Global Shelter Cluster
ShelterCluster.org
Coordinating Humanitarian Shelter

Reflection Paper on Adapting "Shelter Methodology for the Assessment of Carbon" (SMAC) for Transitional Shelter Designs in Malawi

Greening the Shelter Response

September 2023 Reflection Paper on Adapting "**Shelter Methodology for the Assessment of Carbon" (SMAC)** for Transitional Shelter Designs in Malawi

Humanitarian Aid and Civil Protection

Greening the Shelter Response

Contents

Introduction

Identifying the amount of carbon dioxide (CO_2) associated with materials, transportation and packaging for transitional shelter designs is a useful indicator when considering greener transitional shelter solutions. As part of the "Greening the Shelter Response" project, funded by the Directorate-General for European Civil Protection and Humanitarian Aid Operations and the United Nations High Commissioner for Refugees, disaster risk reduction and shelter and settlement specialists from Catholic Relief Services (CRS), along with CRS Malawi staff and local partners, adapted two separate tools for identifying CO_2 emissions in shelter design to determine which tool was most appropriate for use in rural Malawi. The Health Housing for the Displaced (HHFTD) Calculator and the Shelter Methodology for the Assessment of Carbon (SMAC) tool were applied to transitional shelter designs currently implemented in disaster-affected regions throughout southern Malawi.

This reflection paper aims to share the experience of adapting the SMAC tool to the context of rural Malawi. This document is intended to be consulted by other shelter and settlement actors looking to adapt the tool in similar contexts.

1. The HHFTD Calculator

The HHFTD Calculator provides a snapshot of the estimated embodied carbon of any shelter by analyzing the carbon emissions of shelter materials only during the lifespan of the shelter, which is described as a "cradle-to-gate" analysis. The tool was developed by a consortium of universities in Jordan and Turkey, along with Bath University in the United Kingdom. A useful component of HHFTD is that it shows how any specific shelter design compares to case studies of shelter designs used globally.

The HHFTD Calculator has collected 81 case studies from shelter designs around the world and ranked them based on their relative contribution to greenhouse gas emissions. The shelter design for Malawi, which the team uploaded into the HHFTD Calculator, ranked 39th out of 81 global shelter designs. This ranking in the middle of the spectrum indicates that the tool was applied correctly. However, in using the tool, the CRS team had to make broad assumptions based on the categories set in the tool, as the materials listed did not align with shelter designs throughout rural southern Malawi. For example, the HHFTD tool did not have any equivalent material category for sand stabilized bricks or compressed earth blocks. In addition to making assumptions about specific materials, the team had to calculate the density of materials to appropriately upload them into the HHFTD Calculator. This extra step required the team to work through each material item of the bill of quantities (BOQ) and its density to work out its weight.

2. The SMAC Tool

The SMAC tool was developed by the Building Research Establishment Trust, the Environment Community of Practice and the U.S. office of the World Wildlife Fund (WWF) to support the comparison of shelter solutions in terms of their CO_2 equivalent emissions. It is intended as a decision-support tool to help identify the most carbon-efficient shelter option. Because the SMAC tool provides a "cradle-to-grave" analysis of the materials (i.e., it analyzes the carbon emissions each shelter material is responsible for, from extraction to end-of-life breakdown following the material's use in the shelter) and includes aspects of transportation and packaging into the overall assessment, the CRS team decided it would provide the most comprehensive analysis.

Despite the strengths of the SMAC tool, its list of materials does not accurately reflect the local materials found on the BOQ for shelter design in Malawi. The CRS team has therefore revised the tool to include more local materials.

3. Steps Taken to Revise the SMAC Tool for Context in Malawi[1]

1) Acquire the BOQ for all shelter designs that the team plans to incorporate into the CO_2 emissions analysis.
    a. For this initiative, the CRS team used three BOQs:
        i. The commonly used BOQ from the Malawi Shelter Cluster
        ii. A BOQ for a traditionally built home
        iii. A BOQ based on a concrete block home according to standards set by the Government of Malawi (GoM).

2) Become familiar with the SMAC tool, using step-by-step guidance on how to use the tool.

3) In the SMAC tool, access the "Materials List" tab in the Excel sheet and determine with the team whether the listed materials are appropriate for the context. If the materials are applicable, proceed to use the tool as per the guidance. If the materials are not suitable to the context, proceed to Step 4 below.

4) In the "Materials List" tab of the SMAC tool, determine which materials are not used in the BOQ.

5) Work with an "unlocked" version of the SMAC tool to add materials suitable for the context.
    a. Determine which materials are missing from the BOQ.
    b. Conduct desk research to determine the CO_2 emissions associated with each of the materials and any end-of-life components.

6) In the SMAC tool, go to the "Lists" tab and replace the names of the materials that will not be used for the analysis with the names of the new materials that will be incorporated.
    a. In the case of Malawi, "Textiles" was not needed; therefore, the name was changed to "Earth Block," with two specific materials added as per the Malawi BOQ, compressed earth blocks and sand stabilized bricks.

[1] Steps 1–3 are typical steps associated with the use of SMAC in any context.

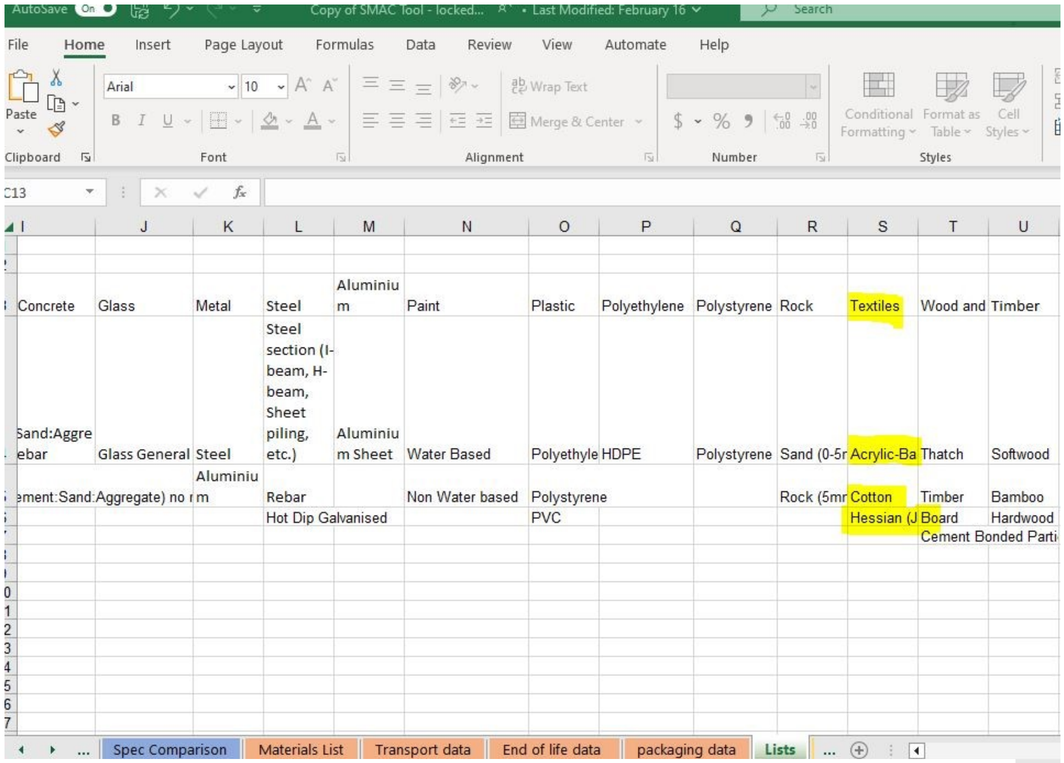


Figure 1: Original SMAC tool: highlighted textile materials are not needed for Malawi BOQ.

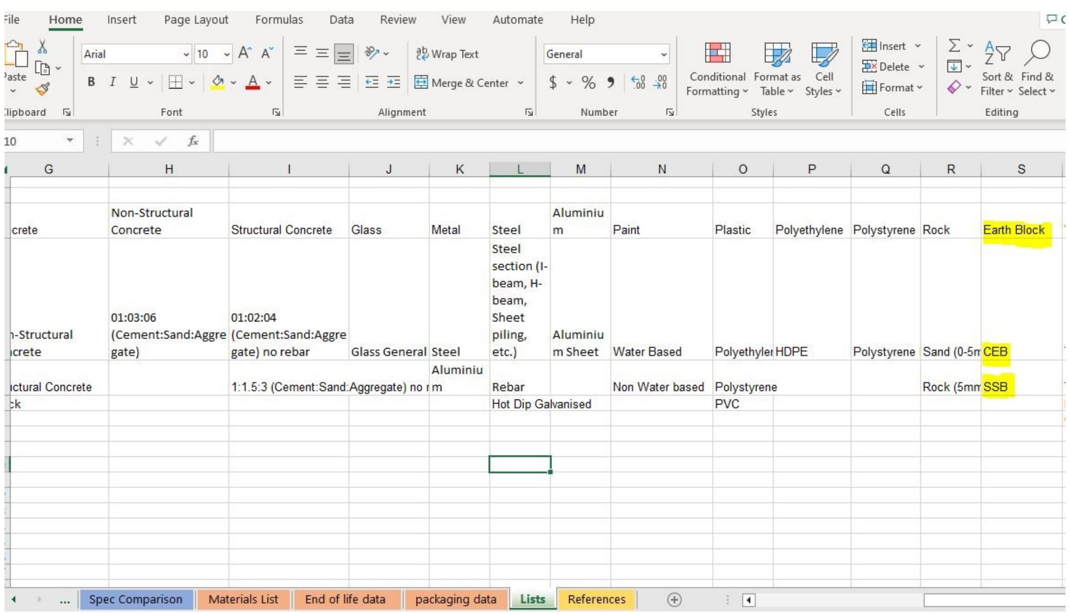


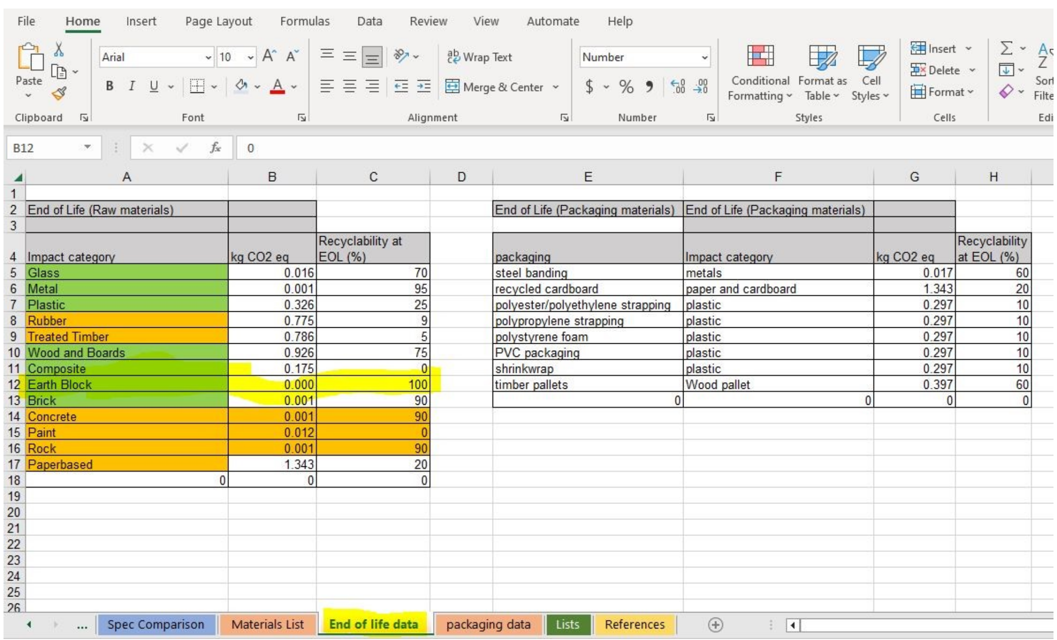
Figure 2: Revised SMAC tool: materials have been changed to reflect the BOQ.

7) In the SMAC tool, go to the "Materials List" tab. The new material names should appear based on the action taken in Step 6. In the column marked "KgCO_2 eq/Kg," update the associated emissions with the new material as per the desk research conducted during Step 5.

	Level 1	Level 2	Level 3	Level 4	Humanitarian S	Hints and Tips	What might this materi	Column1	Column2	Kg CO2 eq/Kg
16	Wood and Boards	Board	Chipboard or particleboard		Y		walls/ partitioning	oard or particleboard,	particleboard,	-0.81
17	Wood and Boards	Board	Hardboard		Y		walls/ partitioning	Boards,Board,Hardb	Boards,Board,Hardboard,	-0.82
18	Wood and Boards	Timber	Hardwood		Y			Boards,Timber,Hard	Boards,Timber,Hardwood,	-1.29
19	Wood and Boards	Board	MDF		Y	much lower	walls/ partitioning	Boards,Board,MDF,	Wood and Boards,Board,MDF,	-0.64
20	Wood and Boards	Board	Fibreboard		Y		Internal and external walls/ partitioning	Boards,Board,Fibreb oard,	Wood and Boards,Board,Fibreboard,	-0.86
21	Wood and Boards	Timber	Softwood		Y		walls/ partitioning	Boards,Timber,Softw	Boards,Timber,Softwood,	-1.29
22	Wood and Boards	Board	OSB (orientated strand board)		Y		Internal and external walls/ partitioning	Wood and Boards,Board,OSB (orientated strand board),	Wood and Boards,Board,OSB (orientated strand board),	-1.05
23	Wood and Boards	Board	Plywood		Y		Internal and external walls/ partitioning	Boards,Board,Plywo od,	Wood and Boards,Board,Plywood,	-0.93
24	Paint	Water Based			Y		Interna and external	Paint,Water Based,,	Paint,Water Based,,	0.430766217
25	Paint	Non Water based			Y		paint	based,,	Paint,Non Water based,,	0.311425781
26	Plastic	PVC			Y		Pipes	Plastic,PVC,,	Plastic,PVC,,	2.695
27	Plastic	Polystyrene	Polystyrene Foam (Density 20kg/m3)		Y	for polystyrene	temporary filling	Polystyrene Foam	Foam (Density 20kg/m3),	3.1
28	Plastic	Polyethylene	HDPE		Y	reference refers to 1m2 as the dlcared unit - covnversion so that it is representative of kg may be necessary	Paritioning/ canopies	Plastic,Polyethylene, HDPE,	Plastic,Polyethylene,HDPE,	0.755
29	Rock	Sand (0-5mm)			Y	cement and mortar fillinf		Rock,Sand (0-5mm),,	Rock,Sand (0-5mm),,	0.00747
30	Concrete	Block			Y			Concrete,Block,,	Concrete,Block,,	0.093
31	Brick	Clay Brick			Y			Brick,Clay Brick,,	Brick,Clay Brick,,	0.213
32	Earth Block	CEB			Y			Earth Block,CEB,,	Earth Block,CEB,,	0.014
33	Earth Block	SSB			Y			Earth Block,SSB,,	Earth Block,SSB,,	0.023
							Various temporary	Textiles,Hessian		

Figure 3: Kg CO_2 amounts have been incorporated for the added materials.

8) In the SMAC tool, go to the "End of life data" tab. In the column marked "KgCO_2 eq," update the associated emissions for the end-of-life components of the new materials as per the desk research conducted during Step 5.



	A	B	C
2	End of Life (Raw materials)		
4	Impact category	kg CO2 eq	Recyclability at EOL (%)
5	Glass	0.016	70
6	Metal	0.001	95
7	Plastic	0.326	25
8	Rubber	0.775	9
9	Treated Timber	0.786	5
10	Wood and Boards	0.926	75
11	Composite	0.175	0
12	Earth Block	0.000	100
13	Brick	0.001	90
14	Concrete	0.001	90
15	Paint	0.012	0
16	Rock	0.001	90
17	Paperbased	1.343	20
18	0	0	0

	E	F	G	H
2	End of Life (Packaging materials)	End of Life (Packaging materials)		
4	packaging	Impact category	kg CO2 eq	Recyclability at EOL (%)
5	steel banding	metals	0.017	60
6	recycled cardboard	paper and cardboard	1.343	20
7	polyester/polyethylene strapping	plastic	0.297	10
8	polypropylene strapping	plastic	0.297	10
9	polystyrene foam	plastic	0.297	10
10	PVC packaging	plastic	0.297	10
11	shrinkwrap	plastic	0.297	10
12	timber pallets	Wood pallet	0.397	60
13	0	0	0	0

Figure 4: End-of-life Kg CO_2 amounts have been incorporated for the added materials.

9) Complete the SMAC tool as per the guidance provided.

4. Recommendations

While the application of the SMAC tool analysis allowed for a quick snapshot of CO_2 emissions associated with several common shelter designs in Malawi, the team recognizes that the process was not perfect. The list of materials in the SMAC tool is limited, and certain materials, including earth blocks, are not listed. CRS found that adding new materials to the tool was challenging and called for Excel expertise, which was not readily available. Replacing data within the existing cells of the Excel file was more straightforward and provided a quick solution to complete the analysis. Moving forward, the process of using the SMAC tool could be improved with the following additional inputs:

1) Continued resources made available by the government, Global Shelter Cluster, academia and other stakeholders to access amounts of CO_2 for commonly used shelter materials across sub-Saharan Africa.
2) Tutorials for how to adapt the SMAC tool to incorporate new or revised materials.

Conclusion

The SMAC tool offers a quick comparison of CO_2 equivalent emissions for temporary or transitional shelters to help identify the most carbon-efficient shelter option. It provides an overview of the impact of the shelter solution split between components, packaging, transport and end-of-life. Incorporating an assessment like this during the design phase of an intervention aids project teams in making decisions about appropriate shelter solutions. The use of the carbon analysis of shelter materials in the market assessment is a huge step toward incorporating climate- and environment-related issues into shelter design.

For this exercise, CRS was able to use the SMAC tool for basic analysis as described above. However, due to limited expertise in calculating greenhouse gas emissions, tool users were unable to perform analysis beyond the direct outputs the SMAC tool provided. As with many technical tools, this limitation highlights the need for technical experts when using specific tools.

Carbon calculation is an essential aspect of any environmental assessment; however, it is only one component of a comprehensive environmental analysis, and the most efficient solution must take a balanced approach. In the future, this type of approach could be improved with additional community consultation and with analysis of what impact the extraction of any local material may have on the natural environment, regardless of the associated greenhouse gas emissions.