pressure on the legitimate producers to stay competitive, with possible implications for quality as margins are squeezed and there is a need to increase productivity. Whilst price pressure is one concern pressure is also being applied to the industry from the HSE.

Recent history within the scaffold board industry has drawn close scrutiny from the HSE, the governments directives to drive down the number of construction site injuries along with the HSE philosophy that there is “no such thing as an accident”, as all accidents have contributory causes, has put the scaffolding industry under close scrutiny. A recent case has highlighted the current HSE drive to improve site safety. The incident happened three years ago during the construction of an oil storage complex in Kent. The incident involved a fabricator who dropped on to a relatively new scaffold board that failed under his weight and though the worker was wearing a safety harness, it was not attached, and the incident resulted in his death. HSE pursued all parties, with particular attention being paid to the scaffold board producer and the grading machine manufacturer that produced the machine on which the failed board was graded. The board was from a highly reputable supplier of machine graded boards and they used a computermatic grading

machine to grade the board to the full rigours of BS2482. Unfortunately the board that failed was a very rare occurrence of severe slope of grain that was undetected by the grading machine, although the board was graded to BS2482 by the producer and the machine was approved for scaffold board grading using the settings specified in BS2482. The producer and machine manufacturer were challenged by the HSE to admit contributory liability for the fatality. It was only at the Maidstone Coroner's court in January of 2006 that the jury found both the producer of the board and machine manufacturer not to be responsible for the individuals death. During this investigation BRE held a watching brief as "Technical Expert" for the machine manufacturer.

The HSE investigation has had ramifications through the whole scaffold board producing and using industry. BRE was asked to present a paper on scaffold board grading at the May 2006 meeting of the NASC Technical Committee. The actions of the HSE had cast doubts throughout the industry as to the acceptability of graded scaffold boards, some producers were talking of only visual grading and others of not grading at all. Scaffolding erectors were looking for clarification of the safeness of graded scaffold boards and need reassurance. The grading process had been shown not to be as accurate as the industry had perceived, though in reality based on the number of boards produced each year, the grading system works exceptionally well. The industry is now seeking ways to improve reliability and safety of the scaffold boards.

The scaffold board industry is innovative and BRE have tested plastic composite scaffold boards which were claimed to be specifically engineered to meet the requirements of the scaffold board industry. The composite boards could not conform to BS2482 due to the nature of their composition, but were tested in direct comparison to timber scaffolds boards that did comply with BS2482. The composite boards were found to have excessive deflection under load, well in excess of the timber equivalents, and the deflection increased with time (creep). The ultimate strength capacity was also less for the composite boards compared to conventional timber boards. Therefore, although willing to investigate new approaches the industry requires a high degree of confidence in the products produced.

Industry view

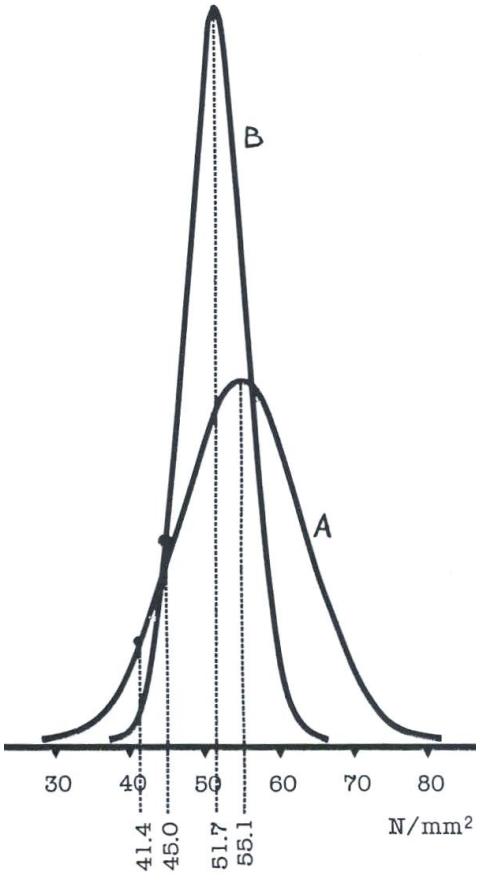
BRE have been in discussions with the Operations Manager, Mr S Beattie, of the John Brash Group, who are major scaffold board producers. The basis of the discussions has been the current state of the market and ways of improving the product. Their main concern is to reduce the risk, as far as possible, of scaffold boards failing in service. They accept that once the boards have left their factory the performance of the board to a large extent is in the hands of the user. However they wish to be able to demonstrate that they take every conceivable care in the manufacture of their scaffold boards to ensure that at the point of leaving

the factory they are as safe as it is possible to manufacture them. This was assumed to be the case until the recent HSE investigation of the industry. The fact that occasional boards can get through the manufacturing process, even after the full rigours of BS2482 has given them concerns as to the quality of production.

The John Brash Group have expressed strong interest in the possibility of laminating scaffold boards as they see this as a method of engineering out the natural variability of the original product and giving them greater quality control of the product. They have recently acquired a number of laminated scaffold boards of European origins and were impressed by their performance, which reinforces their interest in laminating scaffold boards themselves. However, to achieve this end they would need technical guidance to ensure that their processes produced a safe and serviceable board. They have expressed an interest in participating in any project that may be established to investigate the potential for them to produce laminated boards.

Meeting the technical requirements from laminated stock

The principles underlying laminating material for structural purposes is in essence simple, that is to reduce overall influence of any individual strength reducing characteristic and thereby attaining better strength performance than is possible from unlaminated material of the same starting quality. Figure 1 shows the effect laminating has upon structural strength compared to unlamiated timber of the same initial quality.



In the illustration to the left, distribution A shows an idealised distribution of strength for a sample of unlaminated timber. This has a sample mean of 55.1 N/mm ^{2} and a 5th percentile value (the characteristic basis for structural strength) of 41.4 N/mm ^{2}. The total range for the distribution is from just below 30 N/mm ^{2} to above 80 N/mm ^{2}. When this is compared with distribution B for laminated timber from the same species, it can be seen that the total range has been significantly reduced (just below 40 N/mm ^{2} to just below 70 N/mm^2). The 5th percentile value has increased from 41.4 N/mm ^{2} to 45 N/mm ^{2}. However, the mean of the distribution has been reduced from 55.1 N/mm ^{2} to 51.7 N/mm^2.

Therefore the effect of laminating timber is to significantly increase the usable structural strength (5th percentile value) and at the same time to reduce overall variability.

Figure 1 Illustration of the effect reduced variation has upon laminated strength

So by reducing the influence of any single defect (knot, slope of grain or similar) by bounding the limits of the defect with sound timber, structural strength can be significantly increased. However, stiffness and density are not enhanced to the same degree, if at all. Therefore, some degree of pre-selection for the denser and stiffer material may be needed to meet the technical requirements for scaffold boards.

Laminate lay-up.

There are two aspects to the lay-up arrangement for the laminates:

- Adding technical performance by lay-up arrangement
- Ease of manufacture and best use of materials

At this stage it is not known whether these two requirements are mutually exclusive or whether they can be arranged so that the best technical performance and greatest ease of manufacture can be combined in a single lay-up arrangement.

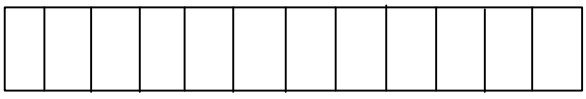
By the manner in which the boards are laminated it may be possibly to contribute to stiffness which would negate the need to pre-select the stiffer boards. However, this needs to be determined and demonstrated.

BS 5268 gives two possible modification factors for strength and stiffness:

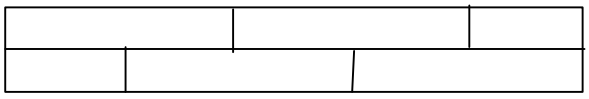
- Vertically laminated (based on 7 laminates*), strength can be increased by a factor of 1.24 and stiffness a by a factor of 1.30.
- Horizontal laminated (based on 7 laminates*), strength can be increased by a factor of 1.39 and stiffness by a factor of 1.07.

* This number of laminates is used only as an indicative value for strength and stiffness.

For scaffold boards the two most likely lay-ups due to ease of manufacture are shown in Figure 2.



Suggested lay-up for vertical lamination



Suggested lay-up for horizontal lamination

Figure 2. Possible lay-up configurations for laminated scaffold boards, (the number of laminates shown is only illustrative and not intended as a design solution).

From the evidence in BS5268 the vertical lay-up arrangement suggests it may prove the better arrangement, though it should be remembered that the guidance in BS5268 is for traditional style glulam whereas the scaffold board is a simpler product. Though this may seem a fine distinction it is a question of scale where traditional glulam is of large cross section (nominal reference size in Eurocode 5^3 is 150mm x 600mm), whereas glued laminated products are much smaller, in this case 38mm x 225mm. It should also be remembered that a scaffold board is flexed, as a plank, about the minor axis as opposed to traditional glulam that is flexed as a joist, about the major axis. These points may affect the overall performance and therefore definitive evidence for the most appropriate arrangement and the resultant increase in strength and stiffness needs to be sought.

The vertical arrangement of the laminates appears to offer greatest manufacturing ease, produced either as single items or as an laminated block that is later cut down to produce multiple boards; whichever method is used the boards will require a degree of final finishing. The horizontal boards require greater accuracy in the laying–up to ensure that the faces all meet appropriately for gluing. Work carried out at one of the UK's largest saw millers into horizontal laminating of falling boards demonstrated the difficulties in this arrangement, though with a higher degree of automated plant the alignment issues may be overcome.

Selection criteria

To commercially produce laminated scaffold boards there has to be some selection or grading process of the feed stock or finished boards. Solid boards are either machine graded or visually graded against a set of criteria that will allow the boards to meet the require technical performance. With laminated boards there are two possible ways of ensuring the finished boards meet the technical requirements:

- Machine grade the finished boards as would be done for solid timber boards.
- Pre-grade the laminates against a set of developed criteria that will allow the finished boards to be designed to meet the technical requirements.

Machine grading.

This would allow the use of unsorted material to be used in manufacture and the fitness for purpose determined by machine grading of the finished boards. For firms that currently have strength grading machines for the production of BS 2482 boards this may appear an attractive option and could prove to be. However, there are both commercial and technical questions that will need addressing. Firstly the greatest proportion of the cost of the boards will be due to the re-engineering. Therefore to produce boards that may later be rejected as unfit for purpose is highly undesirable. One way around this difficulty would be to

exercise some pre-selection of the material being used for the laminating stock. This would resolve some of the issues of boards being produced and rejected but adds an additional process step that incurs cost.

The second difficulty is in regard to grading re-engineered products. As already described the laminating process can significantly reduce the natural variability within the material. It is this variability that bending type grading machines (the only current machine type BRE would recommend for grading scaffold boards due to their ability, in most cases, to detect slope of grain) use to derive the settings that allow for safe grading. The reduced variability would require a much reduced bandwidth between the settings that determine a pass or fail board. It is not known at this time if current grading machines are sufficiently sensitive to be able to operate on such extremely fine setting tolerances, and therefore the possibility of mis-grades exists.

The current settings for scaffold boards in BS2482 are more than likely inappropriate for grading laminated material. In 2005 BRE carried out research on behalf of the Forestry Commission to investigate the potential to machine grade re-engineered Sitka spruce boards (laminated) to current machine settings for structural use, BRE report 222- 187[4]. The results clearly demonstrated that laminated Sitka spruce could not be graded using existing settings. Not only were the results unsafe but the fundamentals of grading did not seem to apply. When comparing the strength, stiffness and densities of the rejects, C16 and C24 samples there was virtually no difference in results with the rejects being similar to the C16 and the C24 values. This clearly shows how unsuitable these current settings for solid timber are when applied to laminated material.

Pre-grade the laminates

The structural and mechanical properties required of the feed stock must be known so that the scaffold board can be designed to meet the required performance, these properties therefore must be first determined. Having determined the required structural properties these need to be mapped to identifiable features within the boards that can be used in the grading or selection process. It is a simple task to set up a suitable grading regime, the difficulty comes in being able to carry out the grading at a speed high enough to produce the large numbers of laminates that would be required to meet production needs. There are really only two ways in which this can be achieved, either by machine grading the laminates or by automated optical scanning.

Machine grading the feed stock has the main benefit of using current machine settings for structural material to select the C24 strength class. A C24 strength class is required as this allows the target value for strength in BS 2482 to be met when the modification factor in BS 5268 is applied to the C24 permissible stress. These could be bought in if the manufacturer did not want to produce their own, unfortunately only a

limited yield of C24 is available from Sitka spruce. Additionally, machine grading below 35mm x 60mm is not permitted due to the excessive deflection required to produce a recordable load. The relative large size of the feed stock, with regard to the scaffold boards cross section, leaves only a limited number of permutations of lay-up arrangements possible. Added to this, is the fact that bought in graded material may not have sufficient head room with regard to price, to bear the cost of re-engineering, making such scaffold boards uncompetitive on price. The material that has greatest head room for re-engineering is falling boards, unfortunately these are of smaller dimensions than can currently be machine graded. Therefore, this approach excludes the most cost effective material from the process. Falling boards are possibly the strongest and stiffest timber produced from a Sitka spruce log and these would make ideal feed stock for laminated scaffold boards. This is where optical / visual scanning has great benefits.

Optical visual scanning offers greater flexibility than current machine grading but requires more work to make the approach market ready. The use of scanning technology is increasing within Europe and the UK, as it is seen as away of increasing productivity over more conventional visual grading / selection methods. This approach has benefits and drawbacks. Mapping across the notable visual features that determine the required structural performance is a relative straight forward task. However, the scanners can only determine features based on colour contrast or grey scale tonal quality, features such as slope of grain or density can not be measured by the scanner and therefore additional measures need to be sought to ensure such features are correctly controlled. However, using such technology would permit falling boards to be used, utilising both the quality of the material and their low cost to make re-engineering a commercial possibility.

Demonstration of fitness for purpose.

Once produced the boards will need testing in the following areas to demonstrate fitness for purpose:

- Strength
- Stiffness
- Creep

These characteristics for laminated scaffold boards can be determined using the methods described in BS 2482 and the results obtained will give a good indication of potential success in meeting the technical requirements. It would be a wise precaution to not only test the boards to BS 2484 but also benchmark the boards against the performance of production European whitewood / redwood boards to fully characterise the boards overall performance.

The adhesive bond should be tested to demonstrate that it can meet the service life criteria of normal scaffold boards (cycling moisture contents and high deflections); to ensure there is no premature failures due to adhesive bond degrade. The use of an EN301 adhesive (suited for service class 3 conditions) should ensure a bond quality suitable for conditions under normal circumstances but the high deflections that can be experienced by scaffold boards, particularly when their moisture content is high will require investigation to ensure fatigue failures do not occur.

Compression creases

The one area of concern about the use of Sitka spruce for scaffold boards is the ease with which compression creases can be generated within the timber. This is partly due to the low density and partly due to the low stiffness of the timber. The low stiffness allows for potential over stressing and high deflections to result, which can generate compression creases. The low density is indicative of the lack of wood substance and due to this, the timber can offer little resistance to the development of the compression creases when stressed. At this point it is unknown whether laminating the timber will reduce the tendency for Sitka spruce to generate compression creases. If the indications in BS5268 are correct when applied to scaffold boards an increase in stiffness should reduce this tendency. The presence of the glue-line may act as a natural break to the propagation of the crease to the adjacent laminate, but this is uncertain. Therefore it is recommended that testing is carried out to investigate the ease of compression crease formation in laminated boards and benchmark this against scaffold boards made from European redwood / whitewood.

It is believed that the predisposition to compression crease is a greater threat to the success of laminated Sitka spruce scaffold boards than any of the other technical performance issues, as they are a known point of weakness for products like scaffold boards. They do not affect the bending strength or the stiffness of the timber but they do significantly reduce the impact strength. This is a critical property for scaffold boards as they can be subjected to high “jump” loads by construction workers on site. Once a compression crease is present in a board, the board is a **potential failure waiting to happen**. The potential to detect compression creases in boards is very limited, for boards used on site it is it is almost impossible due to their surface condition. The most successful way to detect compression crease is a visual inspection of a freshly planed surface, which in the scaffold board industry is an impossibility. Some stress-wave equipment manufacturers make claims for their product to be able to detect compression crease but this relies on a break in stress wave transmission by a discontinuity of the adjacent surfaces of the crease. Many compression creases do not have such a discontinuity, therefore only large open creases will be detectable.

It needs definitive testing to establish the resistance of the laminated Sitka spruce scaffold boards to compression crease formation before it would be wise to proceed with manufacture. Currently there is no definitive research available on which to base any judgement as to success.

Technically approved products

Innovation in the market place happens with greater rapidity than the development of national and European standards. Normally it is not until innovative products have become the norm that standards tend to be drafted for their inclusion. This could be seen as a barrier to market development by inhibiting innovation but there are ways of bringing new products to market and ensuring they are fit for purpose. The "Technically Approved Product" is the most common approach for developing new products beyond the limited cover afforded by standardization. They define the product, its performance and method of production; this is done independently of the manufacture under a third party certification scheme. Probably the best know type of technically approved product is the BBA certificate. The certification body undertakes third party verification of a customer's product and verifies that it meets a defined set of performance criteria, and issues a certificate where appropriate. Whilst BBA is the best known other certification bodies offer similar services, including BMTRADA, BSI and BRE Certification.

The technically approved product is the most feasible route to getting laminated scaffold boards made from Sitka spruce into the market place. Technical approval for scaffold boards made by any other process than that covered by BS2482 would require the manufacturer to demonstrate:

- The strength requirements of the board is equal to or superior than a BS 2482 board.
- The creep and deflection characteristics of the board is equal to or superior than a BS 2482 board
- The adhesive bond of the laminations is in excess of the stated service life of the board, this would require a service life equal to greater than a BS 2482 board to be commercially viable.
- The incidences of naturally occurring degrade of the board to be similar to that of BS2482 boards.
- These performance criteria would need to be demonstrated for all boards taken from a number of non-consecutive shifts to ensure production quality control.
- The quality of the feed stock needs to be defined.
- The method of production would need to be defined and broken down by manufacturing procedures in a manner that allows third party audit to ensure conformity in production.

Drawbacks to technically approved products

Whilst the technically approved product allows access to the market for products that do not comply with a noted British or European standard, they also have drawbacks that should not be overlooked and can add to the overall cost of production.

These are:

- A tightly defined product; once the product has been defined in terms of the technical performance, nature of construction and methods of production and these have been accepted by the third party certification body for audit purposes no changes can be made to the product or manufacturing process. This obviously limits the potential of the product to be continually improved and reduces overall production flexibility to incorporate changes post certification.
- Cost – third party certification incurs a cost additional to normal production costs. There are initial setup costs involved with the certification process, the need to provide independent verification of performance, plus the initial audit carried out by the certification body to establish the product. Finally there is the yearly cost of running the scheme with a minimum of a yearly audit; some schemes require 6 monthly audits.
- Cost associated with variation of the product description, performance or method of manufacture. When the manufacturer wishes to apply changes to the product or production methods, these most be independently verified and audited.

Conclusion and recommendations

1. Laminated Sitka spruce scaffold boards do not comply with BS2482 due to species and method of construction

2. It is highly doubtful that Sitka spruce as solid timber can ever meet the technical requirements of BS2482, therefore this species will be permanently excluded from use as scaffold boards, thereby reducing a potential market, but as a laminated product there is a strong possibility that a scaffold board made from such material can meet the required technical performance.

3. Laminating has been shown to considerably increase useable structural strength, and there is a possibility that an increase in stiffness can also be achieved, if an appropriate lay-up arrangement is used.

4. Calculations based on the modification factors in BS5258 suggest that the feed stock requires a C24 strength class timber. Whilst this would be difficult from normal structural Sitka spruce it is possible from falling boards.

5. BS EN301 adhesives suitable for service class 3 (exposed) may give a bond that has sufficient service life for scaffold boards.

6. Production of laminated Sitka spruce scaffold boards (if proved to meet the necessary technical requirements of BS2482) would need to be under third party certification and produced as “Technically Approved Products” both to ensure the quality of the scaffold boards and give confidence in the market place.

7. Whilst it is believed such scaffold boards could meet the technical requirements of BS 2482 there is an unresolved question as to the development of compression creases. If an improved resistance to the development of compression creasing can not be definitively proved by test then regardless of all other technical issues it would be unwise to proceed.

8. At this point it is not known whether laminated scaffold boards could be produced at a competitive cost or if they could be sold at a premium due to their reduced natural variability. Currently there are no producers in the UK with the capacity to achieve economic production. There is, however, one producer of scaffold boards that has expressed an interest in developing

the technology for designing and producing laminated scaffold boards but they are far away from having most of the plant required to do so.

9. Laminated scaffold boards are or have been produced within Europe which demonstrates an understanding of the potential of the product.

10. To get a commercial producer to consider production there must be a clear and definitive body of work demonstrating the potential of both the species and the technology on which they can base their own testing and verification programme for third party certification.

References

1. British Standards Institution, Specification for timber scaffold boards, BS 2482: 1981. London.
2. British Standards Institution, Structural use of timber: Part 2, Code of practice for permissible stress design, material and workmanship, BS2568: 2003.London.
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4. BRE 222- 187 – Evaluation of the potential to machine grade re-engineered timber using current machine settings. March 2005.