

Producing ConFib Blocks

**Manual for Producing Blocks from Fibrous Concrete**

**From Waste to Resource Project**

**Nogales, Sonora**

**Fall 2011**



## Producing ConFib Blocks

### Introduction:

- **What is this project?** This project addresses the management of waste paper, a significant solid waste problem for Nogales. According to city officials, 52,000 pounds of paper end up in the municipal landfill each year. On top of that, an unknown amount of paper is burned and contributes to air quality problems in Nogales. Civic leaders recognize that effective programs for materials reuse and/or recycling require a consistent market; the more local the market the more economically feasible the programs. They seek local solutions that will reduce burning and landfilling and make the paper available as a resource. At the same time, over the past five years, various individuals and groups living and working in Nogales have shown renewed interest in alternative construction technologies, especially to meet the need for low-cost housing and insulation. Any successful alternative must be affordable, made of available materials, easy to construct using local knowledge and skills, amenable to construction in phases, secure, private, and of low fire risk. Current estimates indicate that if all of the waste paper currently going to the Nogales landfill were used in the production of fibrous concrete there would be sufficient material available for building a home every three weeks. Reaching that level of production will require developing a complete system from the collection and processing of paper through design and construction. This project will develop and evaluate that system.
- **Why does it matter?** This project will build upon the efforts of the many individuals and groups who have participated in the exploration of fibrous concrete and will (1) establish the local infrastructure for and demonstrate the feasibility of removing paper (and other waste products such as Styrofoam) from the waste stream; (2) utilize paper, and other appropriate waste materials, in the production of fibrous concrete, a mixture of paper, sand, water, Portland cement, and other materials; the project will test three mixtures of fibrous concrete, incorporating problematic waste materials, such as plastic and Styrofoam, and report on their basic properties of compression, shrinkage, and flammability; (3) utilize the fibrous concrete in the production of blocks and panels, design a modular demonstration structure composed of at least one module approximately 400 square feet in area, and utilize the fibrous concrete blocks and panels in the development of this structure.
- **Who is involved?** Faculty, students, and organization leaders from the Grupo Ecológico de Sonora-Arizona (GESA), Centro de Capacitación para el Trabajo Industrial N. 118 (CECATI 118), the Engineering Department of the Instituto Tecnológico de Nogales (ITN), Colegio Nacional de Educación Profesional Técnica (CONALEP), the Centro de Estudios Tecnológicos industrial y de servicios N. 128 (CETis 128), Grupo ConFib Flores Magón (Grupo Confib), and the University of Arizona (UA).
- **Overall Project Task:** Develop and test three mixtures of fibrous concrete, based on differing proportions of the three primary categories of paper found in the Nogales waste stream (cardboard, newsprint, and office/glossy paper). The three mixtures will be used to produce **standard blocks of 6"x8"x20"**. Mixture A will include only cardboard; mixture B will include only newsprint; and mixture C will include only office/glossy paper. **THIS MANUAL COVERS PRODUCTION OF BLOCKS.**
- **Work stations:** Each fibrous concrete workstation will have **water, sand, Portland cement, equipment for measuring quantities of each, a data log for recording the quantities of materials used** (see attached), **and a mixer**. The workstations will also have **molds** for making fibrous concrete blocks. The facility will also have **drying racks** and a **place for storing completed blocks**.

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- **Steps for paper collection:**

1. Separate paper into cardboard, newsprint, and office/glossy paper.
2. Identify one type of paper to process. Record the batch number on the data log.
3. Take tare weight of an empty container and record it on the data log.
4. Fill the container with paper and weigh it again. Record the final weight on the data log – *Fibrous Concrete: Paper Collection*.
5. Put the paper into the mixer with water, pulp it, and pour the pulp into the molds. Record the number of paper blocks produced with the pulp, to the nearest ¼.
6. Drain the excess water, let the paper block dry until it can hold its shape, and remove the mold.
7. Stack the blocks for use at the confib workstation.

- **Steps for paper evaluation:**

1. Remove 30 pounds (13.5 kilograms) of one type of paper from one of the three containers. Carefully sort the paper, separating cardboard, newsprint, and office/glossy paper from any other types of paper or materials.
2. Weigh each type of paper found and record the weight to the nearest gram on the data log: *Fibrous Concrete – Evaluation of Paper Collection*.
3. Repeat twice more for the first type of paper.
4. Repeat the entire process for each of the other two types of paper.

- **Steps for producing blocks:**

1. Use the Mix Matrix to determine the proportion of ingredients for the batch. Record the mix on the data log – *Fibrous Concrete: Production of Blocks*.
2. Thoroughly stir the mixture and pour the pulp into the 6"x8"x20 molds. Record the number of paper blocks produced with the pulp, to the nearest ¼.
3. Drain excess water, let the fibrous concrete block dry until it can hold its shape, and remove the mold.
4. Transfer the block to a drying rack and let it dry for at least 10 days.
5. Stack the blocks for use at the construction site or for testing.

### **Training and Certification:**

- **No special certifications are to measure and mix the fibrous concrete, make the blocks, or complete the data log.** Training will be provided by the project managers and QA manager to ensure they understand how to complete the tasks and logs and the importance of these activities to the overall project success.
- **Logs** will be collected and reviewed by the project manager daily for the first week of the project and then weekly for the remainder of the project. The data loggers will receive **immediate feedback on any problems identified with their methods or data logging**. The **completed logs will be stored in locked file cabinets on site** and collected weekly by the project manager. The project manager will enter the data into an electronic database and prepare a weekly summary of the data. The formulas necessary for preparing the summaries will be stored in the database so uniform summaries will be prepared each week. The electronic database will be maintained on a computer at the main project site; the database will be backed up weekly and stored offsite on an external storage device (thumb drive).
- **The QA management team will visit each site once per week for the first month of the project (monthly thereafter) to assess the block production procedures and walk through the measurement and recording of data with the project staff.** The QA manager will compare data collected and recorded at each visit with that recorded the previous day, week, and month, and discuss any differences with the project staff.



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**Fibrous Concrete: Evaluation of Paper Collection**

Log # \_\_\_\_\_ Location \_\_\_\_\_

Type of Paper \_\_\_\_\_ Remarks \_\_\_\_\_

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Date	Test Sample #	Type of Material	Tare (g)	Tare + Weight (g)	Analyst Initials
	% of Intended Paper in Sample 1				
	% of Intended Paper in Sample 2				
	% of Intended Paper in Sample 3				

Average % of intended paper: \_\_\_\_\_



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Mix Matrix

Kilograms of Paper	Kilograms of Portland Cement	Kilograms of Sand
1	1.59	1.07
2	3.18	2.14
3	4.77	3.21
4	6.36	4.28
5	7.95	5.35
6	9.54	6.42
7	11.13	7.49
8	12.72	8.56
9	14.31	9.63
10	15.9	10.7
15	23.85	16.05
20	31.8	21.4

\*Barry Fuller's original formula: 27 kg paper, 43 kg cement, 29 kg sand, and 727 liters water

\*\*Paper = 100%, Cement = 159%, Sand = 107%