A New Methodology for Collecting and Analysing Building Stone Information and its Potential Benefits to Local Planning and geology

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The study of building stone has a direct impact on understanding the built environment and assists planning policy and the conservation of buildings. This paper explains the importance of conducting a building stone survey and proposes a method for the survey using the Borough of Taunton Deane as an example. The survey follows a municipal boundary which intersects a long stratigraphic record of sedimentary and volcanic rocks from the Devonian to the Pleistocene. The analysis of building stone data show that use of laid stone was close to its outcrop although building design and rock properties have influenced use. The study shows the value of local building stones as a resource for geological teaching and leisure use. Historically, builders in Taunton Deane had a wide variety of choice of building stone. The use of these diverse rock types as building stone have imparted a unique and individual character to settlements across the borough.

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Background

In 2015 the Historic Environment Service of the South West Heritage Trust (SWHT) identified the need for a survey of traditional building stones in Somerset (South West Heritage Trust, *Unpublished*) to assist with preserving the character, appearance and local distinctiveness of towns and villages in the county. This paper describes the geological aspects and results of the application of a methodology developed by the authors to collect and include in a database, building stone information in Taunton Deane.

Importance of Building Stone Surveys

Geological knowledge about building stone provides a basis for conservation of existing buildings and sets a planning framework for preserving the distinctiveness of towns and villages. Building stone surveys provide a valuable record of local geology, the industrial use of stone and historical information about the development of transportation. Educationally, building stone provides access to good examples of evidence for sedimentary processes and environments normally difficult to see in the field. Enterprising museums and societies recognise the educational and tourism value of these 'outcrops' by creating tours of the best examples.

The work for which this paper describes the geological part integrates all aspects of surveying building stones in the borough of Taunton Deane, covering the area shown in Figure 1. We propose a methodology for building stone surveys, illustrate how the recorded data can be used and show the geological benefit of conducting such a survey.

Figure 1. *Location and extent of Taunton Deane.*

Methodology for Building Stone Surveys

Approach to recording building stone type

Unpublished previous work has been conducted in Somerset by Mike Barr (*pers. comm.*) who recorded in detail the geology of building stones of individual buildings and stone structures and Hugh Prudden, who compiled a table of building stones of Somerset Churches (South West Heritage Trust, 2019). In his table, Prudden adopted an architectural approach by classifying stone type in Somerset by church structure, such as tower walls or buttresses. Neither of these previous surveys have analysed the data collected. Prudden also produced several

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publications on the local geology and building stones (Prudden 2001, 2003a, 2007). Elsewhere, Bone (2016) adopted a method which, used the terms Occurs, Common and Abundant to describe qualitatively the relative abundance of Sussex church stone types.

For vernacular buildings and boundary walls we aggregated the data by settlement. For churches and significant civic buildings, we rejected Bone's method in favour of estimating the percentage of each building stone type used in walls and dressings. This approach for churches provides for a more accurate breakdown of the building stone type usage which can be represented digitally and allows for data analysis using Geographic Information System (GIS) software. Further refinement of our method could be achieved by using Prudden's method of recording the stone type according to where in the church it was used. Data aggregation satisfied the objectives of SWHT. Where building or walls had more than one stone type, we recorded each type as a fraction of the total.

Identification and description of the building stone types

We have used currently accepted names as far as possible to describe the building stones. Where the use of a modern term is not appropriate, as it does not clearly define the rock type, we have used the traditional names for building stones even though these names may be obsolete. Table 1 shows the correlation between traditional building stone names and the present-day stratigraphy. Prior to commencing work on the survey, a review of literature (Edmonds and Williams, 1985; Prudden, 2003a; English Heritage, 2011) identified sixteen local building stones or groups of building stones which we might expect to be able to identify in the field. During the survey this number increased to twenty-one. Rock types were identified by visual inspection based on colour, grain size, composition and other features such as sedimentary structures. All rocks exhibited some degree of weathering given the age of the buildings surveyed. The rock types were calibrated to the nearest known outcrops or geological horizon identified on BGS mapping. This calibration is based on the assumption that usually the poor state of roads and the cost of transportation before the mid-nineteenth century, would limit the transportation distance from the extraction point to building use. Where stratigraphy was uncertain, such as two sandstones looking similar, calibration was achieved by looking for the nearest potential source.

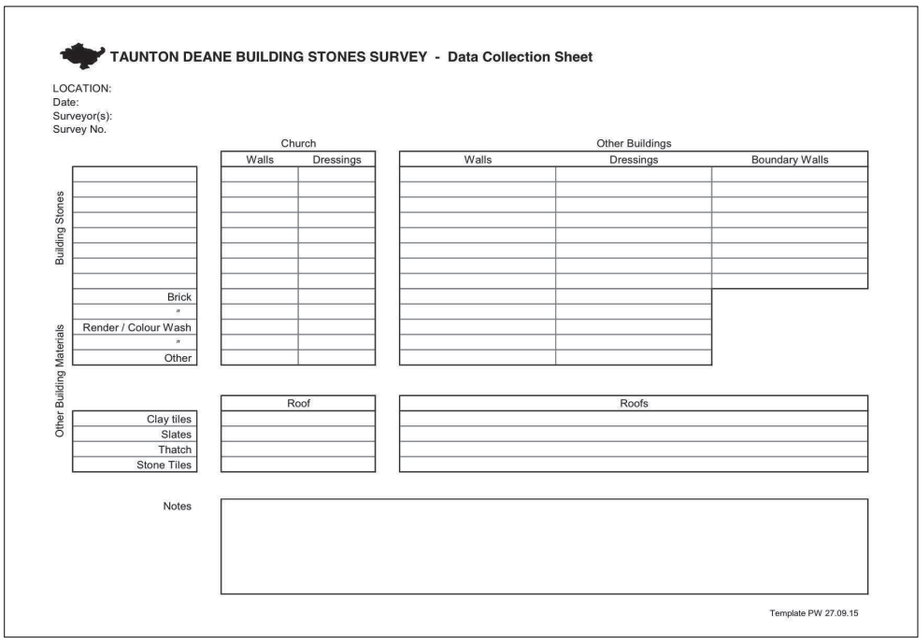
Field work method

The principal data collected were the building stone type used in the external walls of buildings, including dressings and boundary walls. Dressings are defined as any stonework which surrounds an opening in the walls of a building such as around a window or door. Cut stone used elsewhere in the building, such as that used at corners, was recorded as part of the walls. Data on the other materials used for the construction of building walls such as brick, cob and render, and roofing materials such as slates, stone or clay tiles and thatch were also collected but this paper only discusses the building stones recorded in this survey. The other data were recorded as part of a wider SWHT investigation.

Surveys were conducted on a parish by parish basis, by recording all buildings built before the First World War, that could be seen from a public road or footpath within the limits of each village or hamlet. Data was recorded in the field using the form shown in Figure 2. The form recorded the number of occurrences of each building stone type or other material in churches (walls and dressings) and other buildings (walls, dressings and boundary walls).

For churches and civic, administrative, educational or historic buildings in Taunton, percentages of building stone were recorded for each building. All other buildings were aggregated on a settlement by settlement basis. Where it was not possible to identify building stones in the field, their properties were noted and the observations cross-checked with data on building stones collected by others (Barr, *unpublished*; Prudden, 2001; British Geological Survey, 2016b), The National Heritage List for England (NHLE) database of listed buildings (Historic England 2016) and Pevsner's guide to the buildings of South and West Somerset (Orbach and Pevsner, 2014).

A total of 63 towns and villages consisting of an estimated 2,434 stone buildings and walls were surveyed. A database was created comprising the number of occurrences and percentages of each building stone by settlement for vernacular buildings and percentage for each church and significant building. The database was interrogated to understand the distribution of building stone type versus use and function. For more detail on the methodology see Dawson and Wright (2018) and for the data see South West Heritage Trust (2019).


TAUNTON DEANE BUILDING STONES SURVEY - Data Collection Sheet

LOCATION:
Date:
Surveyor(s):
Survey No.

Building Stones

Other Building Materials: Brick; "; Render / Colour Wash; "; Other

Church		Other Buildings		
Walls	Dressings	Walls	Dressings	Boundary Walls

Other Building Materials: Clay tiles; Slates; Thatch; Stone Tiles

Roof	Roofs

Notes

Template PW 27.09.15

Figure 2. *Data collection form for the Taunton Deane Building Stones Survey.*

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Table 1. *The approximate stratigraphy of building stones, showing the traditional names used in the survey and the equivalent (present day) British Geological Survey nomenclature.*

	Current BGS Group or Formation Name	Current and Traditional Local Names for Building Stones used in Taunton Deane and its environs		
		Originating locally	Originating locally Undifferentiated	Originating out of the area
Paleogene	Clay With Flints	Chert		
LOCAL UNCONFORMITY				
Cretaceous	Holywell Nodular Chalk			Beer Stone
	Upper Greensand	Calcareous Grit		
LOCAL UNCONFORMITY				
Jurassic	Chalfield Oolite			Bath Stone
	Inferior Oolite			Doulting Stone or Other Inferior Oolite
	Bridport Sands			Ham Hill Stone
	Blue Lias	Blue Lias		
Triassic	White Lias	White Lias		
	Arden Sandstone	North Curry Sandstone		
	Helsby Sandstone	Otter Sandstone	Other Permo-Trias Sandstones Conglomerates and Breccias	
	Chester Sandstone	Budleigh Salterton Pebble Beds		
	Aylesbeare Mudstone	Vexford Breccias		
Permian	Exeter Group	Wiveliscombe Sandstone		
	Minor Intrusive Suite – Lamprophyre	Hestercombe Diorite		
	Thornverton Sandstone			Exeter Volcanics
LOCAL UNCONFORMITY				
Carboniferous	Westleigh Limestone			Westleigh Limestone
	Pilton Mudstone	Pilton Mudstone		
Devonian	Pickwell Down Sandstone	Pickwell Down Sandstone	Other Devonian Sandstones and Slates	
	Morte Slate	Morte Slate		
	Ilfracombe Slate	Devonian Limestone (See Note)		
		Cockercombe Tuff		
	Hangman Sandstone	Hangman Sandstone		

Note: Devonian Limestones from the Quantock Hills, comprising Leigh Barton, Holwell, Aisholt, Roadwater and Rodhuish Limestones, were not differentiated.

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Topography and Geology of Taunton Deane

Topographically, Taunton Deane is bounded by the Quantock Hills in the north, the Brendon Hills to the west, the Blackdown Hills to the south and the Somerset Levels to the east. The geology of the area is shown in Figure 3 and is described in detail in the BGS Memoir for Sheet 295 (Edmonds and Williams, 1985). In summary, the area to the north and west comprises Devonian and Carboniferous rocks with a faulted or unconformable margin to Permo-Triassic strata. Around Taunton, Triassic rocks are present and to the south onlapping Mesozoic strata that is younging from west to east. Erosional deposits of chert are also found.

greenish rock which occurs within the Ilfracombe Slates sequence on the eastern side of the Quantock Hills. Within Taunton Deane its only use is as a decoration on buildings using other stone types. The distinctive grey-green colour makes it ideal for this function.

The **Rodhuish, Roadwater, Aisholt, Holwell** and **Leigh Barton Limestones** occur as thin beds within the Ilfracombe Slates and are, in places, discontinuous, passing laterally into calcareous slates. They were widely quarried for lime manufacture and building stone. Use of the limestone for building within the study area is, however, confined to Cothelstone where Rodhuish and Aisholt limestone was quarried and can be seen in the church and the manor house.

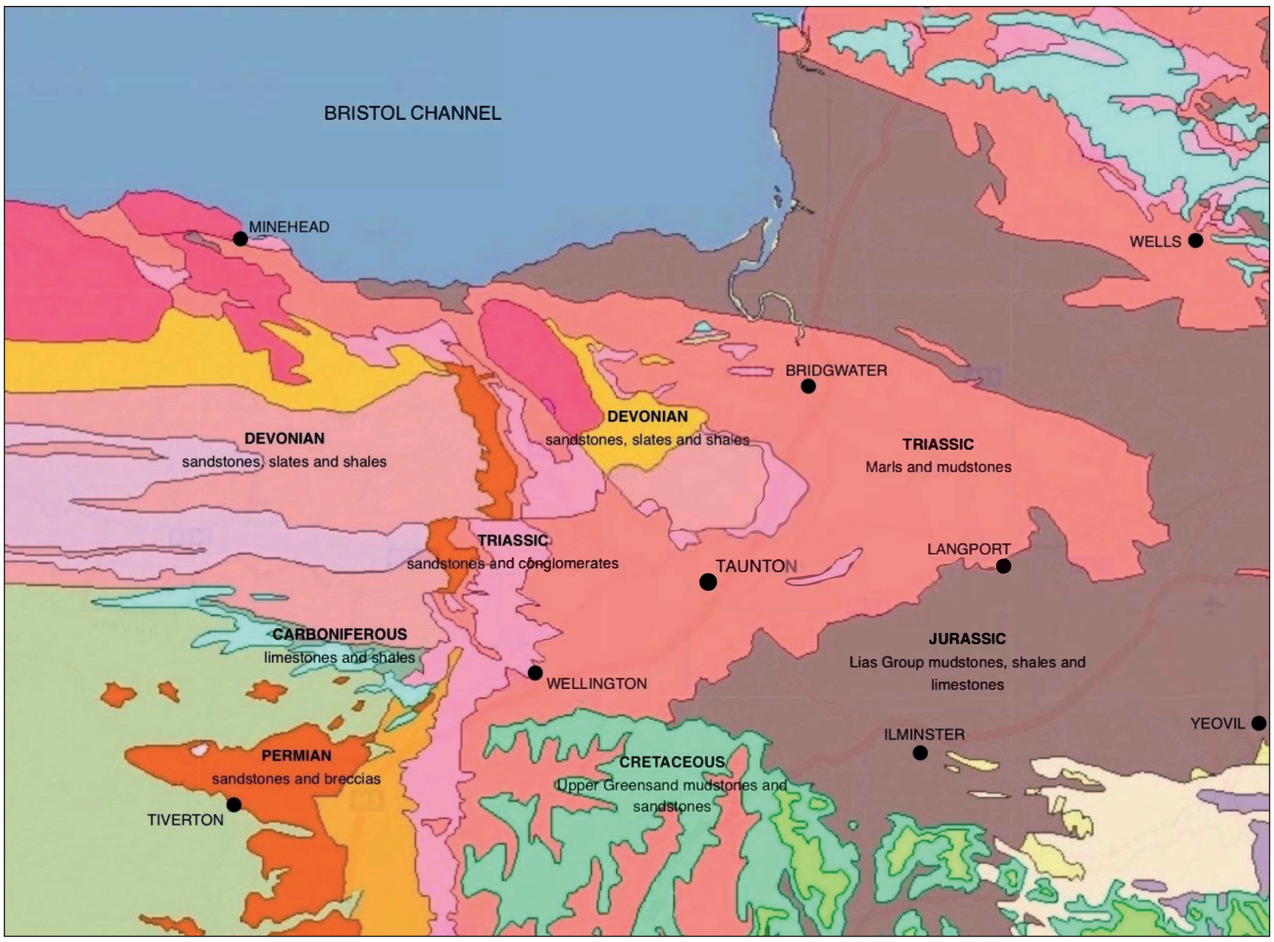

Figure 3. *Geology of Taunton Deane and West and Central Somerset.*

Below we give a brief lithological description of the building stones used in the Taunton Deane, their relative importance and the main location of their use as a building stone.

Devonian Rocks

The **Hangman Sandstone Formation** comprises reddish-purple to green siltstones, sandstones and conglomerates (Edmonds and Williams, 1985) occurring in the northern part of the Quantock Hills. Although widely used for building in West Somerset and North Devon (English Heritage, 2011) sandstones from the formation were only recorded in use as building stone at one location in the Taunton Deane – West Bagborough.

The **Ilfracombe Slate Formation** which consist of slates, siltstones and limestone crop out in the central portion of the Quantock Hills. They have only been seen used as a building stone at Cothelstone (ST 1826 3178).

The **Cockercombe Tuff** is a distinctive fine-grained grey-

The **Morte Slate Formation** comprises grey-green to purple-red slates, siltstones and sandstones. The sandstones are not easily dressed and shaped and are difficult to distinguish from sandstones within the Ilfracombe Slate Formation and Hangman Sandstone Formation. The proximity to extraction criteria was used to guide identification for the Morte Slate sandstones. Slates, siltstones and sandstones from the Morte Slate Formation have been widely used for building in Taunton and the southern Quantock Hills.

The **Pickwell Down Sandstone Formation** is a hard, red-purple sandstone which has been used widely for building around Wiveliscombe. Except when seen in fresh section when it is lighter in colour, it can be confused with Hangman Sandstone

Other **Devonian Sandstones** and **Slates** were used for a few cases where Devonian sandstones or slates could not be identified in the field and where identification could not be established through literatures searches after the field work.

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Devonian/Carboniferous Rocks

The **Pilton Mudstone Formation** consists of grey mudstones and siltstones with thin to thick-bedded, locally calcareous, sandstones. The sandstones can be difficult to distinguish from the Pickwell Down Sandstone. For example, we disagree with Barr (*unpublished*) who identified the building stones in Waterrow as from the Pickwell Down Sandstone and yet the village is on the Pilton Mudstone outcrop with adjacent disused quarries. Similarly, the church at Bathealton has been reported as built of Pickwell Down Sandstone (Barr *unpublished* and Prudden *unpublished*). A pamphlet on the history of the church, seen during our survey, identified the exact source for the stone at a quarry situated on the Pilton Mudstone (Berthon, 2005).

Carboniferous Rocks

The **Westleigh Limestone Group** comprises hard, grey fine-grained limestone, which usually contains dark chert banding. The limestone has been extensively quarried in East Devon and has been a commonly used building stone in Taunton Deane since the middle of the nineteenth century. Several civic and public buildings in Taunton, and in Wellington, are built of Westleigh Limestone. The quarry remains active today but only for aggregate.

Permian Rocks

The **Exeter Volcanics** are a series of lavas which occur between Exeter and Tiverton. These rocks have had limited use in Somerset despite their common use as a building stone in Devon.

Hestercombe Diorite is hard, fine-grained and reddish in colour (Prudden and White, 2007) which crops out as a few dykes at Hestercombe (ST 2429 2917). It is the only intrusive igneous rock occurring in the survey area and is related to the Exeter Volcanic suite (Edmonds and Williams, 1985). The hardness and the limited extent of outcrop of the rock seem to have limited its use.

Undifferentiated Permo-Triassic Rocks

A wide range of lithologies, from fine-grained sandstones to breccias exist within the Permo-Triassic strata. The sequence is subdivided by BGS into Halberton Breccia, Budleigh Salterton Pebble Beds and Otter Sandstone formations. It is not possible, however, to determine the exact stratigraphic position of many of the red sandstone building stones. For this reason, we have recorded these as a single category of building stone.

Figure 4. *Otter Sandstone wall with Ham Hill Stone window surrounds, The Old Library, Taunton.*

Triassic Rocks

The **Otter Sandstone** is a red, fine-grained sandstone which is an excellent building stone as shown in Figure 4. The sandstone occurs in the west of the region around Bishops Lydeard. We have used the proximity criteria of linking building stones to possible nearby sources in order to identify Otter Sandstone as a building stone.

North Curry Sandstone is a medium to coarse grained greenish, brown or grey-brown sandstone. The sandstone is often cross-bedded and contains shale clasts. Characteristically, the sandstone forms ridges within the Mercia Mudstone to the west and east of Taunton (Ruffell and Warrington 1988).

White Lias Limestone is found to the south and east of Taunton. Apart from Holy Trinity Church, Taunton, where its white colour is particularly distinctive, it is not used widely as a building stone in Taunton Deane.

Jurassic Rocks

The **Blue Lias** strata comprise inter-bedded mudstone and limestone. The bedding and jointing create natural rock breaks which make the limestone ideal for building although the limestones can suffer with age as the rock can flake on exposure, causing the stone to be of variable building quality. The limestone is currently quarried to the east of Taunton where the Blue Lias Formation forms a prominent ridge.

Ham Hill Stone is a medium to coarse grained bioclastic limestone which is quarried today at Stoke-sub-Hamdon in South Somerset. The rock is golden-brown, well cemented and in many examples (as seen in Figure 5) characterised by cross-bedding. Figure 6 shows that Ham Hill Stone is the most widely used stone for dressings in churches and also occurs, albeit usually in small quantities, in more church walls than any other stone.

Doulting Stone is a white, crystalline limestone usually containing crinoid ossicles and oolites. The rock is a freestone quarried in the Shepton Mallet area of East Somerset and is used

Figure 5. *Ham Hill Stone, showing distinctive cross-bedding, with Blue Lias; St Mary Magdalene Church, Taunton.*

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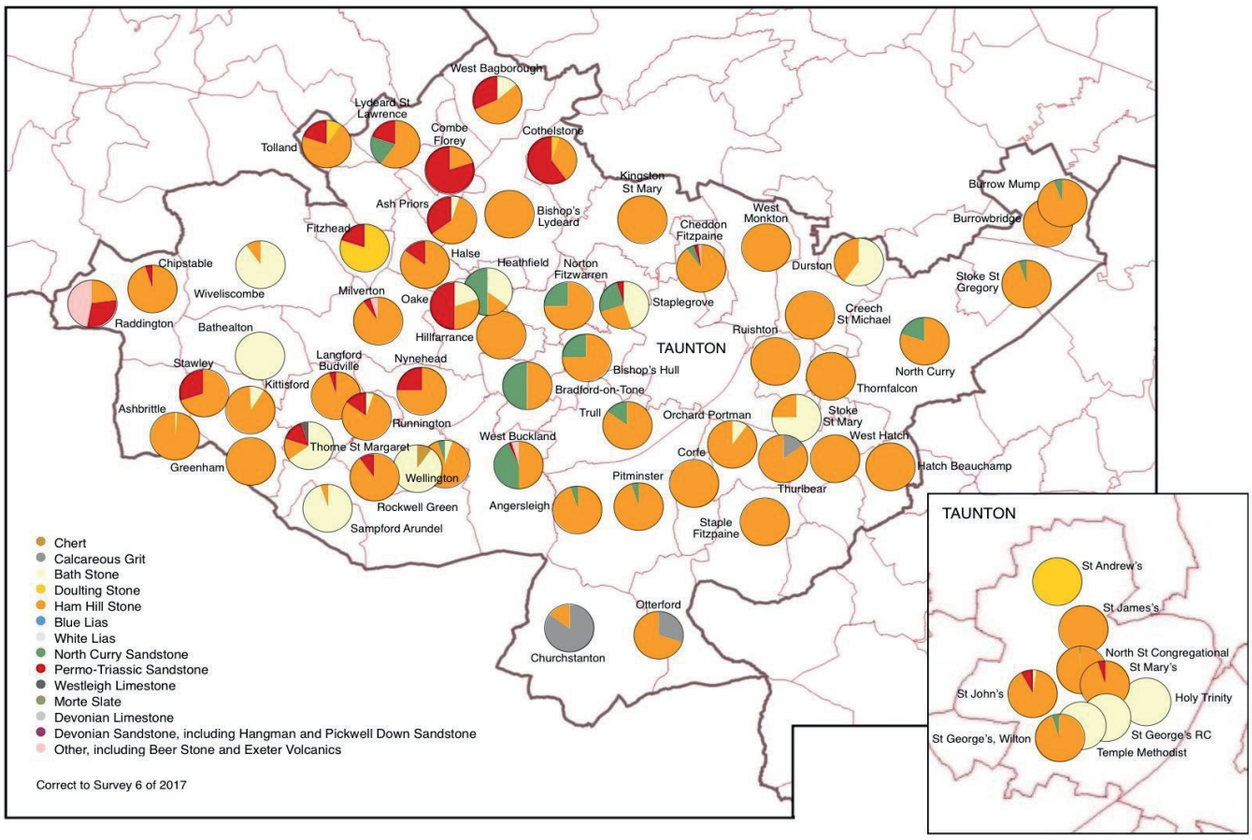

Figure 6. *Diagram showing the percentages of stone types used for the external dressings of churches.*

for dressings in the Taunton area. It can be distinguished from Bath Stone through the presence of crinoid ossicles.

The term **Other Inferior Oolite** was used where the provenance of an oolitic limestone could not be established.

Bath Stone is a yellow or pale yellow oolitic limestone which, along with Ham Hill Stone, is the most widely used stone for dressings. Although the survey data show that Ham Hill Stone is more widely used than Bath Stone for church dressings, the popularity of Ham Hill Stone over Bath Stone is due to its availability from very early times whereas Bath Stone only appears to have been used in Taunton Deane from the beginning of the nineteenth century.

Cretaceous Rocks

Calcareous Grit is a white-cream calcareous sandstone with both quartz grains and shell fragments. It was quarried in the Blackdown Hills and is used in a few buildings in Taunton and for the Wellington Monument (ST 1374 1723).

Miocene to Pleistocene Rocks

Chert is a micro-crystalline form of quartz which is also described as flint in Cretaceous chalk. Chert is a hard and durable building stone but is difficult to cut and shape. In the Taunton Deane area chert is a Miocene to Pleistocene weathering product derived from the Chalk and Upper Greensand. It predominates in buildings in the parishes of Churchstanton and Otterford. As a result of landslips on the northern slopes of the Blackdown Hills (Freeborough *et al*., 2005), chert is found in soils away from the source and is a common building stone as far north as Taunton.

Factors Affecting the use and Choice of Building Stones in Taunton Deane

Survey results show that the following four factors have influenced the choice of building stone.

Location

The survey data, as shown in Figures 6, 7 and 8 illustrates the distribution of building stone rock type within each of the settlements. The results show a close correlation between dominant building stone rock type and the corresponding geological subcrop. For example, the Morte Slate Formation building stone use dominates in the centre of Taunton Deane close to its outcrop.

The location of a building in relation to the suitable potential building stone has driven the choice of building stone due to the poor state of transportation. Before the mid-nineteenth century poor quality roads and the absence of canals and railways in the region dictated the use of rocks adjacent to the building site. Even though some rock types, such as the Permo-Triassic, cover a large area building stones were still sourced locally. In situations where suitable building stone is absent building stones are brought in from the nearest available source. For example, in and to the east of Taunton where no suitable building stone exists, Blue Lias Limestone was imported from the south and Morte Slates from the north. Some builders made a virtue out of this two-way supply and several buildings in Ruishton and Creech St Michael, as illustrated in Figure 9, are attractively built of alternating courses of Morte Slate and Blue Lias.

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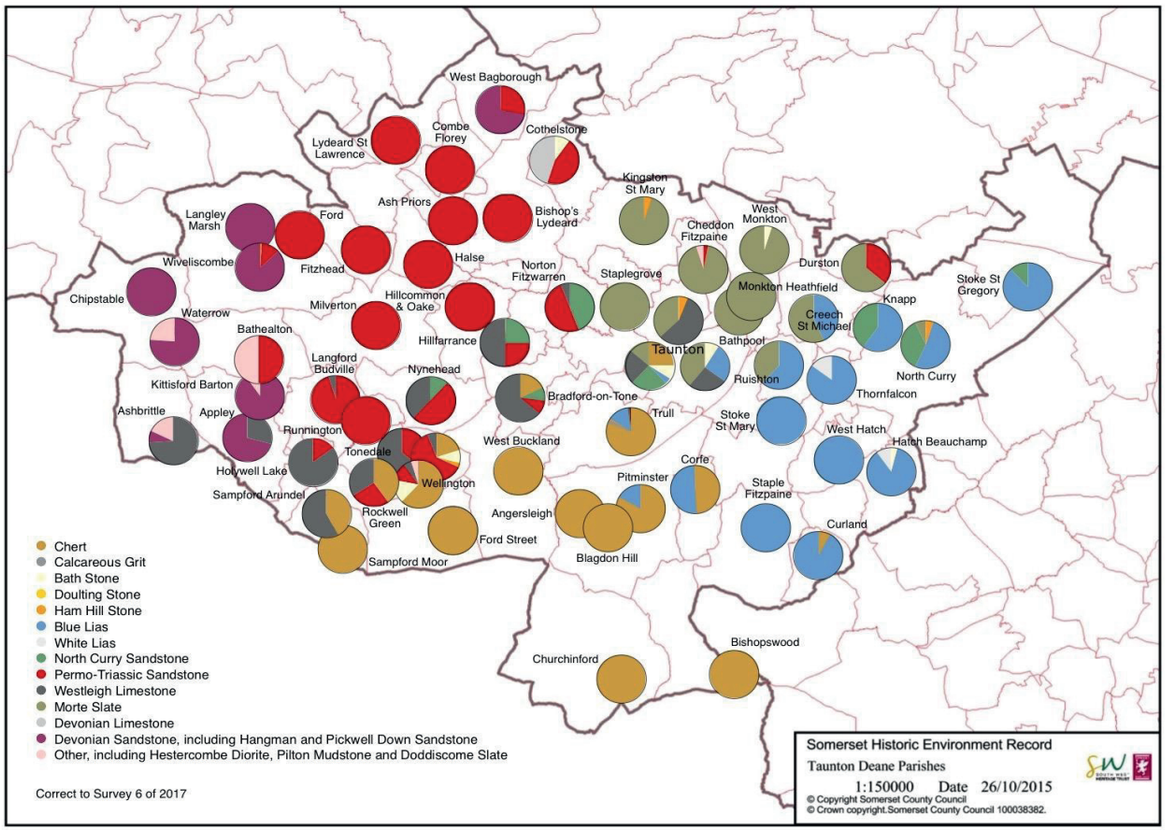

Figure 7. *Diagram showing the percentages of stone types used for the external walls of buildings, not including churches.*

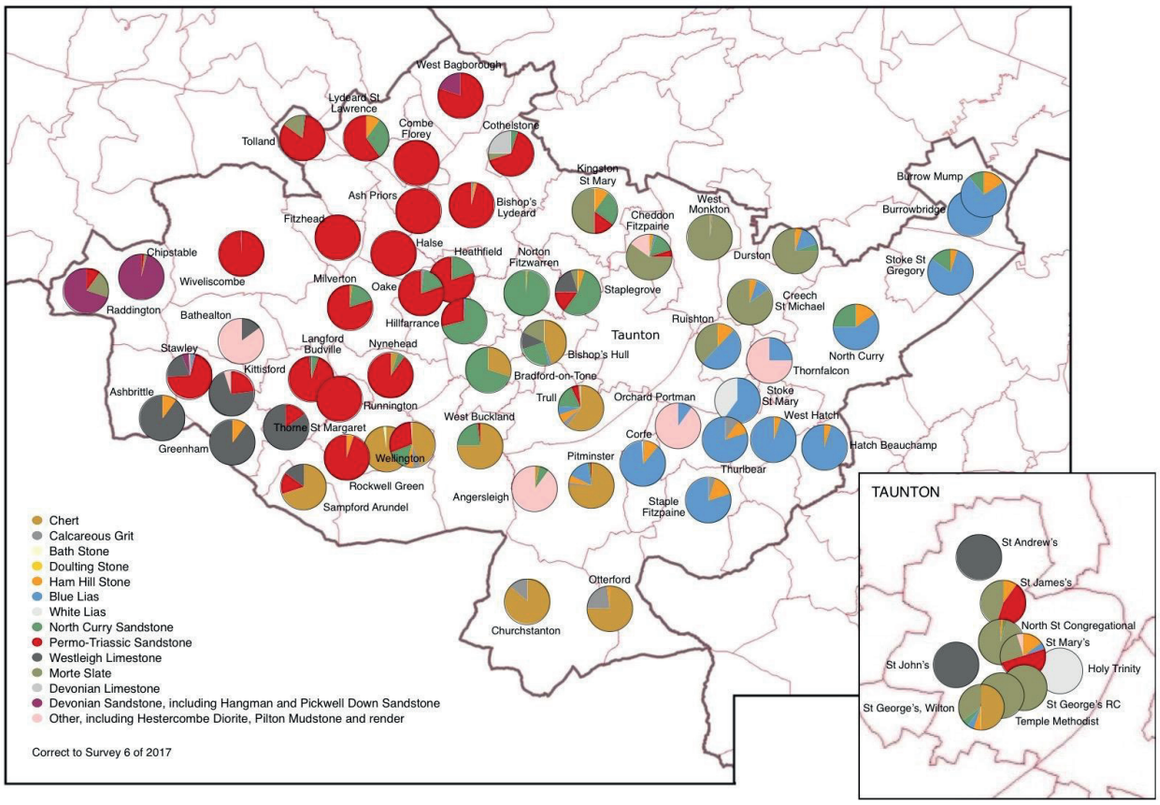

Figure 8. *Diagram showing the percentage of stone types used for the external walls of churches.*

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Figure 9. *Alternate courses of Blue Lias and Morte Slate in house wall, Ruishton, Taunton.*

Builders have even sacrificed workability and durability of stone in preference to reduced transport costs at several locations in the area. The use of Hestercombe Diorite has been limited by its hardness to Hestercombe House (ST 2417 2873) with a few samples also seen in St Mary Magdelene Church, Taunton and Broomfield Church (ST 2243 3202).

North Curry Sandstone, despite being susceptible to weathering through time, has been used to good effect at Norton Fitzwarren Church (ST 1968 2598) and Queen's College, Taunton. Other than Portland Stone, imported from Dorset, we have not identified any buildings stones from outside of Somerset and its immediate area or from overseas. The self-sufficiency of building stone in the borough reflects the varied nature of the stratigraphic column.

Function of the stone

Building stone has to fulfil three broad functions of being suitable for cutting into regular blocks for building walls (ashlar), roughly shaped stone to enable wall building with mortar (ragstone and rubblestone) and finally carved stone for doors, windows and mouldings (dressing stone). The use of stone for these various functions varies greatly according to the type of building. In general, the best quality building stone was used for churches and other 'high status' buildings, with high architectural standards and concomitant structural requirements. Figures 6 and 8 illustrate the dominance of Ham Hill Stone and Bath Stone in church dressings and Permo-Triassic sandstones in church walls. Similar relationships exist in other 'high status' buildings.

Figures 10 and 11 show the breakdown by function in terms of walls and dressings for both churches and other buildings. The analysis shows that dressing stone for all buildings is dominated by the Jurassic aged limestones of the Ham Hill Stone, Doulting Stone and Bath Stone. Each of these rock types would have had to be imported into Taunton Deane as no quarries exist in the area.

The Ham Hill Stone quarries have been in operation for many centuries over which time they would have established strong

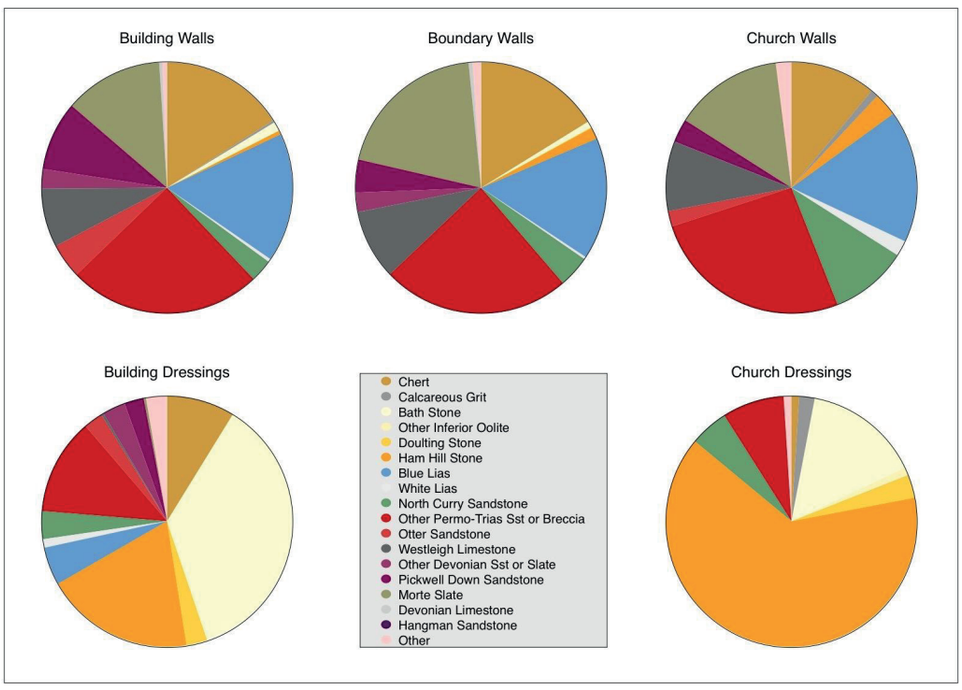

Figure 10. *Pie diagram showing the use of stone types according to function.*

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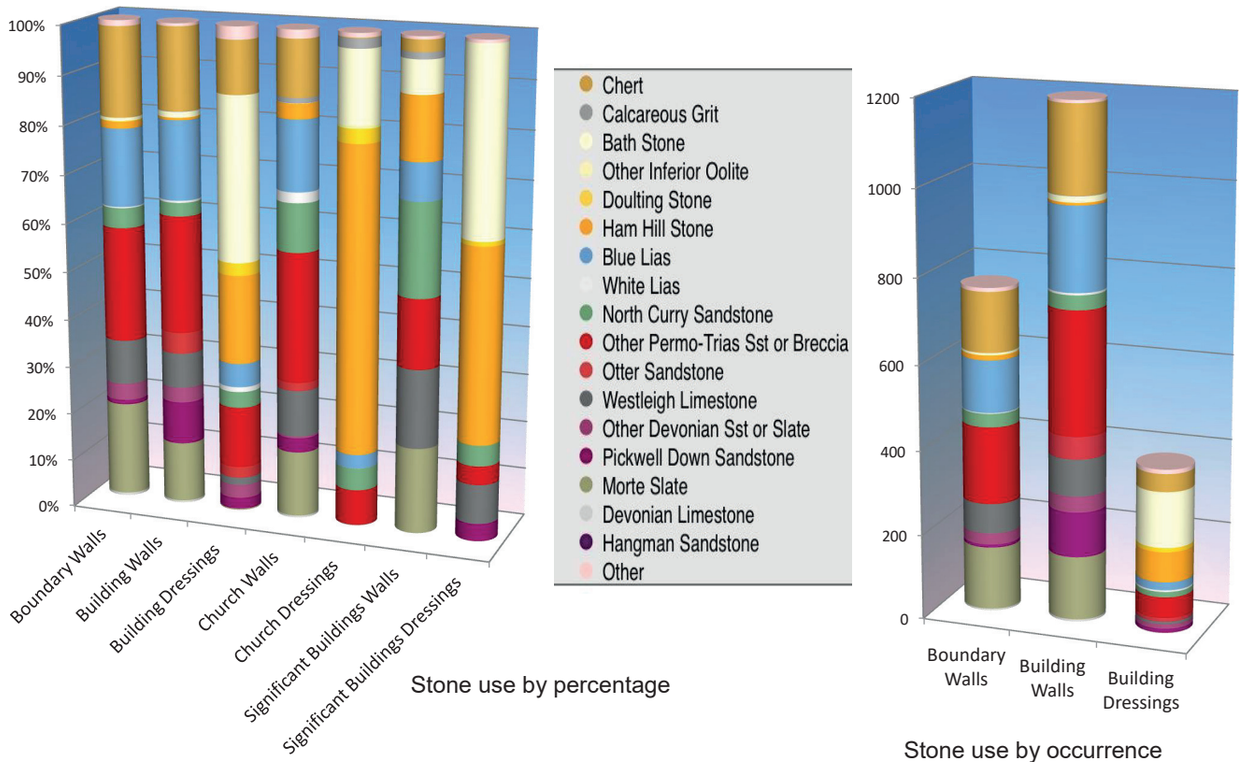

Figure 11. *Column diagrams showing the functional use of stone for all purposes by percentage and occurrence.*

supply chains to builders engaged in high status buildings. For example, Taunton Castle, which was constructed in the twelfth century has Ham Hill Stone in its walls.

Date of Construction

The key control on the distribution of building stone, other than that stone was derived locally, was the development of a transport infrastructure. Before an infrastructure was created, Ham Hill Stone was transported by the rivers Parrett and Tone (Prudden, 2001). Westleigh Limestone was shipped, initially, from 1838 onwards, via the Tiverton to Taunton Grand Western Canal to the growing towns of Wellington and Taunton. From 1875, the Bristol to Exeter railway transported large quantities of limestone from Westleigh in East Devon (via a linking tramway) to Taunton and Wellington for use in several prominent buildings, quality housing and railway infrastructure.

Elsewhere canal and railway networks allowed for the increased use of the Bath Stone in dressings and large country houses and the importation of Portland Roach or Screwstone from Dorset (Thomas, 2008) for the abutments of the main railway bridge in Station Road, Taunton.

Properties of Building Stone

Building styles are constrained by the structural (load bearing) and weathering characteristics of the building stone which in turn is controlled by the rock's lithology and chemistry. We have identified four geological properties of cleavage, matrix strength, bedding and rheology that have influenced the use of building stone in the area.

Cleavage

Slates from the Morte Slate Formation are cleaved and easily split, whereas the inter-bedded sandstones of the formation are blocky and un-cleaved. The slate facies can only be used for rubblestone in walls whereas the sandstone facies are more adaptable for multi-use in building.

Matrix Strength

The Permo-Triassic sandstones have a wide variability of grain size which has not prevented these rocks being used for a wide range of buildings – see Figure 12 for an example of breccias in use for building. The usability of these rocks is due to their load bearing strength produced by the cement which forms the matrix binding the grains. In the coarse-grained facies (conglomerates and breccia) the matrix is stronger than the pebbles resulting in clean fractures across worked surfaces.

Figure 12. *Permo-Triassic breccia with sandstone wall and Ham Hill Stone window surround at All Saint's Church, Rockwell Green, Wellington, Somerset.*

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Bedding

Blue Lias Formation limestone, which occur interbedded with siltstone and mudstone, is quite consistent in thickness. This thickness, in conjunction with the regular jointing of beds, creates block size stones suitable for building. These attributes enable builders to construct level and true walls.

Rheology

Chert is hard, homogeneous and often breaks with a conchoidal fracture. This fracture pattern prevents the use of chert in quoins and it is largely restricted to walls. Chert-based buildings are often seen with brick or other building stone quoins or dressings.

Discussion – the Applications of Building Stone Data

The survey has provided a detailed description of the building stone use in Taunton Deane. The data collected during the survey provides a geological basis for planning and conservation decisions concerning the distinctiveness of local towns and villages and provides a valuable record of local geology. The results show a close correlation between settlement building stone and nearby geology where extraction has taken place. The resulting different rock characteristics have imparted a distinctive character to many of the settlements in Taunton Deane. For example, the Morte Slate used in the Quantocks has a different character to the flint cottages of the Blackdown Hills, which in turn have a completely different look to the Blue Lias villages in the east of the borough. These differences in building character are unique and present a challenge to planners and conservationists.

This type of detailed study provides planners with a framework within which to set controls for building design and appearance. By understanding the geological influences on the use of building stone, planners can set explainable boundaries for developers to ensure new buildings are sympathetic to the local environment.

Providing information on building stones assists conservation officers in maintaining and preserving existing stone buildings. In many parts of the study area replacement stone for repairs is in short supply or non-existent. Without the replacement building stone from the original source the character of existing villages and towns would change in times of repair or building extension. This study gives conservation officers detailed description of the attributes of a building stone and allows for them to search for alternatives. Recycling of stone from derelict buildings may provide an alternative source of building stone given the limited number of active quarries producing building stone.

Discussion – Why Geologists should Study Building Stones

Building stones were for many years a neglected geological resource with un-realised potential for use in geological research, education and leisure/tourism. This is beginning to change and detailed surveying and documenting of local building stones is important to the process. As extraction and use of local stone has declined numerous quarries and pits which local building has relied on for centuries have become overgrown or lost to geology through development, leaving local buildings the only places where some lithologies can be viewed.

Building stone 'exposure' can add value to the local geology to be seen in the field as the rock's characteristic features, such as fossil content or cross-bedding, become visible as the building stone weathers. Where stone has been imported to the area there are increased opportunities for local geological study.

The geological study of building stones can provide clues to the history of an area or individual buildings. At Kingston St Mary Church (ST 2229 2971) a few building stones are coated with a green mineral. This likely copper mineralisation together with the fact that the lane by the church is called Lodes Lane supports the hypothesis that copper was mined in the district in the past (Hamilton and Lawrence, 1970). Concerning the history of individual buildings, the study has noted that some older churches can have as many as six different building stones in the same wall, for example at Trull (ST 2163 2219 – see Figure 13) and Stawley Churches (ST 0703 2264). At Trull Church, five pieces of possible Exeter Volcanics were noted, despite the nearest source being over 35 miles away; a considerable distance to transport building stone in Medieval times. Whether this is due to local reuse of stone or the builder using several sources concurrently is an interesting question best answered by historians rather than geologists.

Building stones, particularly in urban areas, are much more accessible than natural exposures making ideal circumstances for educational and leisure parties to easily and safely examine the stone. Building stone trails and descriptive leaflets (for example, Prudden, 2003b) provide more information for all users and complete the picture by engaging the interest of non-geologists. The collection of building stones data by survey and the provision of the data on the web enables geologists to know where to go to pursue their interest.

Figure 13. *Use of several different stone types (chert, North Curry Sandstone, Ham Hill Stone and Permo-Triassic sandstone) at All Saint's Church, Trull, Taunton.*

Conclusions

The survey results show a very close correlation between the type of building stone used in Taunton Deane and the local geology. This correlation is especially true for vernacular buildings and for most churches from the time of the oldest surviving stone buildings until the spread of canals and railways in the nineteenth century.

Where we have seen any variation from the local sourcing

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of stone it is either because the local stone is unsuitable, for example Mercia Mudstone in the Taunton area, or because the landowner could afford to acquire stone from further afield. Wealthy landowners initially used Ham Hill Stone for building dressings until more recent time when it was supplemented by Bath Stone.

The survey methods described in this paper has proved to be a practical way to collect valid and useful data comparatively quickly for use by geologists, planners, building conservation officers, and those interested in landscape management. The methodology could easily be applied to other areas. Integrating data from local surveys would yield information of potential replacement building stones for conservation and preservation work.

Although it has not been fully explored here, using building stones data in GIS would provide planners and conservation authorities with a powerful tool for managing Landscape Character Areas, Areas of Outstanding Natural Beauty, Conservation Areas and National Parks.

Robinson (1995) challenged geologists to add further detail to the work of Alec Clifton-Taylor's (1972) on relating building stones to local geology. He saw this as an interesting and rewarding task for local geology groups which this study has borne out. Many of the building stones recorded in the Taunton area are today not easily seen in the field and their availability in buildings allow geologists continued access to these building stones for educational and leisure purposes. Furthermore, the study of building stone connects geology to other fields of study such as local history and provides valuable information for the conservation of local landscapes, and local opportunities for educational and recreational geology. To gain most from their work, geologists studying building stones need to have an appreciation of the history of buildings. Equally historians can benefit from an understanding of geology and building stones.

The geological community has in recent years begun to recognise the value of building stone to its science. Most counties now have relevant publications such Strategic Stone Atlases (British Geological Survey, 2016b) and there are numerous stone trails and walks, but these tend to focus on high status buildings such as churches. Whilst this is not surprising it does not give a complete picture. The methodology used in this survey captures the use of stone in all buildings and produces data that can be used by conservation officers, developers, planners and others to preserve the character, appearance and distinctiveness of local towns and villages. If required it can also be used to record information for individual buildings. Taunton Deane has a rich and varied geology and which has translated into a correspondingly rich mix of building stones.

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