EUROLITHOS European Ornamental Stone Resources

Eurolithos case study

Connecting stone in constructions with stone resources: a technical case study

Thematic focus: Stone in constructions

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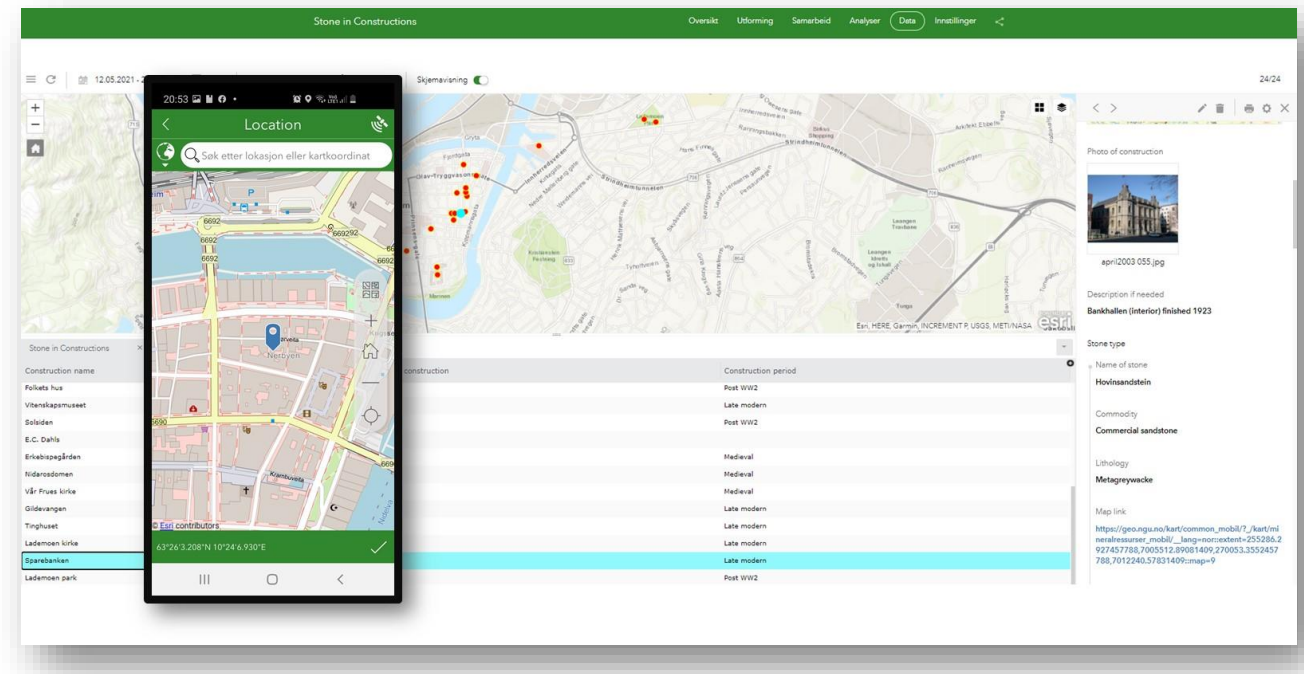

GeoERA RAW MATERIALS

Executive summary

The use of ornamental stone in architecture "as it is" makes it unique compared to other geological resources. Thus, the connection between constructions and the resources is a crucial part of the resources' intrinsic value. This case study aims at exploring possibilities for making such links, not just by exploring and describing constructions, but also by creating a digital registration and interpretation system. The city of Trondheim, Norway has been used as a case study area. By defining key features to be included in such a survey, and thereafter exploring applications and tools that can provide the needs, the case study concludes by recommending a tool based on ArcGIS survey123. A version 1.0 of registration and analysing application has been made and will be made available to the GeoERA community.

Keywords

Ornamental stone, dimension stone, constructions, buildings, use of stone,

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Introduction

The use of ornamental stone in architecture "as it is" makes it unique compared to other geological resources. Thus, the connection between constructions and the resources is a crucial part of the resources' intrinsic value.

This case study aims at exploring possibilities for making such links, not just by exploring and describing constructions, but also by creating a digital registration and interpretation system. The city of Trondheim, Norway, has been used as a case study area.

Some conditions for the study were drawn:

- One construction can include many stone types; thus, there is need for "one-to-many" relations in the system.
- We want to include different types of use for each stone, i.e. façade, floor. This means the need for registration of many types of uses for each stone employed.
- We wanted easy solutions for uploading pictures "as we go".
- No borders: no restrictions for where one can use the application – i.e. that a Norwegian stone used in Shanghai easily can be registered together with national uses.

Stakeholder activities in the case study included discussions about what features to include, aiming at balancing easy registration with need for information. Regarding the latter, we have tried to stick with information that is not easily achieved from other open information sources.

Methods applied

First phase: defining information to be included

Construction: rough characterization of different types, i.e. building, street, monument. In addition, the period of construction (Table 1). In addition, text fields such as name, construction year and description, should be included. Geographical coordinates are also needed.

Table 1. Codelists for construction type and construction period, the latter with explanation

Construction type	Period	Period explanation
Building	Pre-history	Before written history. The ending varies from place to place from 5000 years ago until recent.
Square	Antiquity	Between pre-history and the Middle Ages (Medieval period)
Road	Medieval	From the fall of the Roman Empire to the Renaissance
Bridge	Early modern	From the Middle Ages to c. 1820
wall	Late modern	From c. 1840 to WW2
Monument	Post WW2	After 1945
Sculpture		

Each stone type should be roughly characterized by its unique name, commodity type (Table 2) and lithology. In addition, there should be place for map link (i.e. google maps or other) and link to more information about the stone. Finally, information about how the stone is used in the construction (Table 2).

Table 2. Codelists for commodity and place of use in construction

Commodity (INSPIRE)	Place of use
Commercial granite	Facade
Commercial basalt	Base
Commercial marble	Columns
Commercial sandstone	Ornaments
Commercial greenstone	Frames
Commercial limestone	Cornice
Commercial slate	Roof
Miscellaneous dimension stones	Paving
	Interior wall
	Interior floor
	Monument
	Sculpture

Second phase: defining conditions of use

The ideal solution would be simple to make, simple to use, can be used and copied by many and provide a geographical platform to study distribution patterns of stone resources. It should also be easy to use by third parties, such as national building authorities and others in need for information about a building of historic interest in need for restoration. Thus, it should be easy to publish to professional users.

The collected data will be valuable also in the future. Thus, secure storage is needed preferably with logs of new data entries.

Choice of solution

At an early stage, several systems and applications were evaluated (Table 3). The following issues were important in the evaluation:

- Easy to use
- Secure storage
- Export possibilities/analytical tools
- One-to-many relations possible

Table 3. Overview of solutions/software evaluated and result of the evaluation

Solution	Strength	Weakness	Result
Qfield (QGis)	Open, free	Complex relations not possible	Discharded
MS Access	Complex relations possible	geographic interface weak/difficult	Discharded
Open Streetmap/Wiki	Open, free, Complex relations possible	Tracking and logging difficult, not possible to control changes and storage	Discharded
ArcGIS collector	Flexible for registration of polygons and points	Difficult to use without basic GIS knowledge, Complex relations possible, but difficult in use	Discharded
ArcGIS fieldmap	Flexible for registration of polygons and points	Difficult to use without basic GIS knowledge, Complex relations possible, but difficult in use; still new, more testing of opportunities needed	Discharded
ArcGIS Survey123	Easy to use	Complex relations not possible for registration Choose either points or polygons	Discharded
ArcGIS Survey123 connect	Easy to use, complex relations possible, good publishing possibilities	Choose either points or polygons	Selected

Survey123 Connect was selected mainly due to its easy ability to serve the one-to-many relations (i.e. many stone types in one construction). In the future, there will probably be similar tools also available in the open source community, but so far there is not. However, many institutions working with spatial data (i.e. geological surveys) have Esri-license including ArcGIS online, which will enable them to use the application.

Structure, data and connections

ArcGIS Survey123 (the basic version) is web-based, so there is no need for software download. However, for getting access to the more complex solutions (such as one-to-many relations) a special version that needs downloading and installation is needed – ArcGIS Survey123 Connect. This application operates in interface with MS Excel, where excel sheets define “programming” (Figure 1) and codelists (Figure 2). For instance, creating an option of adding an infinite number of stone types to a building, requires a code in excel defining beginning and end of the feature group that can be repeated many times (“begin repeat” and “end repeat” in Figure 1).

This sheet also commands if an entry shall display all options, autocomplete, etc.

A second sheet defines the codelists for the “one choice” or “multiple choice” entries, and language (Figure 2).

type	name	label	hint	guidance_hint	appearance	required
note	generated_note_surveyDescription	Eurolithos survey stone in buildings	Stone registration tool			
note	generated_note_form_submit_text	Send				
note	generated_note_form_footer	Levert av ArcGIS Survey123				
note	generated_note_prompt_submitted	 <img src="				
text	construction_name	Construction name				
select_one list_country	country	Country			autocomplete	yes
select_one list_type_of_construction	type_of_construction	Type of construction			autocomplete	yes
select_one list_construction_period	construction_period	Construction period			minimal	
text	construction_year	Construction year (or years)				
geopoint	location	Location			hide-input	
image	photo_of_construction	Photo of construction				
text	description	Description if needed				
begin repeat	Stone_type	Stone type				
text	name_of_stone	Name of stone	Please enter uniq			
select_one list_country	country	Country			autocomplete	
select_one list_commodity	_commodity	Commodity			autocomplete	
text	lithology	Lithology				
text	map_link	Map link				
text	fact_link	Fact link				
image	photo	Photo				
select_multiple list__use	_use	Use				
end repeat	Stone_type	Stone type				

Figure 1. MS Excel sheet displaying the “programming” of the registration tool

	A	B	C	D	E
1	list_name	name	label	image	label::language1
2	list_type_of_constructio	Building	Building		
3	list_type_of_constructio	Square	Square		
4	list_type_of_constructio	Road	Road		
5	list_type_of_constructio	Bridge	Bridge		
6	list_type_of_constructio	wall	wall		
7	list_type_of_constructio	Monument	Monument		
8	list_type_of_constructio	Sculpture	Sculpture		
9	list_construction_period	Pre_history	Pre-history		
10	list_construction_period	Antiquity	Antiquity		
11	list_construction_period	Medieval	Medieval		
12	list_construction_period	Early_modern	Early modern		
13	list_construction_period	Late_modern	Late modern		
14	list_construction_period	Post_WW2	Post WW2		
15	list_commodity	Commercial granite	Commercial granite		
16	list_commodity	Commercial_basalt	Commercial basalt		
17	list_commodity	Commercial_marble	Commercial marble		
18	list_commodity	Commercial_sandst	Commercial sandstone		
19	list_commodity	Commercial_greens	Commercial greenstone		
20	list_commodity	Commercial_limesto	Commercial limestone		
21	list_commodity	Commercial_slate	Commercial slate		
22	list_commodity	Miscellaneous_dime	Miscellaneous dimension stones		
23	list__use	Facade	Facade		
24	list__use	Base	Base		
25	list__use	Columns	Columns		
26	list__use	Ornaments	Ornaments		
27	list__use	Frames	Frames		
28	list__use	Cornice	Cornice		
29	list__use	Roof	Roof		
30	list__use	Paving	Paving		
31	list__use	Interior_wall	Interior wall		
32	list__use	Interior_floor	Interior floor		
33	list__use	Monument	Monument		
34	list__use	Sculpture	Sculpture		
35					

survey | choices | settings | types

Figure 2. MS Excel sheet displaying code lists for one-choice or multiple-choice

How to use the application

In field, the application is downloaded through usual channels (google play or alternative IOS platform). Next, you will be asked to log into your ArcGIS online account. When done, you will have access to the

Survey123 application “Stone in constructions” if the rights are distributed to you or you have it ready on your ArcGIS online account. Click on the icon and you can start (Figure 3).

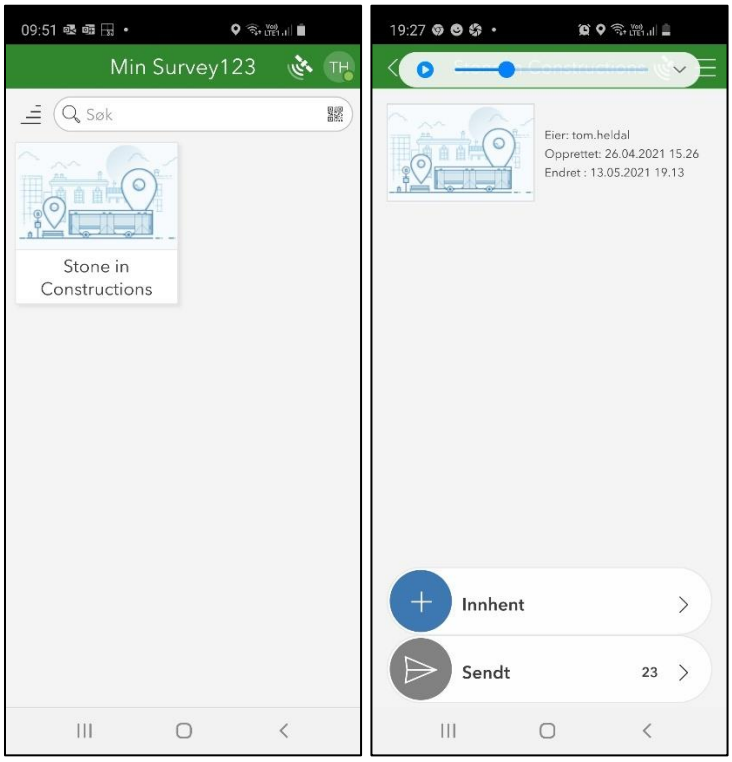

Figure 3. When logged in, click the icon of the survey. Next, you may add new registrations (“innhent” in the figure) or view your previous ones (“sendt”).

Next step is to register a construction. You fill in the form, provide the map location and take or upload photos needed (Figure 4, Figure 5).

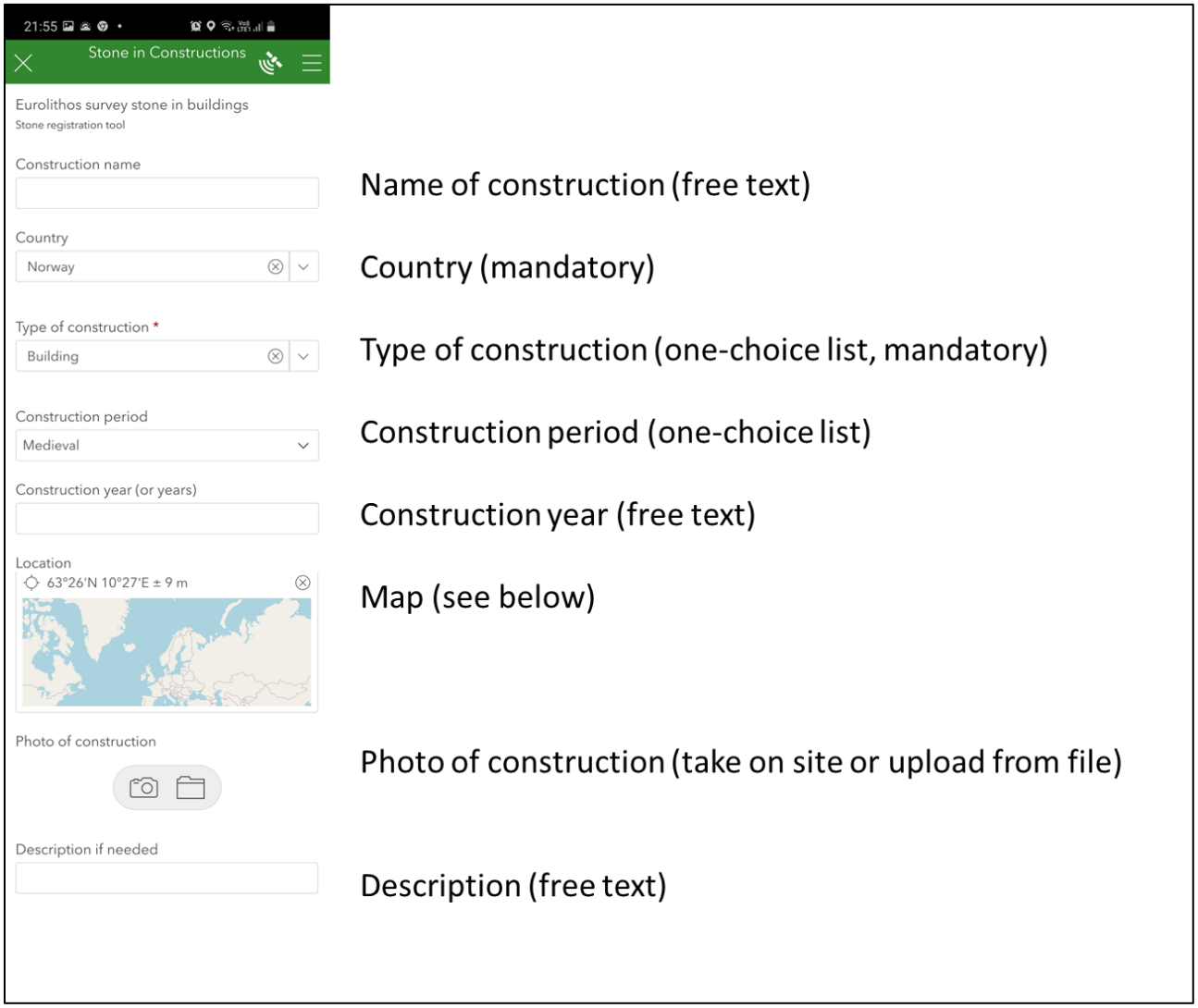

Figure 4. How to register a construction with geographical location

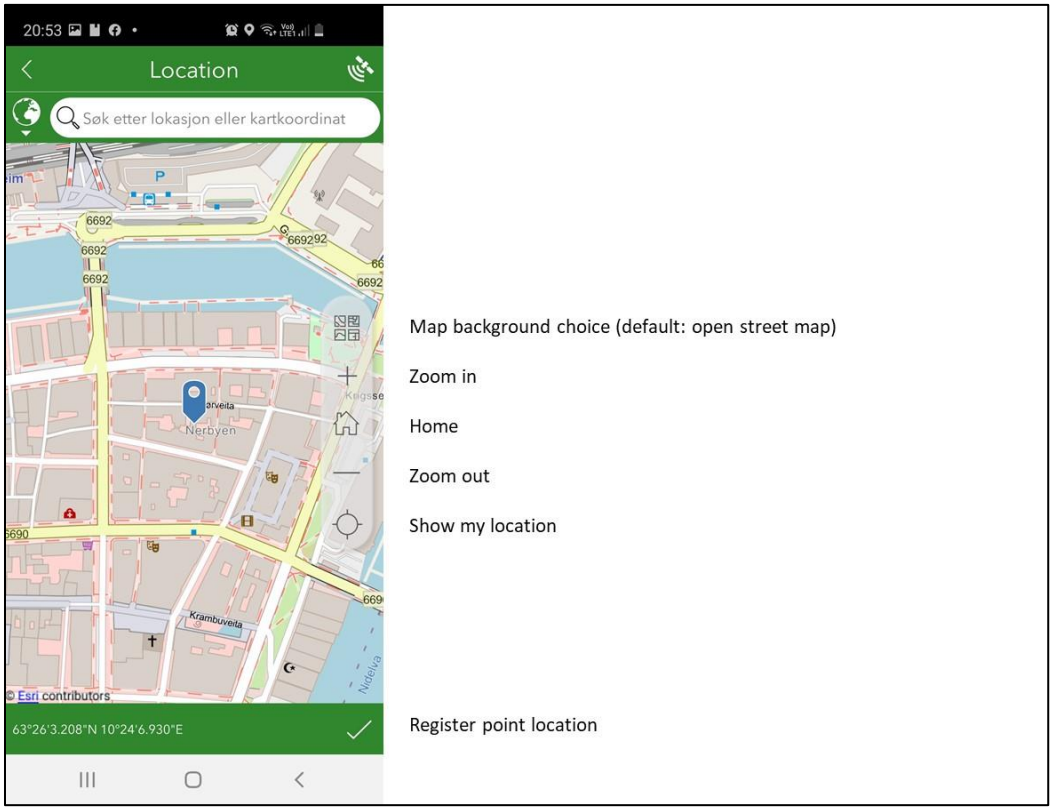

Figure 5. How to register location from map provided

Next, you fill in the form for the first stone type in the construction, that you want to register. You fill in the form, take or upload photos (Figure 6), and move on to the next stone type.

Please use the Eurolithos vocabulary: For commodity, use the terms having “dimension stone” as “parent” (such as Commerical granite, Commercial slate”). For “Lithology”, use the terms given in each of the “Commercial” groups (such as monzonite, rhyolite, etc.). See vocabulary here.

In “Map link” it is possible to give the most useful link to a point or to an area on a map, either your national database, EGDI or google maps.

In “fact link”, you may use any fact sheet, but clearly link to uploaded EuroLithos directory sheets is a natural selection.

Photo of the particular stone in the construction you may take on site or upload.

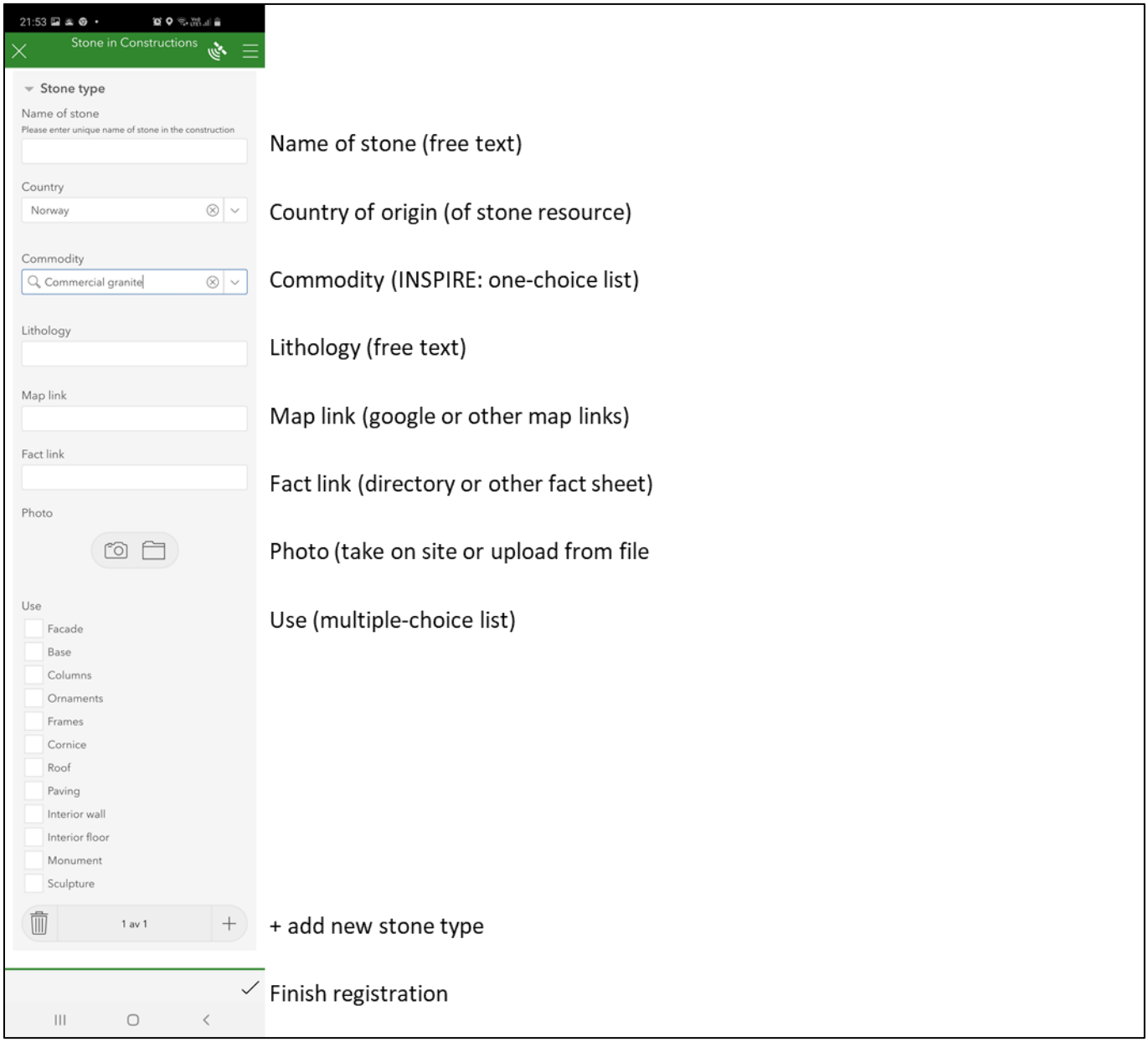

Figure 6. Form for stone type

When you have finished registration of all stone types, you click on the √ for ending the session. You will now be asked if you want to send, abort or save for later sending (Figure 7).

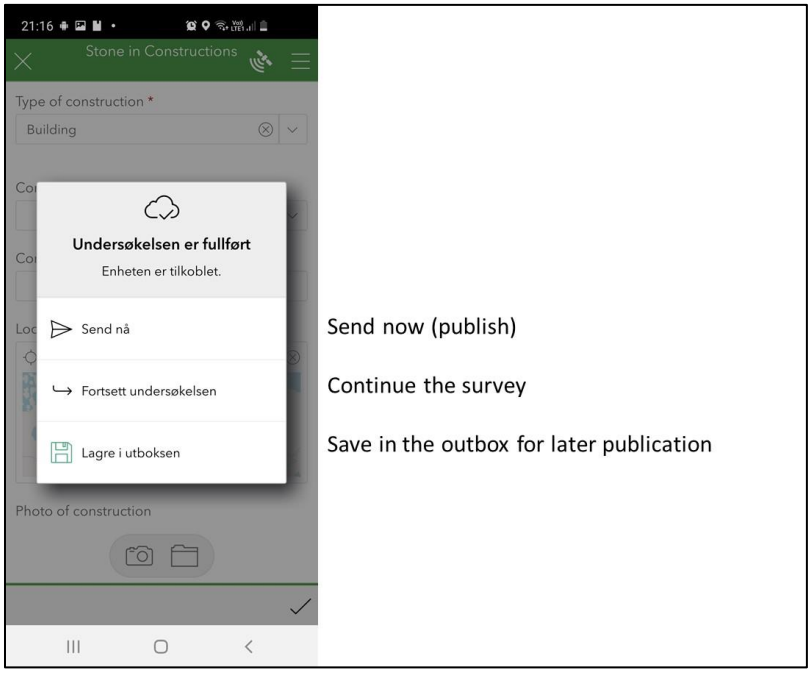

Figure 7. Ending the session

Editing and analysing data

When accessing the data by logging into ArcGIS survey123, it is possible to edit and analyse them.

First, you will get an overview of data entries (Figure 8).

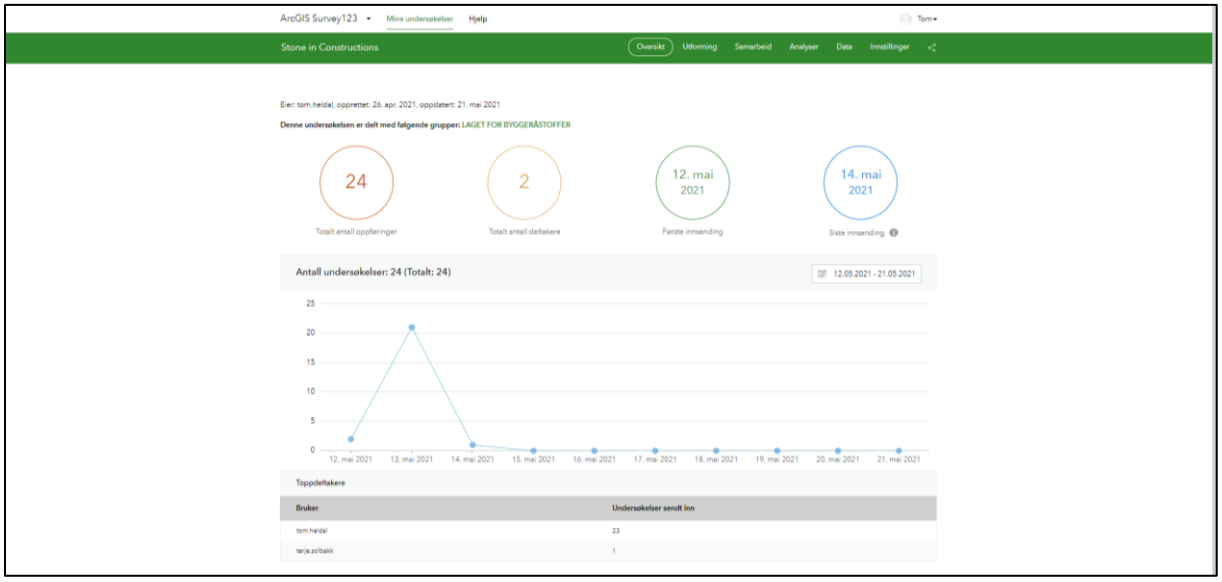

Figure 8. Overview of number of entries, number of people making the entries and dates for first and last entry

If entering “data” tab, you can view the registrations of constructions. You can also edit the data by entering editing mode.

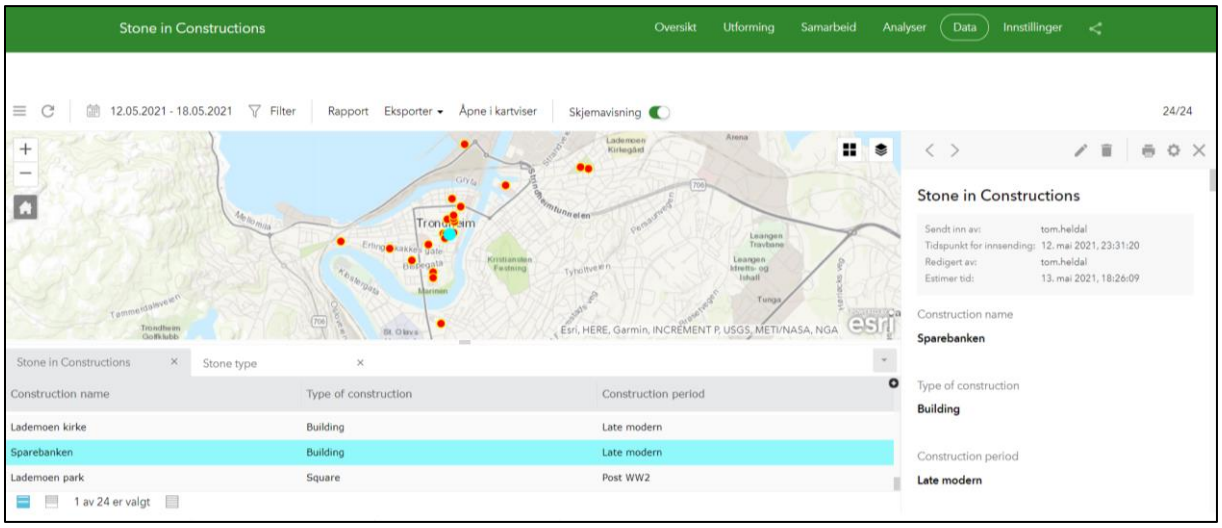

Figure 9. Map view and individual view of entries. Here you can enter editing mode

By viewing tab “stone type” you can view all the stone types employed in your survey.

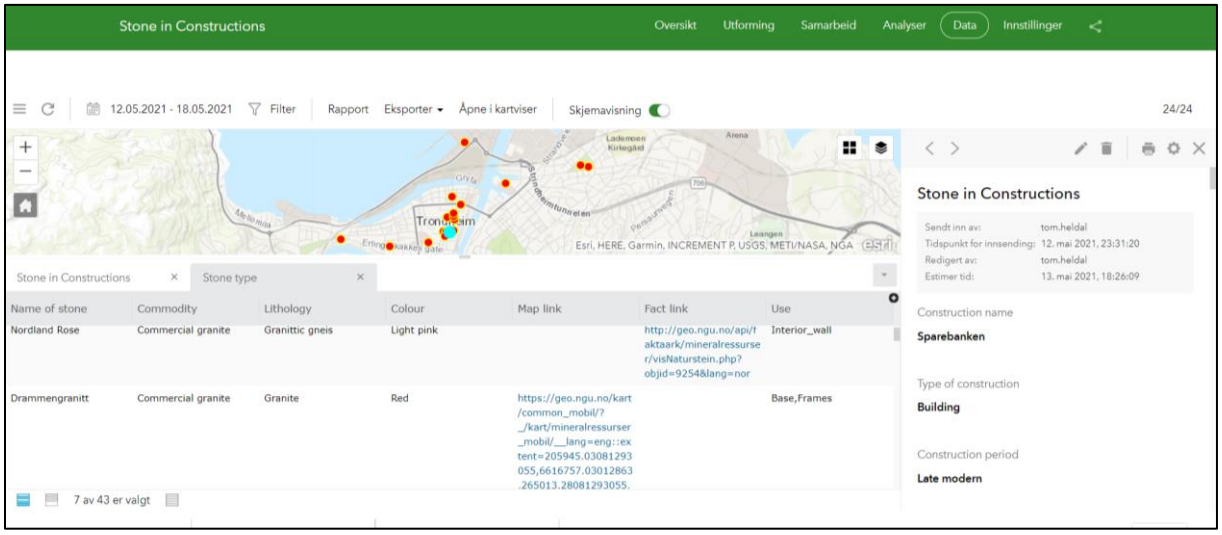

Figure 10. Stone type tab

The tab «analyses» give you access to statistical, pre-defined analytical tools, such as distribution of construction types, stone types employed, etc. (Figure 11, Figure 12, Figure 13). It is also possible to display photos or other information for viewing (Figure 14).

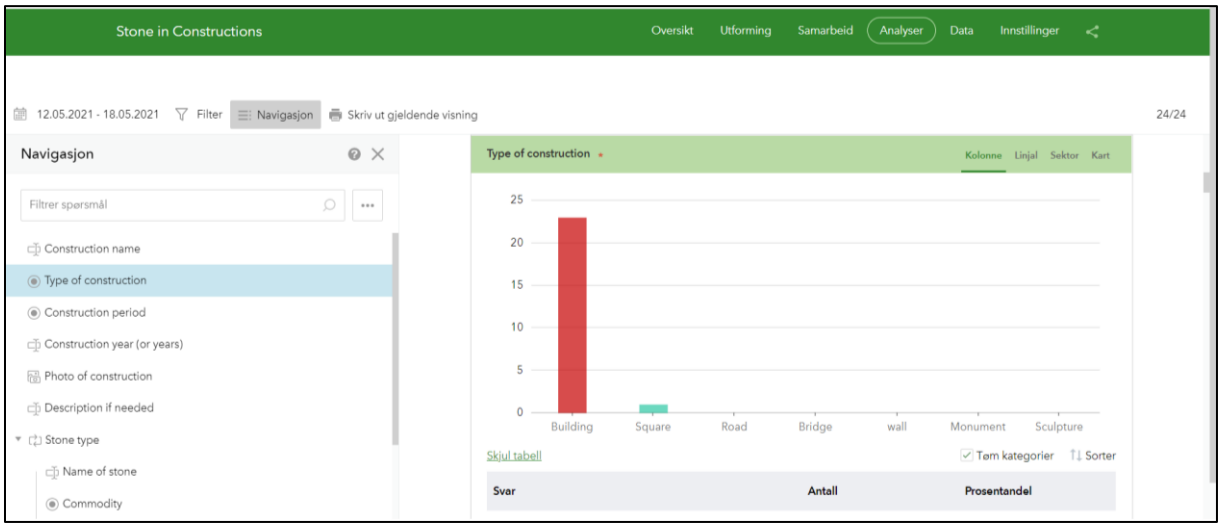

Figure 11. Analysing: type of construction

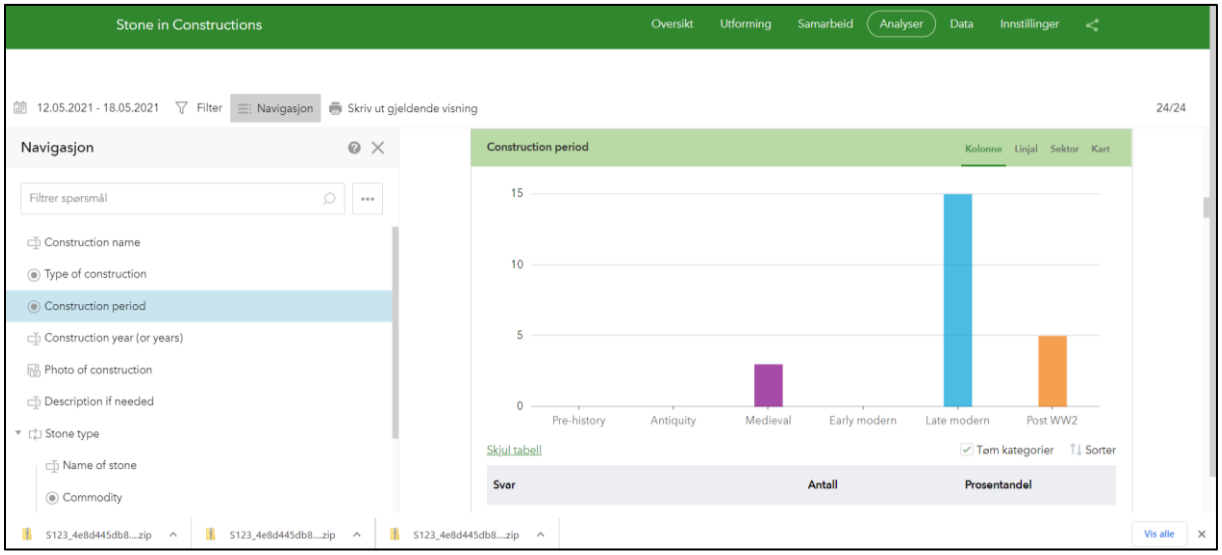

Figure 12. Analysing: construction period

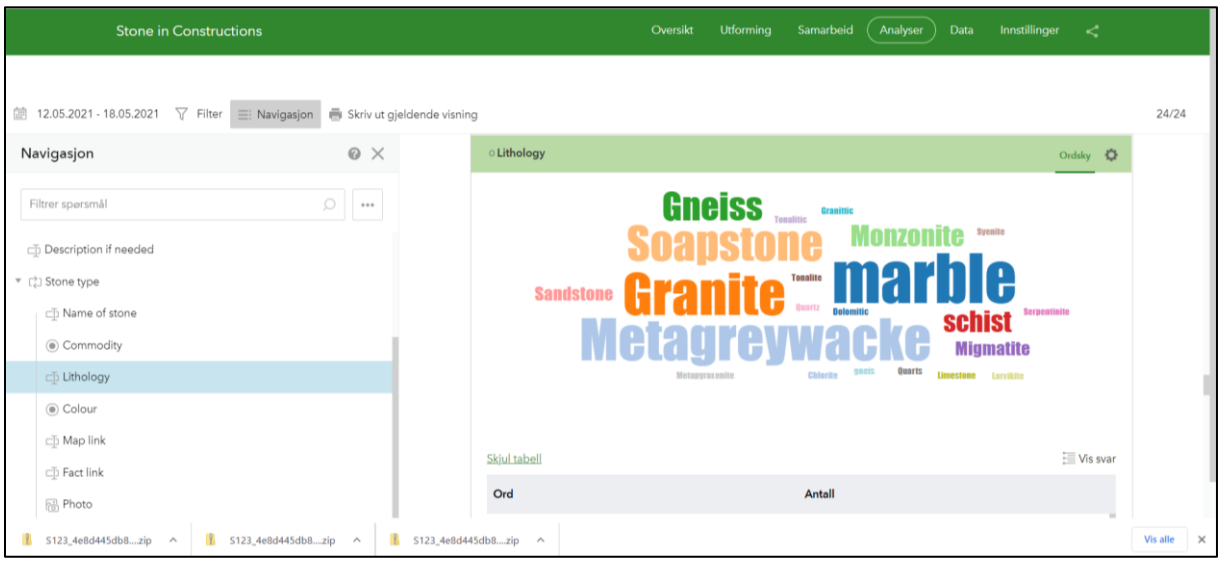

Figure 13. Analysing: commonly used lithologies, word cloud style

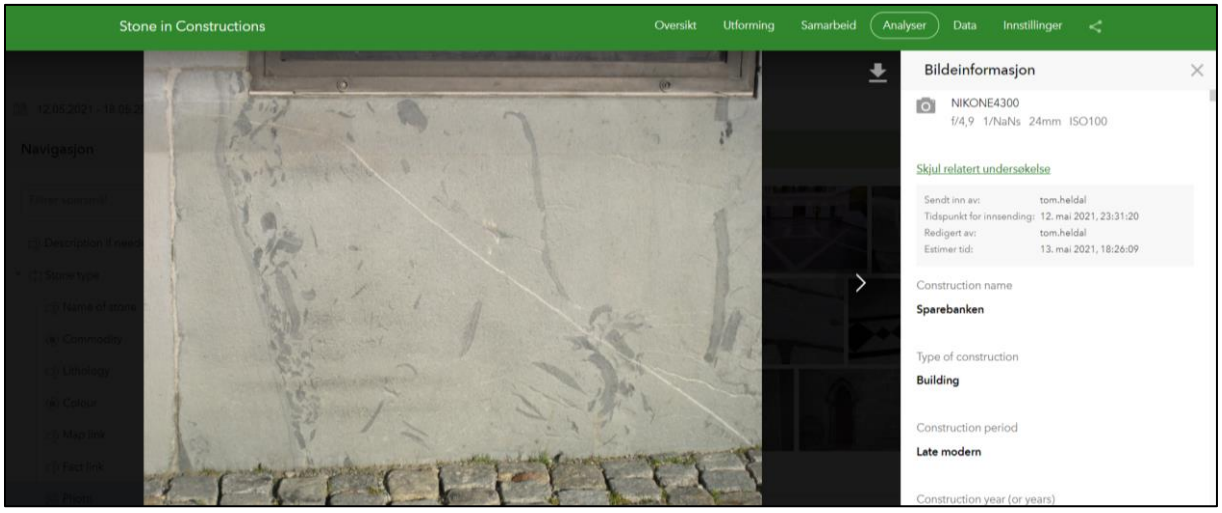

Figure 14. Displaying: photo of stone type in part of construction

The next step – exporting data to other applications

At regular intervals, one may want to export the collected data to other formats (Figure 15). There is an export tab, where you may decide to export to csv, excel, shape or geodatabase formats. Geodatabase is the only format that can maintain the complex structure of the original data. When opening in ArcMap or ArcGis pro, you may explore different ways of visualising the data. For example, by joining the Survey table with the Stone type table, you may display the use of particular stone types on a geographical scale.

When all the data is stored in a geodatabase, it is easy to store the data intact and for future need, given that your data forms a part of a geoscience data infrastructure, nationally or internationally.

It is also possible to publish on an ArcGis online platform, to be shared by everyone with access to that.

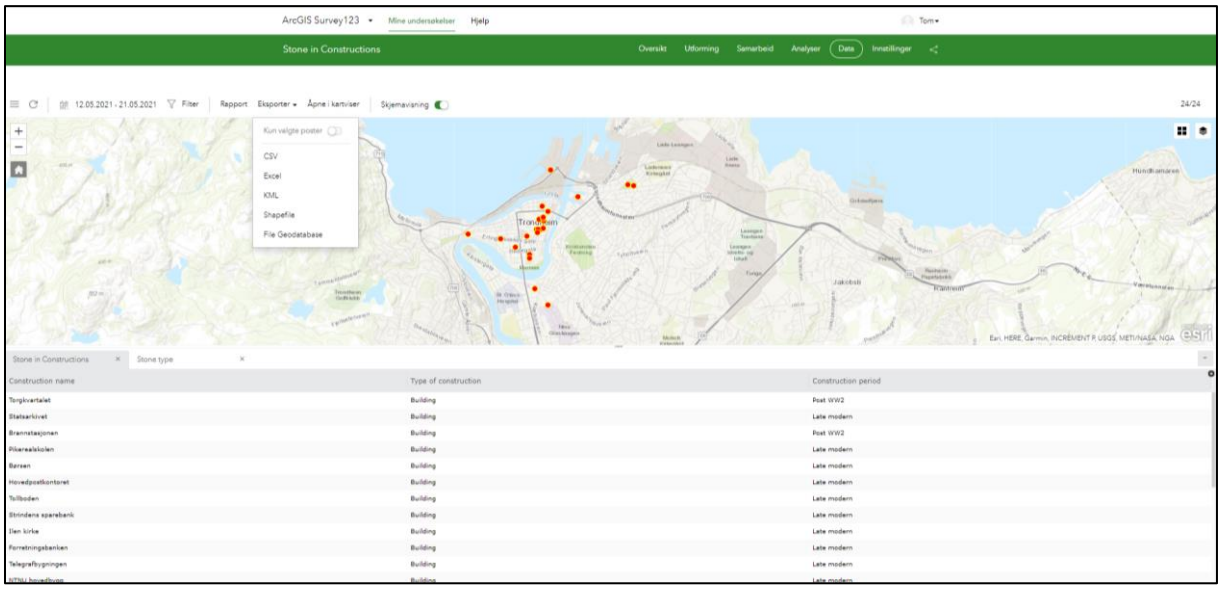

Figure 15. Export options

Publishing this survey

There are several ways to make such a survey active:

1) Make it public, available to everyone. This will make everyone capable of using the ArcGIS survey 123 on their mobile or other hardware and register new data. However, the user will be anonymous and cannot view the end results without this being published by the administrator. The administrator thus cannot see if the contributions are Of high quality or not.
2) Invite individuals with access (mostly through their employer) to ArcGIS online account. All contributors can be identified, and all users/contributors can access analytical tools and edit their own data.
3) Make the coding and setup for surveys available to those who want to use the app for their national survey.

Here, there are no absolute answers. However, these three alternatives can be tested and evaluated.

Case study conclusions

At the present time, the ArcGis Survey123 seems to be the best option for registration, storing and displaying data about stone in constructions. To make the survey template, ArcGis Survey 123 Connect is needed. For making registrations, only ArcGis Online account is needed.

In theory, it is possible for the whole European partnership on ornamental stone to use the solution in one central survey, but it will create very large files, due to the photos. When the files are stored on ArcGIS online, credits run and this may turn out costly for the owner.

Thus, until there are open source solutions, national scale (and in some countries, regional) seems to be an appropriate, practical level. By using the same survey, export to file geodatabase, it is easy to regularly update, for example, a European distribution map for stone types in constructions. One step further could be to keep the heavy database containing images on a regional/national scale, and create a data export line for databases without such content.