

SURVEY AND DIGITAL DOCUMENTATION OF ENDANGERED TEMPLE WALL PAINTINGS IN  
SHANXI PROVINCE, CHINA

# The Recording Manual



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## Brief Summary

This is a technical manual designed to be used by the project team. It assumes that the users of this manual already have basic knowledge of photography, photogrammetry and historic building recording. It acts as a guideline and reminder of the common and agreed approaches, standards and outcomes. This version of the manual was created following a pilot study undertaken jointly by two main universities involved and therefore reflects already discussed methods. There may be further additions and follow up versions of the manual and those will be immediately made available publicly.

The manual will be available on project webpages. It will help the researchers of the end results of the project to understand the methodology used in documenting the wall paintings. Printed copies will be given to the field teams.

The project for Survey and Digital Documentation of Endangered Temple Wall Paintings in Shanxi province (hereafter, The Project) aims to survey Buddhist and Daoist wall paintings, resulting in the publication of a digital catalogue of sites, buildings and paintings structured as an open access resource for research, education and conservation. There is a hope that the final database, built on open-source Arches platform, will also help with the management of the sites.

This manual is designed to facilitate the delivery of the digital catalogue and link the different outputs in the best and simplest possible way.

## Health and Safety on site

Most of the sites/temples to be documented are in remote locations, some are in ruined state, and majority are fragile. The field teams must think about the safety of the personnel involved and about the fragility of cultural material.

The field team should undertake a Risk Assessment before visiting the sites and identify potential hazards. There will be a specific risk assessment form that needs to be filled before visiting each site. There should be a properly stocked first aid box with every team. The teams should know contacts of emergency services and the locations of the nearest hospitals.

Every care should be taken to eliminate possibility of falls, trips, heavy manual lifting and any other potentially hazardous situations.

All staff are responsible for ensuring that they behave in an appropriate manner, showing respect for local community representatives, local officials, colleagues and all others working alongside or engaged with the activities of the project.

## Photogrammetric recording

One of the main priorities of the project is to create a library of high-resolution photographic images of the wall-paintings through photogrammetric recording. Once made available digitally, this library will become a digital catalogue of scaled and accurate orthomosaics for each documented wall. A brief set of guidelines below, as well as additional texts at the end of each section, emphasise the set of agreed best practices and approaches in order to achieve that priority goal.

### Brief guidelines for taking photographs of the walls.

1. Set up the lighting as best as possible to evenly illuminate the entire wall. Make sure there are no dark places. If the lighting is insufficient, please make a note about it and store the note with the images.
2. Set up (ordinary) scale and photo board in the bottom left corner of the wall (or bottom right if left is inaccessible). Take a few photos with scale, photo board, and make one of your colleagues hold the balance board while you take the colour control photos. Once you take the photo with photo board and scale, please remove them.
3. Set up scales with photogrammetric targets in two or three areas. This can be in front of the wall, but should not be on it. It is important that targets appear in some photos, but do not obstruct the view of any wall or wall painting. Photogrammetric scales should always remain in the same place and never be touched until the end of the recording. Please plan the positions in order to avoid accidental movements of photogrammetric targets.
4. Take three photos – one of the entire wall and two half-wall sections, so that to include beginnings of neighbouring walls. This will help us identify the location of the wall later on.
5. Total Station (theodolite) survey should deliver reference points for wall paintings, therefore the teams do not need to record any other control points.
6. Start taking photos of 1.5-2 m sections of the wall when standing on the left side of it. You should be standing approximately 1.5 meters from the wall to make sure photos are detailed.
7. Avoid zooming in and out. You should use the same zoom level in all photos, unless it is not possible due to space restrictions. Using the same zoom will prevent any errors when processing photos and reconstructing surface. Please make a note if zoom is used due to space restrictions.
8. Start in the top left corner and proceed to the right, then once you reach the edge proceed downwards and left. Make sure each photo has an approximate overlap of 60% with the previous one.
9. Maintain the same right -> down -> left -> down pattern until you record the entire wall. This is a suggestion, you may proceed in a different direction, or move around, but following a set path would ensure you track your progress. Please make sure all of the surface is covered with your photos.
10. Move to the centre of the wall (or as central as possible) and proceed with the same pattern you followed when taking photos from the left-hand side.
11. Move the camera to the right side of the wall and follow the same procedure.
12. Now use the monopod to take pictures from a higher point looking down. Try to get the camera as close to the ceiling as possible with the monopod and take photos from left, centre and right of the wall. This will give us additional camera angles, which will ensure accurate reconstruction of the surface of the wall.
13. Finally, take the same photos from the bottom of the wall (as low as you can) in three locations. The positions can be more than three if the wall is extensive.

14. There will be instances where an area of the wall/wall painting is obstructed by an object/vegetation or is simply not accessible from planned photo taking locations. In that case you will have to get closer to the wall or work around it to make sure the entire surface of the wall is captured. Make sure you adjust/move the lighting to illuminate the obstructed surface. Use flash if the lighting cannot be adjusted sufficiently.
15. Once you finish documenting the wall in overlapping pattern and from nine (or more) camera locations you can move to the next wall painting.
16. Make sure photos are clear. If you are not sure, re-take the photo. This includes the initial photo with scale and photo board. Do not re-take the photo of the scale and photo board after you've taken any other photos – it is important that this photo (or photos) remain at the beginning of each sequence.

The fieldwork teams will be experienced in photogrammetric recording and modelling and they will need to make judgements based on condition and location of each individual wall. They will also need to use their judgement in taking pictures with enough overlap. It is simply impossible to create a formula that will be applicable to every single wall because of the diversity of shapes and configurations involved. The pilot study showed that adapting to every wall and planning the picture taking on site is the best way forward.

Each team will have a set of excellent digital cameras designed to perform well in low-light conditions. The cameras have Wi-Fi and NFC connections and can be controlled from mobile phones when attached to long monopods. Each camera will have a wide-angle lens (for close up, overlapping photography) and zoom lens (for architectural features and the areas of difficult access). Each team will have at least one experienced photographer with good understanding of the equipment. Each photographic set will include a tripod and monopod. Using a tripod will result in sharper images and allow taking pictures with higher f-stop numbers.

The ideal scenario is using a natural daylight. However, that is not always possible due to the location of the sites and structures. It is beneficial to use lighting in those situations. Each team will have dedicated lighting equipment, power units or a generator, and additional camera mountable flash unit. Importantly, when taking pictures, the light sources themselves should not be in the field of view of the camera.

Templates of Photogrammetric Scales will be shared with this manual, but the teams are free to create their scales as long as they provide detailed information about the measurements of the scales. The accuracy of the final outputs needs to be very high and we expect sub-mm accuracy. From that point of view, it is absolutely crucial that very accurate photogrammetric scales with machine readable targets are used. The coded targets on the scales should not be changed or written on. We expect at least two (preferably three) of them present in every wall photography exercise. Additional photographic scales can be used too as a control mechanism (of both colour and measurements), but they should not obstruct the view of the wall. Once again, the team members are well experienced in this area and potential problems can be resolved through team discussions.

Pictures should be taken in RAW+JPEG. Having JPEGs is important, because they will be useful to check the results rapidly and to transfer over the internet.

Please make sure that the date and time settings is correct on the cameras. Please make sure that EXIF data in general is recorded correctly. Those matter in the stage of processing and analysis of the outputs.

More experienced team members should ensure that the area of interest is clear of tools and alien objects during photographic recording. We also do not want our colleagues to be visible in the pictures.

Every image should focus on interest areas and should cover as much of interest area as possible. You can alternate between portrait and landscape orientation of the camera if that is useful for capturing the interest area and avoiding unnecessary parts of the background.

### Brief guidelines to checking the results in the field

The teams are expected to do rapid check of the images in the field. This include both visually reviewing the images to ensure that they are of expected quality and also aligning them in photogrammetric software (such as Agisoft PhotoScan) to see that there is enough overlap and coverage of the areas of interest. Ideally, this should happen in the field. The teams can leave laptops running the photo alignment process while performing other tasks. If that is not possible, then the teams can process photos in the hotel and return to address any issues the following day.

1. Copy all of the photos from the SD card to your local drive under the folder structure created in accordance with file naming and folder structure conventions below (Section on Metadata, Data-structure and moving data)
2. Once you have the photos copied over you can launch Agisoft PhotoScan and go to Workflow -> Add photos. Select all of the photos for processing (exclude the ones with photo board/scale/balance card or any blurry, dark or otherwise unsuitable photos).
3. Select Workflow -> Align Photos. Make sure accuracy is set to Low (this will be sufficient to identify any gaps in coverage), leave other settings at default and click OK.
4. Leave the process running (it might take around 15-30 minutes) and get back to other tasks.
5. Once the processing is completed, have a look at the point cloud and see if the coverage is even and you have sufficient number of points in all areas of the wall. Then see the left pane, open the Chunk information and see if all of the cameras have been aligned.
6. Agisoft PhotoScan (as well as other photogrammetric software packages) has a useful 'Generate Report' command (File -> Export -> generate Report). It provides very valuable data about the overlap, camera locations and alignment. Please use it to check the results.
7. If there are any issues with coverage please go back to the wall and take additional photos in the areas that are missing points. If some of the photos have not been aligned, check which ones they are and inspect each of them to see what the problems might be.
8. If there are no issues, or you have addressed them, then the photos are ready for backing up on external drives and moving to the cloud.
9. Once again, move them into the folder structures following guidelines below.

Accessing walls or architectural features from different angles will not be easy and rapid checks on-site are the best way of ensuring that everything is in perfect order. Our photogrammetric recording approach will only be successful if a series of overlapping images is taken from a variety of angles. Being systematic in taking the photos is the key to successful models and it is important to spend time planning the data gathering. Please pre-plan your approach to taking pictures of features with a very difficult geometry. Please plan your sessions in a way that it will avoid leaving any blind-zones in the coverage area. As a simple rule, please remember that having many photos is better than having too few.

We often aim at 60% - 80% overlap between two consecutive images. Another way of achieving a good overlap is making sure that every area of the surface is clearly visible at least from five different camera angles. Although it might seem challenging, most specialists learn to take systematic and overlapping images very quickly. Seeing the results of processing stages on the computer makes it a lot clearer.

Experience is important in this approach and every recording will help to plan the next exercises better.

## Use of Unmanned Aerial Vehicles

Although not a first priority, the use of Unmanned Aerial Vehicles (UAV or drones) will provide an important contextual data that can enrich the final outputs of the project. As it was tested during the pilot study, the aim here would be creating 3-dimensional model of the buildings/sites where the wall paintings are located.

The methodology for collecting data with UAV is very similar to photogrammetric recording of the wall. It can be summarised in several steps:

1. Please plan the flight grid before the flight and ensure over 60% longitudinal and over 60% latitudinal overlap of images. If the area is complex, please increase the percentage of overlap or use 'double-grid' planning. The use of flight planning apps (such as 'Pix4D capture') will make this process easy. However long the planning is, it is usually worth it as it saves from making another flight or even another trip.
2. For grid flights, please keep the camera looking vertically down. If the building is very complex with specific architectural features, then taking oblique images will add value to the models. They can be taken as part of the manually controlled flights. The angled pictures and the overlapping vertical pictures can be combined together to cover complex areas.
3. Please use automatic picture taking (with intervals of 3 or 5 seconds) or ensure that pictures are taken in regular intervals. The pictures should be in JPEG format and there is no need for RAW format images.
4. Please copy the images to the computer after each flight following the folder structures.
5. Similarly to wall photographs, please check in photogrammetric software that all images align together and provide enough overlap to reflect all the complexity.
6. Please keep the altitude of the flights low. In most of the sites, your ideal altitude will be somewhere between 30 and 60 metres from the ground. The team members will need to make a judgement on that with consideration of the surrounding environment.

China is very advanced in manufacture and use of UAV's and the team members are well experienced. However, UAV regulations are gradually changing and the teams should be aware of the local requirements. Several key rules of UAV operation apply globally. The list below presents a brief summary of those rules:

1. The operator of UAV is responsible for each flight. Please take time to understand the equipment, the surroundings and the restrictions. There will be serious consequences if the flights are not planned and executed properly.

2. Please keep your UAV in sight at all times. There are strict 'line of sight' regulations across the world and having a visual contact is extremely important for full control of the UAV. Please consider having a second person to watch the UAV if necessary.
3. Please do not fly over people or crowds of people. Please do not fly close to a person, buildings or vehicles. Please respect other people's privacy when flying and make sure that people in your surroundings understand that.
4. Do not fly near areas that could cause security concerns locally. Do not fly near airports or in areas where aircrafts are operating. All major airports are already included into official 'no-fly' zones of most UAV's. But those areas might not be comprehensive or autopilot might not recognise them. The operator takes the ultimate responsibility for flying near airports and other aircrafts. Do not fly near telecommunication towers. They reduce efficiency of radio connections between your radio controller and UAV, they make the use of global positioning system difficult, and sometimes they cause quick battery drain. Collisions with mobile towers can be catastrophic.
5. Please only fly under daylight and under good weather conditions. Even small amount of rain can be very dangerous to your equipment. Strong winds can have catastrophic consequences too.
6. During flights, you must stay below 120 metres altitude.

In flying UAV's in these sites, we do not need to aim to take one image from high altitude to show entirety of the site. We will create models of entire site using multiple images collected from lower altitude. Doing that will provide a lot more detailed final result which will be scaled, accurate and easy to analyse and understand. The altitude, in combination with the cameras on board, decide one important factor: ground sampling distance. This shows what each pixel of the eventual raster dataset represents on the ground in terms of its length. The shorter the distance represented by one pixel, the higher the quality of the image and the information contained in that image.

Multi-rotor UAV's (quad-copters) manufactured by DJI will be used for our recording. They are light and easy to fly. They have very good propulsion and navigation systems and their cameras are adequate for our needs. They have an ability to take good pictures with automatic geo-referencing. These make them very suitable for our purposes.

Planning the flights is the most important part of the entire exercise. We are not only interested in taking the pictures, but also conducting it in a safe and useful way. The flights should be manageable and they should serve a specific purpose. But even perfect planning might not provide proper overlap if the windy conditions do not allow the UAV to follow the set paths. Checking overlap by quickly processing the images in the field is the best option to ensure that the images will work when they are processed in software packages at a later date.

The use of UAV results in a much greater number of photos than inside the buildings where the pictures are taken manually. It is very important to take the images from the equipment at the end of the each flight and to upload them to a computer for safe and organised storage. Cataloguing is the key for keeping track of the process.

## Recording Historic Buildings with Robotic Total Station

Each team will have a robotic total station to create survey data of major buildings with wall paintings. AutoCAD drawing created from that data will form an important part of the final digital database and will help users to understand the location of individual wall paintings and specific features.

Although this is a secondary priority and maybe not possible to achieve on every temple site, documenting the temple architecture, so that the images can be placed into their spatial/architectural context, is an important consideration.

A link up of:

- *outside 3D view of the building created with UAV,*
- *a CAD drawing created with Total Station,*
- *and the collection of orthophotos of individual walls with selected individual images*

will provide a comprehensive record with enough contextual information.

### Setting up the TST

1. Position the tripod over a marked ground control point, centering and levelling it as well as possible.
2. Make sure the footscrews of the tribrach are in their middle position, then attach the TST to the tripod and use the footscrews to centre the bubble of the circular level.
3. Turn the instrument on and press SHIFT F12 to activate the laser plummet and electronic level - you should then see a red dot on the ground.
4. In order to get the instrument directly over the control point, adjust the tripod legs and re-level the TST using the footscrews as necessary. Once the laser is close to the control point you can shift the tribrach on the tripod plate, but do not let it extend beyond the plate.
5. Press CONT (F1) to exit the Level & Laser Plummet.

### Creating a Survey Job

1. Select Jobs & Data from the main screen, then select New job.
2. Enter a name for the job, along with a brief description and the initials of the surveyor.
3. Make sure a codelist is selected on the Codelist page and the storage device is set to SD card, then click Store.
4. Click Data... to enter control point data. If you are surveying a site with no pre-existing ground control points you will need to enter the coordinates of the initial control point (if using a local grid this will usually be 1000/1000/100 (E/N/H). If known points already exist, enter the coordinates for these points.

### Survey Setup

If you are using a local grid, the first time you set up the instrument you will use Set Azimuth (orientation) as the method. Once you have set up, it will be necessary to establish a network of ground control points to be used as reference points for when you move the TST or come back to site at a later date.

Once you have a minimum of two ground control points established, you should use Known Backsight or Resection as the setup methods. Known Backsight is quickest and involves taking a

single reading to a second point. Resection is more flexible as you can position the TST anywhere (it does not have to be over a ground control point) but requires readings to a minimum of two existing ground control points (see *Known Backsight* and *Resection* sections below).

#### Set Azimuth (initial setup only):

1. From the main screen select Go to Work! Then choose Survey and Setup.
2. Select the job you created as both Fixpoint job and Survey job.
3. Set the station ID to be the control point you saved in the job you created earlier.
4. Measure the height of the instrument above your ground control point using the Leica hand tape and enter this as the height of the instrument.
5. Press F1 [CONT] to move to the Backsight screen.
6. Point the TST towards magnetic north and position a marker to act as a second control point along this axis - this can be a point on the ground, or you can fix a target to a building wall.
7. If you use a point on a wall as the backsight, make sure the TST is in reflectorless mode (RL) and the reflector height should be zero. Aim the instrument at the target and press F3 [Az=0], then F2 [DIST]. Then press F1 [SET] to set the orientation. A reading will be taken to the target and stored.

If you use a point on the ground make sure it is in infra-red mode (IR) and enter the height of the prism. Position the prism staff on the ground point and aim the instrument at the prism. Press F3 [Az=0], then F2 [DIST]. Then press F1 [SET] to set the orientation. Do not move the prism until a reading has been taken and the orientation set.

#### Known Backsight:

1. From the main screen select Go to Work! then choose Survey and Setup.
2. Select the job you created as both Fixpoint job and Survey job.
3. Set the station ID to be the point number of the control point your station is positioned over.
4. Measure the height of the instrument above your ground control point using the Leica hand tape and enter this as the height of the instrument.
5. Press F1 [CONT] to move to the Backsight screen.
6. Enter the point number of the ground control point you are sighting back to as the Backsight ID.
7. If you use a point on a wall as the backsight, make sure the TST is in reflectorless mode (RL) and the reflector height should be zero. Aim the instrument at the target and press F3 [Az=0], then F2 [DIST]. Then press F1 [SET] to set the orientation. A reading will be taken to the target and stored.

If you use a point on the ground make sure it is in infra-red mode (IR) and enter the height of the prism. Position the prism staff on the ground point and aim the instrument at the prism. Press F3 [Az=0], then F2 [DIST]. Then press F1 [SET] to set the orientation. Do not move the prism until a reading has been taken and the orientation set.

#### Resection:

1. From the main screen select Go to Work! Then choose Survey and Setup.
2. Select the job you created as both Fixpoint job and Survey job.
3. Set the station ID to be the next point number.
4. Measure the height of the instrument above the ground using the Leica hand tape and enter this as the height of the instrument.

5. Press F1 [CONT] to move to the next screen.
6. Sight to a known point and enter its point number as the reference and take a reading to that point [ALL].
7. Sight to the next known point and enter its number as the reference and take a reading to that point [ALL].
8. Repeat until you have taken readings to the appropriate number of control points - three is sufficient but more will be more accurate.
9. Press F5 [CALC] to calculate the current station coordinates, then F1 [SET] to set the station.

### Surveying Notes

Once the instrument is set up and orientated, you should set up a network of further control points at positions that will enable you to move the TST. It is a good idea to do this immediately in case the instrument is knocked out of position. Make a note of the point numbers associated with the control points so you can easily refer to them when you move the TST - if possible write the numbers on the control point markers for easy reference.

Always choose the appropriate code for the point you are surveying, and remember to assign the correct attribute values. If you survey one string of points under the code for wall with the number 1 as the attribute value, these points will be joined together. If you move on to a new wall, you will need to change the attribute number to keep it as a separate line.

If you are using infra-red mode (IR) make sure you change the record of the prism height if you extend or reduce the prism pole. Try to avoid obstacles between the instrument and prism or it will lose its lock on the target.

If you are using reflectorless mode (RL) make sure you do not inadvertently take a reading on a passing obstacle, e.g. a person or vehicle passing by.

## Recording architectural and individual features

Some of the temples will have outstanding architectural features, statues or objects of an important art and heritage value. When encountered, and if there is time to do so, those features can be recorded individually. The teams will need to make a decision in the field about those additional activities.

As it is a norm in archaeological and museum practice, the teams should take high-quality individual photographs of such features with sufficient lighting and with scale. In addition, we would aim to create full 3-dimensional models of such features with the use of photogrammetric recording as above. It requires sufficient number of overlapping images, taken from different angles.

The overlap is the key factor as the software will need to have several good views of the same surface or a point from different angles. The camera used, lighting and computers used for processing all matter, but none can compensate for missing certain angles of view to the object. The next most important thing is approaching it systematically, from planning the shots to setting up the cameras, from cataloguing the images to naming the outputs. Recording the objects and individual features will be a lot more challenging than recording of the walls (usually flat surfaces) or UAV recording (usually only recorded from above).

Exact number of the photographs to be taken will depend on the size of the object as well as complexity of its shape. Please put a scale bar or photogrammetric scales next to the object or feature so that the resulting 3D object can be correctly sized afterwards. As with the recording of the walls, it is important that the placement of the scale bar is carefully managed. It also must be kept in the same position in relation to the object.

Mounting a camera on a tripod creates opportunities for more controlled approach to this. The object will remain fixed and the tripod with camera can be circled around it to take pictures. This is more useful in case of larger or fragile objects.

The lighting will be very important and the teams will need to think about lighting carefully. Flash can be used if necessary. In most cases, using auto focus of your camera will be sufficient. However, please ensure that the object you are photographing is located in the centre of the frame. Zoom can be used only if it is absolutely unavoidable. The best option though is keeping the lens fixed and moving the camera nearer or further from the object. Depending on the complexity of the object, colleagues may prefer using a manual focus control. If properly implemented, it helps to create the best 3D models and reduces the workload in the processing stage.

As with the wall painting recording and the UAV survey, on-field rapid check of the results will be absolutely essential. The same procedures described above will apply here too. Both overlap and alignment of images will be important factors to look at during initial processing in photogrammetric software.

## Multi-spectral photography (MiCAM)

The UCL team has developed a tailor-made approach to multispectral photography of the wall paintings. It will use MiCAM, a camera set designed by Antonio Reis. It will not be possible to implement this method on all sites due to time restrictions. But it will be advisable to use it in selected sites with rich material in order to collect another layer of rich research material.

Each team will have one robust, functional MiCAM set. It will be run as an experiment in the first year of the project and the panel will make a decision as to the effectiveness of the camera and its contribution to meeting the project brief. The MiCAM generated data is adjunct to the objectives of the project and it is an optional part of the recording programme.

Instructions for the use of MiCAM will follow separately as it is at the experimental stage now. Their use will be restricted only to a few team members and they will receive individual advice from UCL team.

## Metadata, data-structures and moving data

The project will result in large amount of data over the period of several years. The collectors of the data in the field will be geographically distant from staff members who are processing it. Over the project's lifespan, personnel involved in the project both in China and UK may change. In this regard, cataloguing the photos becomes extremely important. Please pay attention to the naming of the folders and please make sure that all of the photos have necessary EXIF data associated with them. Numbering of the images should be consistent and not repeated within one session.

When cataloguing the images collected, the teams should take special care to include all additional metadata and all notes. As mentioned above, the correctness of the metadata (such as EXIF) is crucial for the project's success.

During the pilot study, the teams agreed a joint naming convention and it is strongly advised to follow them in detail.

### File naming conventions for Shanxi project:

#### 山西省濒危壁画数字化项目命名规范

(project acronym)\_(county acronym)(village acronym)(site number)\_(room)\_(wall)\_(description).  
extension

#### Where:

project acronym = SDDP

site code = 2 letters (county name), 2 letters (village name) and 3 numbers starting with 001 and ascending, giving each site individual number

room = room name or number

wall = wall name or number

description = states what the file contains

extension = type of file

#### For example:

- SDDP\_LMNT001\_r1\_w3\_ortho.tif
- or
- SDDP\_LMNT001\_rse\_ww\_ortho.tif
- SDDP\_ETDB033\_r3\_w4\_detail\_IR.jpg
- or
- SDDP\_ETDB033\_rn\_wne\_detail\_IR.jpg

Depending on what field team decides to name rooms and walls after visit to first site.

- SDDP\_FGAL124\_plan.dwg
- SDDP\_FGAL124\_plan.pdf

Plan produced for the whole site, so the name does not include the room or wall.

**ABBREVIATIONS:**

SDDP – Shanxi Digital Documentation Project

r – room

w – wall

e – East

w – West

n – North

s – South

ne - North East

nw – North West

se – South East

sw – South West

ortho – orthomosaic

model – 3D model

plan – Site plan

photo - individual photo

IR – infra red

UV – ultra violet

RGB – red green blue

More to follow once we identify other potential outputs.

### Moving data

The procedures for uploading collected data to shared online space was discussed and agreed during the pilot study. It is currently taking place with the use of Baidu cloud. Its effectiveness will be reviewed regularly and other means of sharing data can be proposed if there are significant issues.

Because of the remoteness of most of the temples, immediate upload of the data to the cloud storage via mobile communication will be challenging. Instead, the expectation is that each team will aspire to upload the data collected from their temporary accommodation (hotels and guesthouses). If it is not possible, then the upload should take place as a priority as soon as the teams reach regional institutional base. It is crucial to upload the data as soon as possible because of

considerations of back-up and assessment of the data integrity and usefulness by all participants of the project.

## Baidu cloud disk folder naming system - 百度网盘文件夹命名系统

以忻州市保德县故城村关帝庙为例

注意：最前面的编号（如1.1、1.1.1）表示元盘中文件夹的级别，实际工作中可以不加此序列号

### **1. SDDP\_BDGC001\_GDM**

（例：SDDP\_保德\_故城\_01\_关帝庙；编号“01”随同一村落中寺观增加而递增，“关帝庙”为庙宇性质说明）

#### **1.1 SDDP\_BDGC001\_Plans**

##### **1.1.1 SDDP\_BDGC001\_UAV**

###### **1.1.1.1 SDDP\_BDGC001\_Flight01**

###### **1.1.1.2 SDDP\_BDGC001\_Flight02**

##### **1.1.2 SDDP\_BDGC001\_RTS**

##### **1.1.3 SDDP\_BDGC001\_Setting**

（注：地面上拍摄的一些建筑物及村落照片）

#### **1.2 SDDP\_BDGC001\_MuralSurvey**

##### **1.2.1 SDDP\_BDGC001\_R1\_FloorPlan**

##### **1.2.2 SDDP\_BDGC001\_R1\_ControlPoint**

（注：包括1.1.2SDDP\_BDGC001\_RTS的CAD图）

#### **1.3 SDDP\_BDGC001\_Photogrammetry**

##### **1.3.1 SDDP\_BDGC001\_R1\_W1**

##### **1.3.2 SDDP\_BDGC001\_R1\_W2**

##### **1.3.3 SDDP\_BDGC001\_R1\_W3**

##### **1.3.4 SDDP\_BDGC001\_R1\_W4**

##### **1.3.5= SDDP\_BDGC001\_R2\_W5**

（注：在同一处建筑物内，随房间序号增加，墙面序号延续上一房间的编号，而不重新从1开始计数）

#### **\*1.4S SDDP\_BDGC001\_Detail**

##### **1.4.1 SDDP\_BDGC001\_ArchiDetail**

（注：图片文件命名后缀可加上位置与信息说明，即：  
SDDP\_BDGC001\_MuralDetail\_Location&Explanation)

#### **1.4.2 SDDP\_BDGC001\_MuralDetail**

(注：图片文件命名后缀可加上位置与说明，即：  
SDDP\_BDGC001\_MuralDetail\_Location&Explanation)

#### **1.4.3 SDDP\_BDGC001\_Figure01**

(注：图片文件命名后缀可加上说明，即SDDP\_BDGC001\_Figure01\_Explanation；塑像位置已有编号故不再作说明)

#### **1.4.4 SDDP\_BDGC001\_Figure02**

#### **1.5 SDDP\_BDGC001\_Report**

#### **1.6 SDDP\_BDGC001\_WorkPhotos**

(说明：本例中，2018年5月在杭州、山西的工作照都包括在此文件夹中，按日期分类)

## Community engagement and Condition assessment

The documentation exercise of the remote temples provides a great opportunity for public outreach and community engagement. The teams should be ready to explain the aim and outcomes of the process to the local communities if there is an opportunity to do so. It will increase pride in the local heritage and will benefit the temples in the future.

It is also important for establishing good working relationships with the local authorities and other stakeholders.

Each visit to the temples is also an opportunity for assessing the condition of the buildings. Although the final results will provide a great tool for heritage specialists to do that digitally and remotely, the teams should be able to take and pass notes on any immediate concerns (such as recent collapse, sign of looting, etc). This information will be included in ARCHES database for reference. The project has good collaborative relationships with the local heritage bureaus and our notes and information can be very valuable for them.

Overall condition and breaking the survey down into separate elements, such as:

1. Structural stability
2. Loss and damage
3. Environmental deterioration factors such as wind, rain and temperature fluctuation
4. Past restoration and replacement of original materials